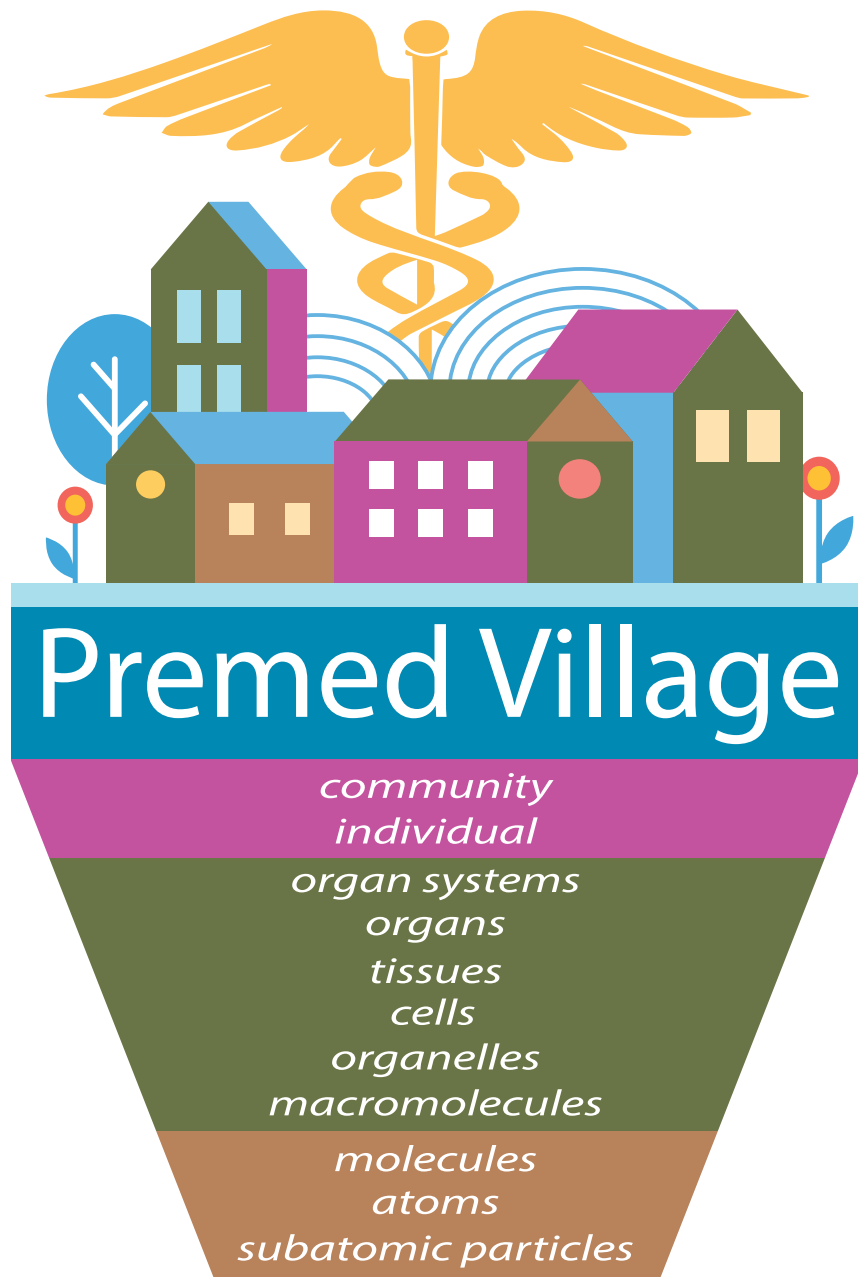


# Crossword Puzzles



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## Puzzles

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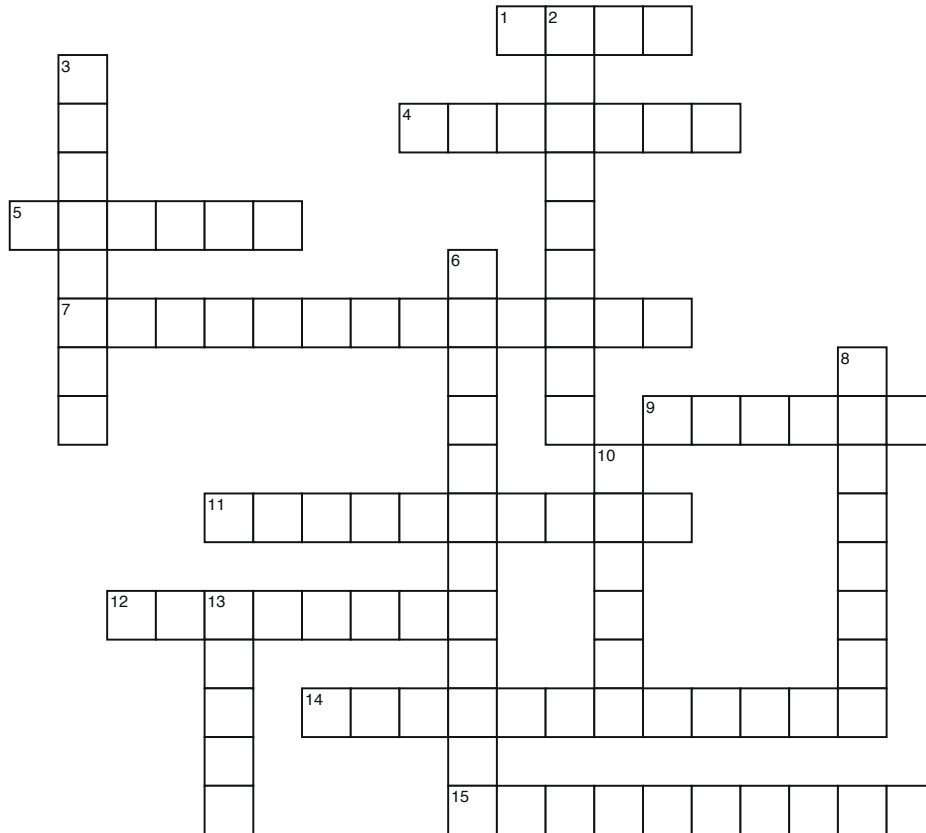
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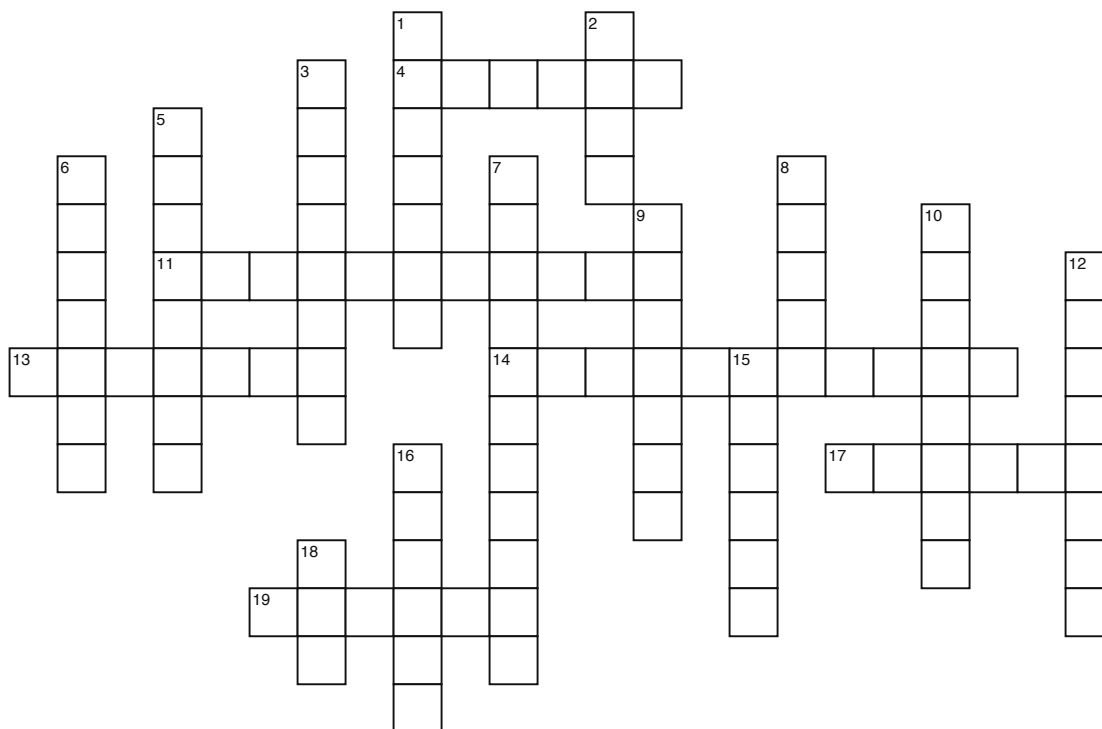


## ACROSS

- 1 \_\_\_\_\_ fall is motion with no acceleration other than that provided by gravity.
- 4 \_\_\_\_\_ circular motion describes motion in which an object moves with constant speed along a circular path.
- 5 \_\_\_\_\_ means a continuous change in the position of a body relative to a reference point.
- 7 The \_\_\_\_\_ System of Units (abbreviated SI) is the world's most widely used system of units.
- 9 A \_\_\_\_\_ is a physical quantity characterized by both magnitude and direction.
- 11 \_\_\_\_\_ is a branch of mechanics which provides the basic tools for describing the motion of objects.
- 12 \_\_\_\_\_ is a numerical description of how far apart objects are at any given moment in time.
- 14 \_\_\_\_\_ is defined as the rate of change of the velocity.
- 15 A \_\_\_\_\_ is the path a moving object follows through space.

## DOWN

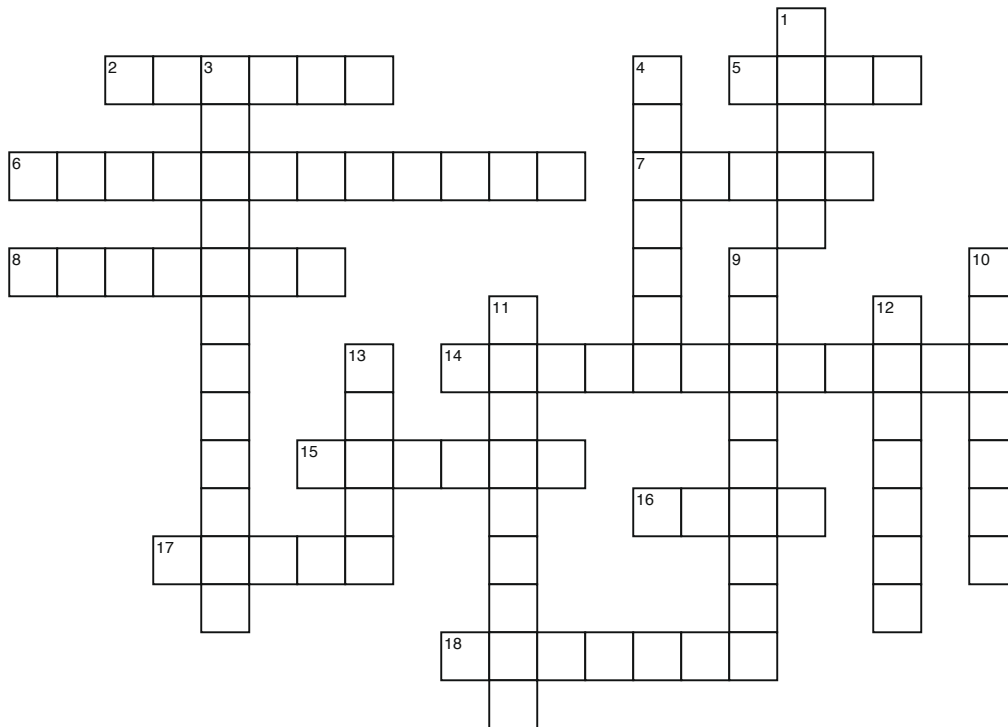
- 2 A frame of \_\_\_\_\_ is a particular perspective from which the universe is observed, providing a set of axes from which an observer can measure the position and motion of all points in a system.
- 3 \_\_\_\_\_ is defined as the rate of change of the position.
- 6 \_\_\_\_\_ is the vector that specifies the position of a point or a particle in reference to an origin or to a previous position.
- 8 A \_\_\_\_\_ vector represents the location of an object in space in relation to an arbitrary inertial frame of reference.
- 10 A \_\_\_\_\_ is a simple physical quantity that does not depend on direction, and is therefore not changed by coordinate system rotations.
- 13 \_\_\_\_\_ is the magnitude of the velocity.

**ACROSS**

- 4 The \_\_\_\_\_ force is the component, perpendicular to the surface of contact, of the contact force exerted by the surface.
- 11 The \_\_\_\_\_ force is the external force required to make a body follow a circular path at constant speed. The force is directed inward, toward the center of the circle.
- 13 \_\_\_\_\_ Galilei was an Italian physicist, mathematician, astronomer, and philosopher who achieved the first systematic studies of uniformly accelerated motion, improved the telescope and supported Copernicanism.
- 14 A \_\_\_\_\_ force or interaction is a mechanism by which particles interact with each other and which cannot be explained in terms of another interaction.
- 17 \_\_\_\_\_ is a measurement of the gravitational force acting on an object.
- 19 The \_\_\_\_\_ is the SI derived unit of force.
- 5 \_\_\_\_\_ is the force that opposes the relative motion or tendency toward such motion of two surfaces in contact.
- 6 A \_\_\_\_\_ force is a force between two objects that are touching each other.
- 7 The \_\_\_\_\_ of friction is a dimensionless quantity used to calculate the force of friction (static or kinetic).
- 8 \_\_\_\_\_ is anything that can cause a massive body to accelerate. It may be experienced as a lift, a push, or a pull.
- 9 \_\_\_\_\_ friction is when two solid surfaces slide against each other.
- 10 \_\_\_\_\_ is the branch of classical mechanics that is concerned with the effects of forces on the motion of objects.
- 12 A \_\_\_\_\_ frame of reference is one in which Newton's first and second laws of motion are valid, ie. that is neither rotating nor accelerated.
- 15 Newton's laws of \_\_\_\_\_ are three physical laws which provide relationships between the forces acting on a body and its movement through space.
- 16 Sir Isaac \_\_\_\_\_ was an English scientist whose treatise *Philosophiae Naturalis Principia Mathematica*, published in 1687, described universal gravitation and the three laws of motion.
- 18 A resultant or \_\_\_\_\_ force is a vector produced when two or more forces act upon a single object.

**DOWN**

- 1 \_\_\_\_\_ is the property of an object to remain at constant velocity unless acted upon by an outside force.
- 2 \_\_\_\_\_ is a fundamental concept in physics, roughly corresponding to the intuitive idea of how much matter there is in an object.
- 3 Newton's third law states that forces occur in pairs, one called the action and the other the \_\_\_\_\_.

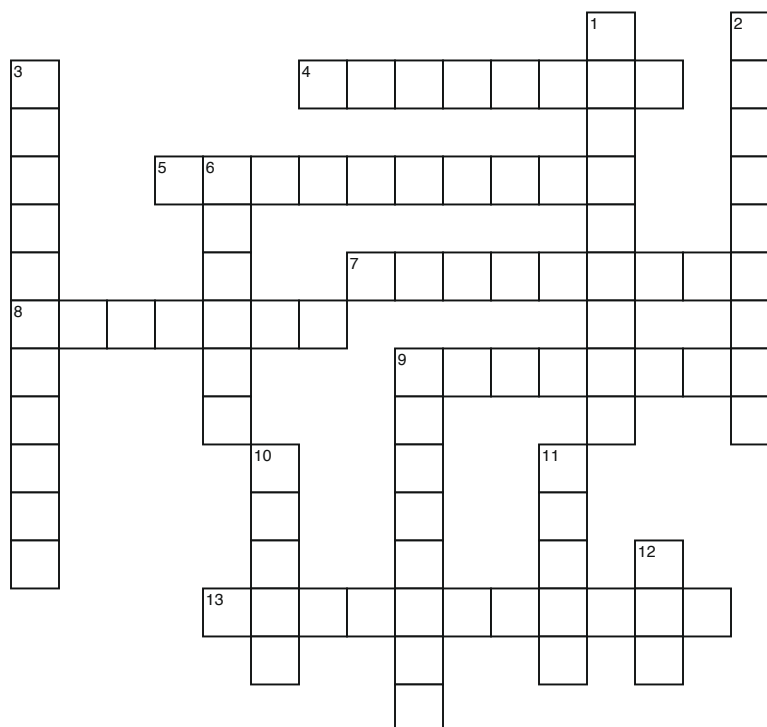


## ACROSS

- 2 In physics and other sciences, \_\_\_\_\_ is defined as a work one system does (or can do) on another system
- 5 Mechanical \_\_\_\_\_ is the amount of energy transferred by a force.
- 6 A \_\_\_\_\_ force is a force that does zero net work on a particle that travels along any closed path in an isolated system.
- 7 A \_\_\_\_\_ is a rigid object that is used with an appropriate fulcrum or pivot point to multiply the mechanical force that can be applied to another object.
- 8 The \_\_\_\_\_ energy is the energy which causes or is released by the physical distortion of a solid or a fluid.
- 14 The \_\_\_\_\_ of energy states that the total amount of energy in an isolated system remains constant, although it may change forms.
- 15 A \_\_\_\_\_ is a wheel with a groove along its edge for holding a rope or cable or belt.
- 16 The \_\_\_\_\_ is the SI derived unit of power, equal to one joule per second.
- 17 The inclined \_\_\_\_\_ is a flat surface whose endpoints are at different heights.
- 18 A simple \_\_\_\_\_ is any device that only requires the application of a single force to work.

## DOWN

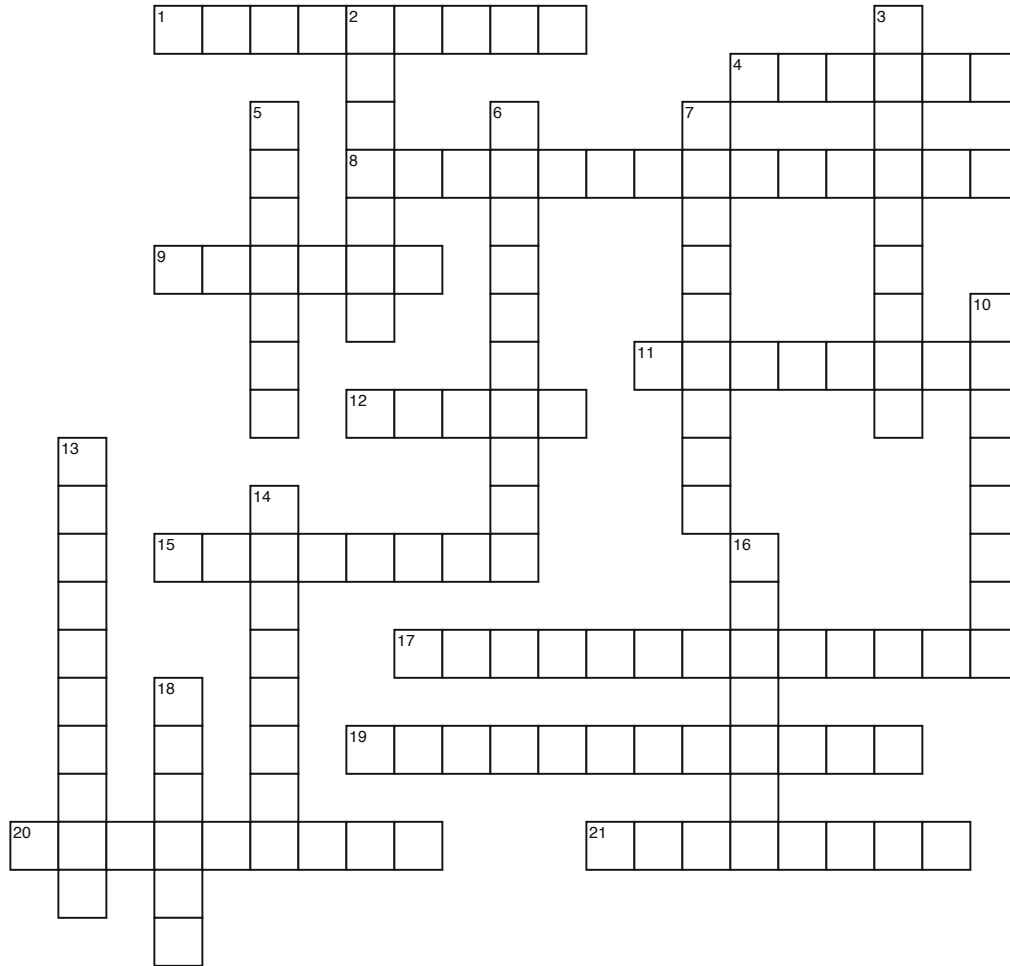
- 1 \_\_\_\_\_ is the rate at which work is performed or energy is transmitted. It is the amount of energy required or expended for a given unit of time.
- 3 The \_\_\_\_\_ is a unit of energy often used also in theoretical physics as a unit of mass. It is the amount of kinetic energy gained by a single unbound electron when it passes through an electrostatic potential difference of one volt, in vacuo.
- 4 A \_\_\_\_\_ is a unit of measurement for energy equal to the amount of heat required to raise a gram of water one degree celsius. In most fields, it has been replaced by the joule.
- 9 Mechanical \_\_\_\_\_ is the factor by which a mechanism multiplies the force put into it.
- 10 The \_\_\_\_\_ energy of an object is the extra energy which it possesses due to its motion, defined as the work needed to accelerate the body from rest to its current speed.
- 11 \_\_\_\_\_ energy is energy stored within a physical system.
- 12 The gravitational \_\_\_\_\_ energy of an object consisting of loose material, held together by gravity alone, is the amount of energy required to pull all of the material apart, to infinity.
- 13 The \_\_\_\_\_ is the SI unit of energy.

**ACROSS**

- 4 Simple \_\_\_\_\_ motion is the motion of a simple oscillator.
- 5 A harmonic \_\_\_\_\_ is a system which, when displaced from its equilibrium position, experiences a restoring force proportional to the displacement.
- 7 The \_\_\_\_\_ is a nonnegative scalar measure of a wave's magnitude of oscillation, the magnitude of the maximum disturbance in the medium during one wave cycle.
- 8 \_\_\_\_\_ is any effect that tends to reduce the amplitude of oscillations of an oscillatory system.
- 9 A \_\_\_\_\_ function is a function that repeats its values after some definite period has been added to its independent variable.
- 13 \_\_\_\_\_ is the variation of some measure about a central value (often a point of equilibrium) or between two or more different states.

**DOWN**

- 1 \_\_\_\_\_ refers to mechanical oscillations about an equilibrium point. The oscillations may be periodic such as the motion of a pendulum or random such as the movement of a tire on a gravel road.
- 2 \_\_\_\_\_ is the measurement of the number of occurrences of a repeated event per unit of time.
- 3 \_\_\_\_\_ is the quality of occurring at regular intervals or periods in time or space.
- 6 A \_\_\_\_\_ is a flexible elastic object used to store mechanical energy usually made out of hardened steel.
- 9 A \_\_\_\_\_ is an object that is attached to a pivot point so it can swing freely.
- 10 The \_\_\_\_\_ of an oscillation or wave is the fraction of a cycle corresponding to an offset in the displacement from a specified reference point at time  $t = 0$ .
- 11 The \_\_\_\_\_ is the SI unit of frequency. Its base unit is the cycle per second.
- 12 A \_\_\_\_\_ is the weight on the end of a pendulum.

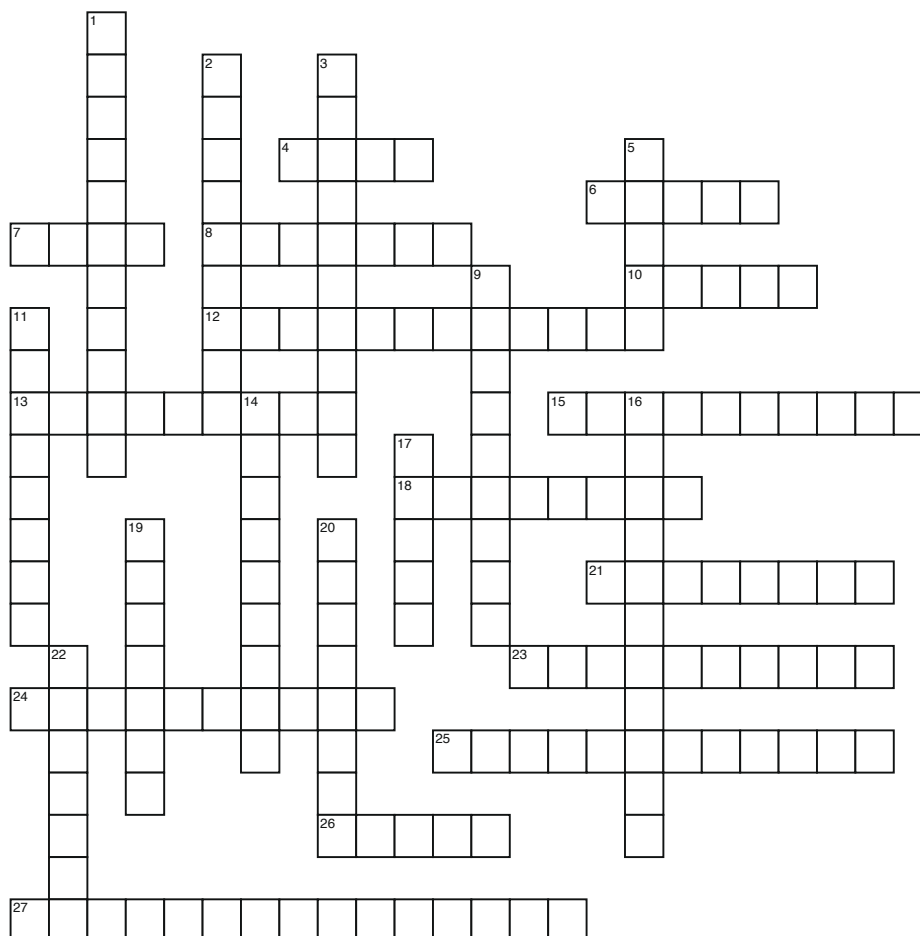


## ACROSS

- 1 \_\_\_\_\_ action is the ability of a substance to draw another substance into it such as with water and porous paper.
- 4 A \_\_\_\_\_ is a fluid that can freely form a distinct surface at the boundaries of its bulk material.
- 8 A \_\_\_\_\_ flow is flow in which the divergence of velocity is zero. This is more precisely termed isochoric flow.
- 9 The \_\_\_\_\_ is the SI unit of pressure or stress.
- 11 \_\_\_\_\_ is the upward force on an object produced by the surrounding fluid in which it is fully or partially immersed.
- 12 A \_\_\_\_\_ is defined as a substance that continually deforms under an applied shear stress regardless of the magnitude of the applied stress.
- 15 \_\_\_\_\_ is the force per unit area applied on a surface in a direction perpendicular to that surface.
- 17 \_\_\_\_\_ is fluid dynamics applied to liquids.
- 19 A flow is considered a \_\_\_\_\_ flow if the change in density of the flow with respect to pressure is non-zero.
- 20 \_\_\_\_\_ is a measure of the resistance of a fluid to deform under shear stress.
- 21 Identifying different flow regimes, such as laminar or turbulent flow, the \_\_\_\_\_ number is the ratio of inertial forces to viscous forces quantifying the relative importance of these two types of forces for given flow conditions.

## DOWN

- 2 \_\_\_\_\_ or streamline flow occurs when a fluid flows in parallel layers, with no disruption between the layers.
- 3 \_\_\_\_\_ flow is a flow regime characterized by chaotic, stochastic property changes such as low momentum diffusion, high momentum convection, and rapid variation of pressure and velocity in space and time.
- 5 \_\_\_\_\_ is mass per unit volume.
- 6 For a viscous liquid flowing through a cylindrical tube with constant circular cross-section, \_\_\_\_\_'s law relates the flow rate, pipe radius, pipe length, and the pressure difference between the two ends.
- 7 \_\_\_\_\_'s Principle states that for an ideal fluid with no work being performed on the fluid, an increase in velocity occurs simultaneously with decrease in pressure or a change in the fluid's gravitational potential energy.
- 10 Fluid \_\_\_\_\_ is the sub-discipline of fluid mechanics dealing with fluids in motion.
- 13 The \_\_\_\_\_ flow rate, also volume flow rate, is the volume of fluid which passes through a given surface per unit time.
- 14 \_\_\_\_\_ is a curve in the surface of a liquid produced in response to the surface of its container.
- 16 Surface \_\_\_\_\_ is an effect within the surface layer of a liquid that causes that layer to behave as an elastic sheet.
- 18 \_\_\_\_\_'s law states that for all points at the same absolute height in a connected body of an incompressible fluid at rest, the fluid pressure is the same, even if additional pressure is applied on the fluid at some place.

**ACROSS**

- 4 A \_\_\_\_\_ is a mode of energy transfer from one place to another, often with little or no permanent displacement of the particles of the medium, but through oscillations around nearly fixed positions.
- 6 A \_\_\_\_\_ wave is a type of propagating disturbance characterized by an abrupt, nearly discontinuous, change in the characteristics of the medium.
- 7 In acoustics, a \_\_\_\_\_ is an interference between two sounds of slightly different frequencies, perceived as periodic variations in volume.
- 8 A \_\_\_\_\_ wave is a wave that travels through the Earth, most often as the result of a tectonic earthquake, sometimes from an explosion.
- 10 The \_\_\_\_\_ of sound describes how much distance a sound wave travels in a given amount of time.
- 12 \_\_\_\_\_ is the superposition of two or more waves that results in a new wave pattern.
- 13 \_\_\_\_\_ is the branch of physics concerned with the study of sound
- 15 \_\_\_\_\_ is the change in direction of a wave due to a change in its speed when a wave passes from one medium to another.
- 18 A \_\_\_\_\_ or harmonic is a natural

resonance or vibration frequency of a system.

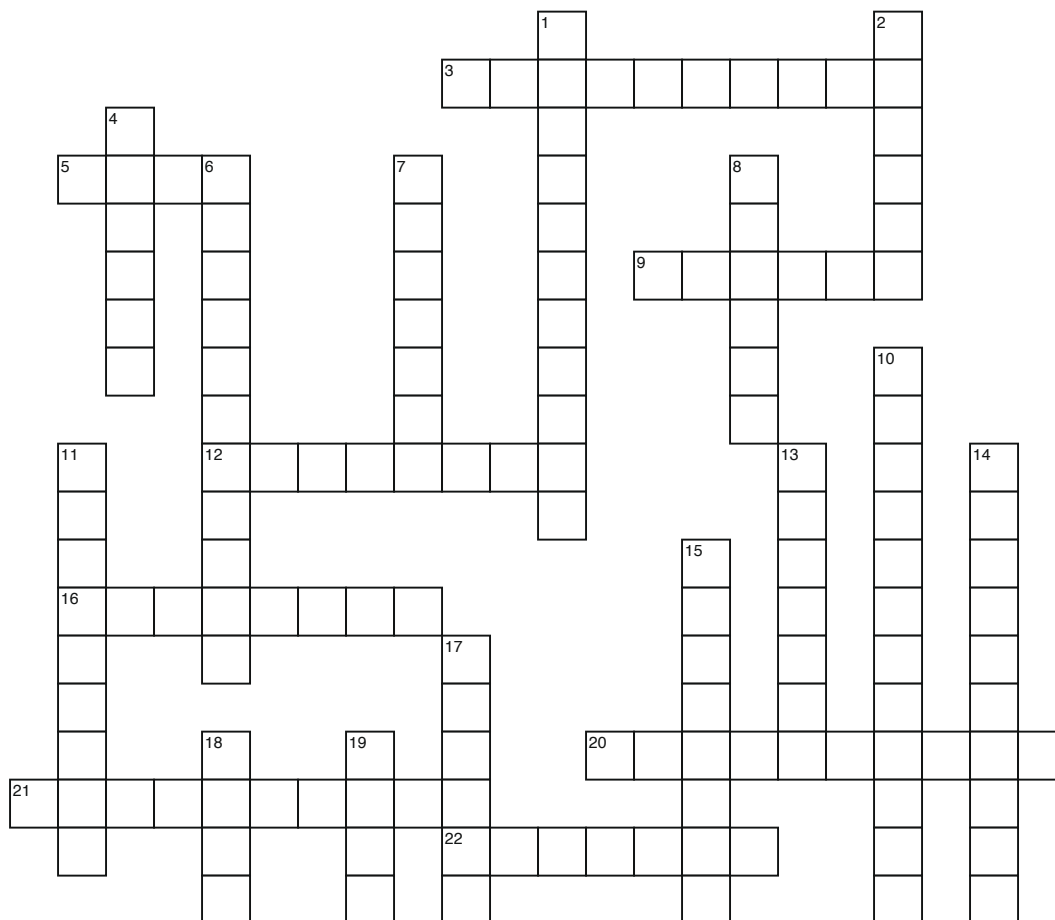
- 21 A \_\_\_\_\_ or overtone of a wave is a component frequency of the signal that is an integer multiple of the fundamental frequency.
- 23 \_\_\_\_\_ is the distance between repeating units of a propagating wave of a given frequency.
- 24 \_\_\_\_\_ is the change in direction of a wave front at an interface between two dissimilar media so that the wave front returns into the medium from which it originated.
- 25 \_\_\_\_\_ waves are waves that have vibrations along or parallel to their direction of travel.
- 26 A \_\_\_\_\_ is the point on a wave with the greatest positive value or upward displacement in a cycle.
- 27 \_\_\_\_\_ radiation, or light, is a self-propagating wave in space with electric and magnetic components.

**DOWN**

- 1 \_\_\_\_\_ refers to various phenomena associated with the bending, spreading and interference of waves passing by an object or aperture that disrupts the wave.
- 2 \_\_\_\_\_ refers to a shortening of a transmitted signal's wavelength.

- 3 A \_\_\_\_\_ wave is a wave that causes vibration in the medium in a perpendicular direction to its own motion.
- 5 The \_\_\_\_\_ of an oscillation or wave is the fraction of a complete cycle corresponding to an offset in the displacement from a specified reference point at time  $t = 0$ .
- 9 \_\_\_\_\_ is the measurement of the number of occurrences of a repeated event per unit of time.
- 11 A \_\_\_\_\_ or stationary wave is a wave that remains in a constant position.
- 14 The sound \_\_\_\_\_ is defined as the sound power per unit area.
- 16 The \_\_\_\_\_ tone is the lowest frequency in a harmonic series.
- 17 \_\_\_\_\_ is a disturbance consisting of vibrations traveling through matter as a longitudinal wave.
- 19 The \_\_\_\_\_ effect is the change in frequency and wavelength of a wave as perceived by an observer moving relative to the source of the waves.
- 20 The \_\_\_\_\_ series refers to the natural frequencies of an oscillator, limited to integer multiples of the lowest possible frequency.
- 22 The \_\_\_\_\_ is a logarithmic unit of measurement that expresses the magnitude of a physical quantity relative to a specified or implied reference level.



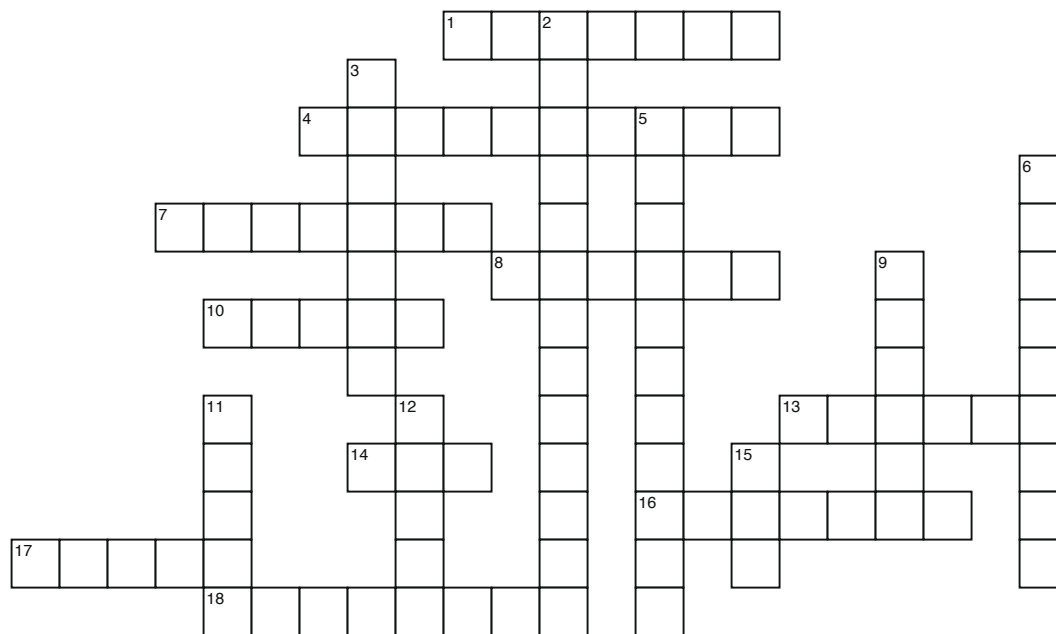


## ACROSS

- 3 In the \_\_\_\_\_ scale, the melting point of water is 32 degrees and the boiling point is 212 degrees, placing the boiling and melting points of water exactly 180 degrees apart.
- 5 \_\_\_\_\_ is energy transferred from one body or system to another due to a difference in temperature.
- 9 The \_\_\_\_\_ is one of the seven SI base units. It corresponds to the absolute temperature scale where the coldest possible temperature is zero.
- 12 \_\_\_\_\_ zero describes a theoretical system that neither emits nor absorbs energy whose temperature is zero Kelvin.
- 16 \_\_\_\_\_ radiation is electromagnetic radiation of a wavelength longer than that of visible light, but shorter than that of radio waves.
- 20 The \_\_\_\_\_ of a material is the ratio of energy radiated by the material to energy radiated by a black body at the same temperature.
- 21 One of the major modes of heat transfer, \_\_\_\_\_, refers in the most general terms to the movement of currents within fluids.
- 22 A \_\_\_\_\_ is a unit of measurement for energy. In most fields, it has been replaced by the joule. However, a thousand-fold variation remains in common use within the field of nutrition.

## DOWN

- 1 A \_\_\_\_\_ is a device that measures temperature or temperature gradient.
- 2 The \_\_\_\_\_-Boltzmann law states that the total energy radiated per unit surface area of a black body in unit time is directly proportional to the fourth power of the black body's thermodynamic temperature.
- 4 The \_\_\_\_\_ law of thermodynamics states that if two thermodynamic systems are in thermal equilibrium with a third, they are also in thermal equilibrium with each other.
- 6 \_\_\_\_\_ is defined as the average energy of microscopic motions of a single particle in the system per degree of freedom.
- 7 \_\_\_\_\_ energy is the energy portion of a system that increases with its temperature.
- 8 The \_\_\_\_\_-Petit law gives the classical expression for the specific heat capacity of a crystal due to its lattice vibrations.
- 10 Thermal \_\_\_\_\_,  $k$ , is the intensive property of a material that indicates its ability to conduct heat. It is used primarily in Fourier's Law for heat conduction.
- 11 Thermal \_\_\_\_\_ refers to electromagnetic waves emitted from the surface of an object which is due to the object's temperature.
- 13 Zero on the \_\_\_\_\_ scale was defined until 1954 as the melting point of ice and 100 degrees was defined as the boiling point of water under a pressure of one standard atmosphere. The definition is more formal today.
- 14 Heat \_\_\_\_\_ is the spontaneous transfer of thermal energy through matter.
- 15 \_\_\_\_\_ heat is the measure of the heat energy required to increase the temperature of a unit quantity of a substance by a certain temperature interval.
- 17 \_\_\_\_\_'s law describes the spectral radiance of electromagnetic radiation at all wavelengths from a black body at a given temperature as a function of frequency.
- 18 \_\_\_\_\_ transfer is the passage of thermal energy from a hot to a cold body.
- 19 \_\_\_\_\_'s displacement law states that there is an inverse relationship between the wavelength of the peak of the emission of a black body and its temperature.

**ACROSS**

- 1 In statistical mechanics, a degree of \_\_\_\_\_ is a single scalar number describing the classical micro-state of a system.
- 4 \_\_\_\_\_'s law states that the ratio between the combining volumes of reagent gases and product can be expressed in small whole numbers.
- 7 \_\_\_\_\_ theory of gases attempts to explain macroscopic properties of gases by considering their molecular composition and motion.
- 8 \_\_\_\_\_'s law of partial pressures states that the total pressure exerted by a gaseous mixture is equal to the sum of the partial pressures of each component in a gas mixture.
- 10 The \_\_\_\_\_ gas law is the equation of state of a hypothetical gas consisting of identical particles of zero volume, with no intermolecular forces.
- 13 \_\_\_\_\_'s law of effusion states that the rate of effusion of a gas is inversely proportional to the square root of the mass of its particles.

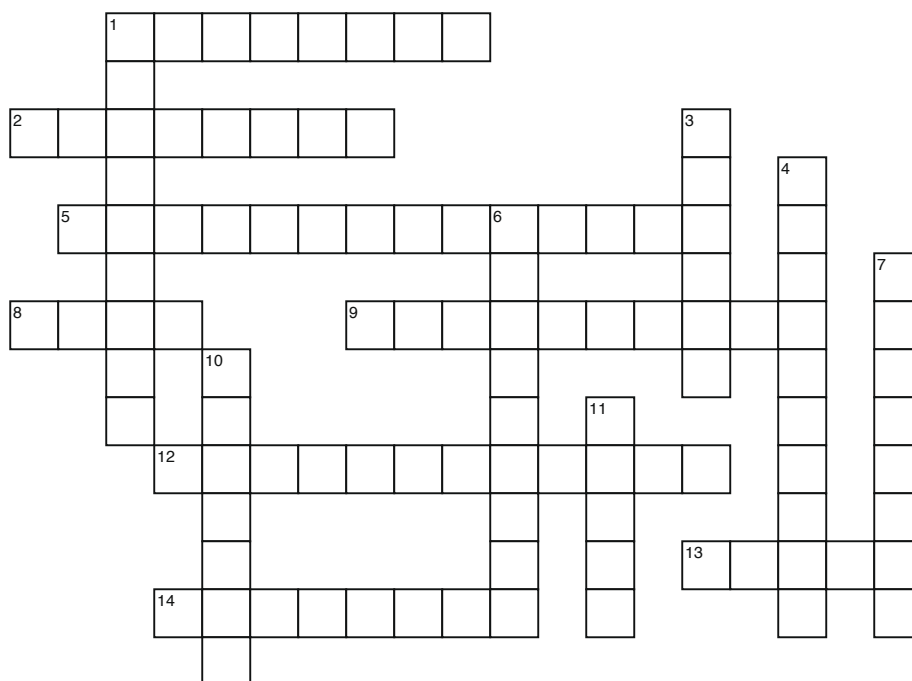
- 14 \_\_\_\_\_ is one of the four major states of matter, consisting of freely moving atoms or molecules without a definite shape.
- 16 \_\_\_\_\_'s law states that at constant pressure, the volume of a given mass of an ideal gas increases or decreases by the same factor as its kelvin temperature increases or decreases.
- 17 A \_\_\_\_\_ gas is a hypothetical gas consisting of identical particles of zero volume with no intermolecular forces undergoing perfectly elastic collisions.
- 18 \_\_\_\_\_ is the process where individual molecules flow through a small pore without collisions.

**DOWN**

- 2 The \_\_\_\_\_ theorem, which relates the temperature of a system to its average energies, depends on the idea that at thermal equilibrium, energy is shared equally among its various forms within the system.
- 3 Each gas in a mixture of ideal gases has a \_\_\_\_\_

pressure which is the pressure which the gas would have if it alone occupied the volume.

- 5 \_\_\_\_\_ mechanics is the application of probability theory to the field of mechanics.
- 6 The \_\_\_\_\_ constant is the physical constant relating temperature to energy.
- 9 Root mean \_\_\_\_\_ speed is the measure of the speed of particles in a gas that is most convenient for problem solving within the kinetic theory of gases.
- 11 \_\_\_\_\_'s law states that the product of the pressure and volume for an enclosed ideal gas will be constant if temperature remains fixed.
- 12 The van der \_\_\_\_\_ equation is the general equation of state for a fluid composed of particles that have a non-zero size and a pairwise attractive inter-particle force.
- 15 The \_\_\_\_\_ constant is a physical constant used in equations of state. It is another name for the Boltzmann constant, though expressed in units of energy per kelvin per mole rather than energy per kelvin per particle.



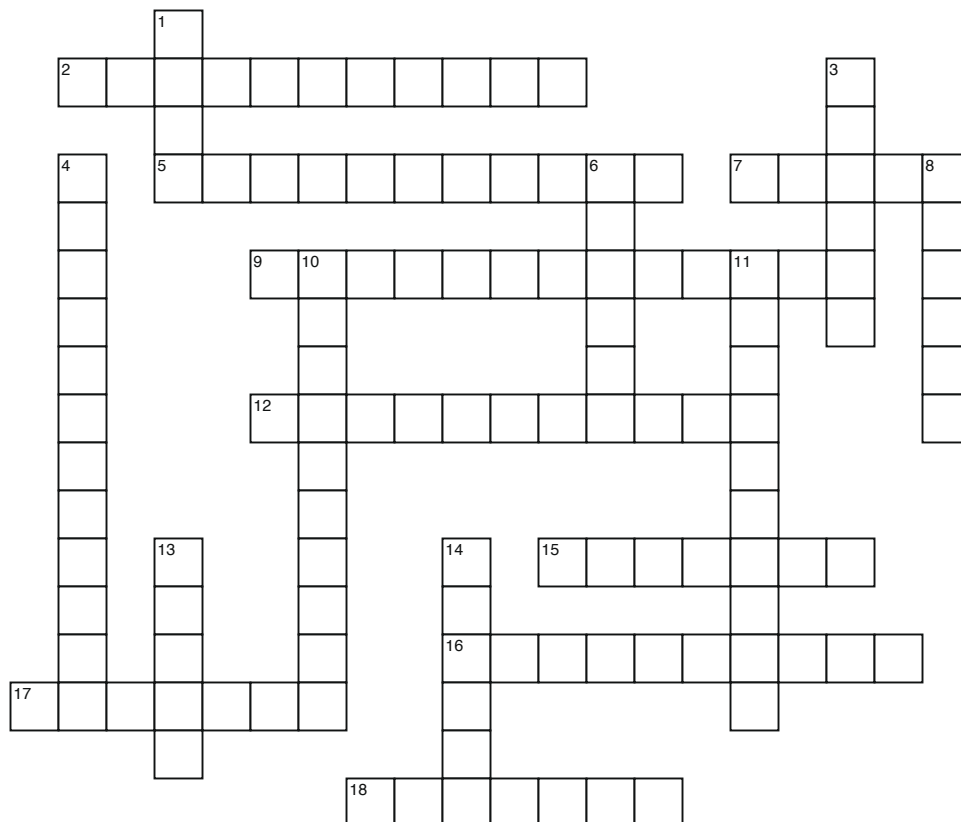
## ACROSS

- 1 The \_\_\_\_\_ energy of a thermodynamic system is the total of the kinetic energy due to the motion of molecules and the potential energy associated with the vibrational and electric energy of atoms within molecules or crystals.
- 2 A \_\_\_\_\_ system, as contrasted with a open system, is a physical system that does not interact with its surroundings.
- 5 \_\_\_\_\_ is a branch of physics that studies the effects of changes in temperature, pressure, and volume on physical systems at the macroscopic scale by analyzing the collective motion of their particles.
- 8 Mechanical \_\_\_\_\_ is the amount of energy transferred by a force.
- 9 The mechanical \_\_\_\_\_ of heat was an expression of 19th century science stating that mechanical work may be transformed into heat, and conversely heat into work, with the magnitude of one always proportional to the other.
- 12 The \_\_\_\_\_ of energy states that the total amount of energy in any system remains constant, although it may change forms.
- 13 A thermodynamic \_\_\_\_\_ is the macroscopic condition of a thermodynamic system as described by its particular thermodynamic parameters.
- 14 A \_\_\_\_\_ process is a thermodynamic process in which the pressure stays constant.

## DOWN

- 1 A \_\_\_\_\_ process, also called an isometric process or an isovolumetric process, is a thermodynamic process that occurs without a change in volume.
- 3 A thermodynamic \_\_\_\_\_, originally called a working substance, is defined as that part of the universe that is under consideration, separated by a real or imaginary boundary from the environment or surroundings
- 4 A \_\_\_\_\_ process is a thermodynamic process in which the temperature of the system stays constant.
- 6 A \_\_\_\_\_ process or an isocaloric process is a thermodynamic process in which no heat is transferred to or from the working fluid.
- 7 Heat \_\_\_\_\_ is the passage of thermal energy from a hot to a cold body.
- 10 A thermodynamic \_\_\_\_\_ may be defined as the evolution of a thermodynamic system proceeding from an initial state to a final state.
- 11 The \_\_\_\_\_ law of thermodynamics states that the increase in the internal energy of a thermodynamic system is equal to the amount of heat energy added to the system minus the work done by the system on the surroundings.

# 2nd Law of Thermodynamics

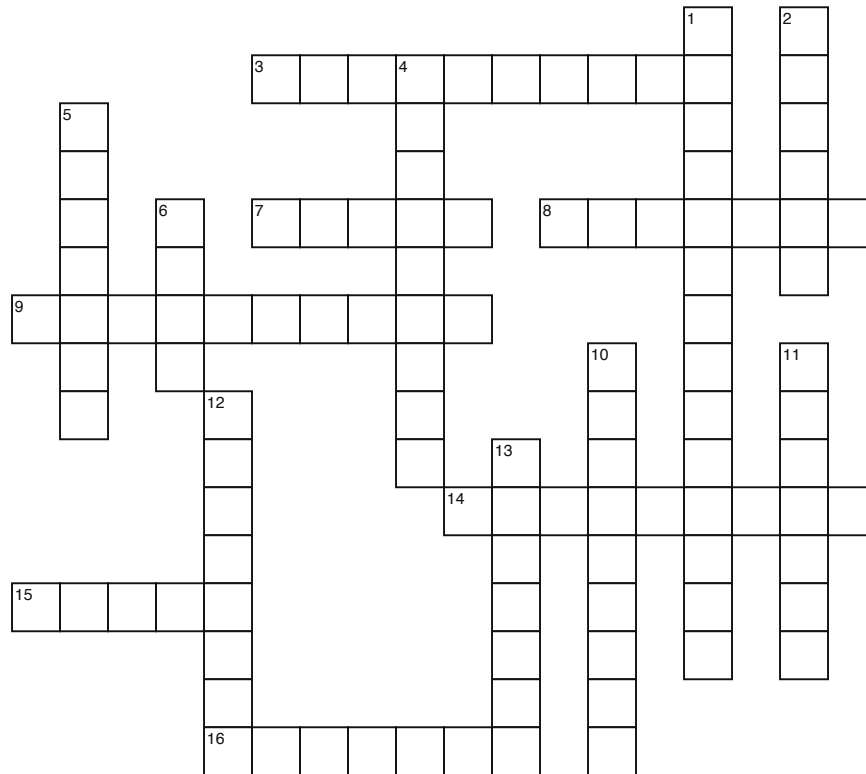


## ACROSS

- 2 A thermodynamic system is said to be in thermodynamic \_\_\_\_\_ when its state is characterized by the minimum of a thermodynamic potential, such as the Helmholtz free energy.
- 5 The coefficient of \_\_\_\_\_ of a heat pump is the ratio of the output heat to the supplied work.
- 7 A thermodynamic \_\_\_\_\_ is a series of thermodynamic processes which returns a system to its initial state.
- 9 \_\_\_\_\_ is the process of removing heat from an enclosed space, or from a substance, and rejecting it elsewhere in order to lower the temperature of the enclosed space or substance and then maintain that lower temperature.
- 12 \_\_\_\_\_ embodies the concept of a dynamical system where important mechanical modes, such as waves or oscillations, lose energy over time, typically due to the action of friction or turbulence.
- 15 \_\_\_\_\_ is a measure of the unavailability of a system's energy to do work.
- 16 A \_\_\_\_\_ process, or cycle, can be reversed by means of infinitesimal changes in some property of the system without loss or dissipation of energy.
- 17 In thermodynamics, \_\_\_\_\_ is often associated with the amount of order, disorder, and or chaos in a thermodynamic system.
- 18 The thermodynamic concept of \_\_\_\_\_ can be described qualitatively as a measure of energy dispersal at a specific temperature.

## DOWN

- 1 A heat \_\_\_\_\_ is a machine or device that moves heat from one location to another via work.
- 3 The \_\_\_\_\_ law of thermodynamics is an expression of the universal law of increasing entropy, stating that the entropy of an isolated system which is not in equilibrium will tend to increase over time, approaching a maximum value at equilibrium.
- 4 A probability \_\_\_\_\_ is a probability measure defined over a state space instead of the sample space.
- 6 The \_\_\_\_\_ cycle represents the most efficient cycle possible for converting a given amount of thermal energy into work or, conversely, for using a given amount of work for refrigeration purposes.
- 8 A heat \_\_\_\_\_ is a physical or theoretical device that converts thermal energy to mechanical output.
- 10 The thermal \_\_\_\_\_ is a dimensionless performance measure of a thermal device such as an internal combustion engine, a boiler, or a furnace.
- 11 In thermodynamics, a \_\_\_\_\_ process is one during which the entropy of the system remains constant.
- 13 The \_\_\_\_\_ law of thermodynamics is an axiom of nature regarding entropy and the impossibility of reaching absolute zero of temperature.
- 14 \_\_\_\_\_'s theorem sets a limit on the maximum amount of efficiency any possible engine can obtain based on the difference between the hot and cold reservoir temperatures.

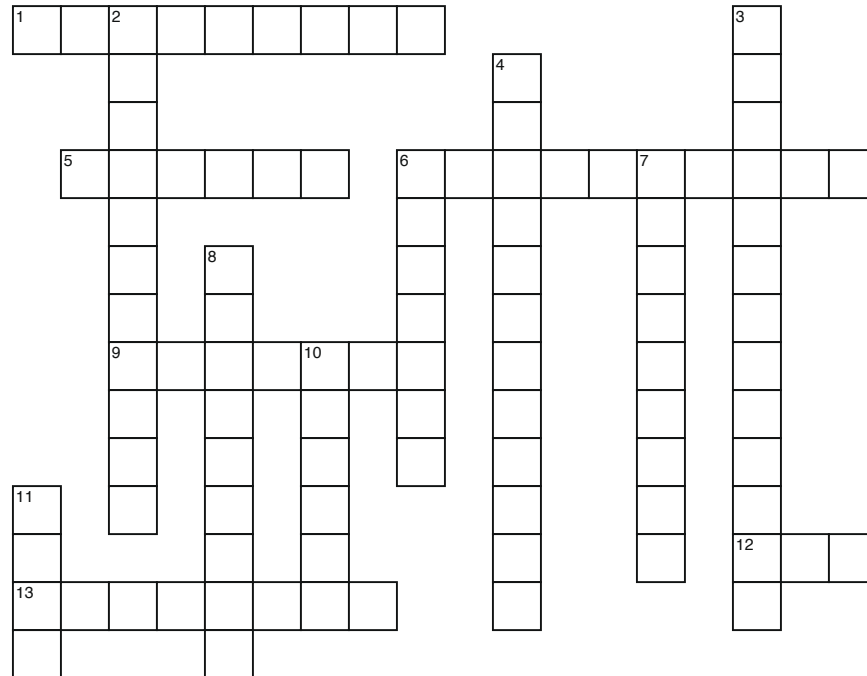


## ACROSS

- 3 \_\_\_\_\_ energy refers to the energy due to the interaction of electric charges with an electric field, and the energy stored in that field.
- 7 The \_\_\_\_\_ is the SI unit of capacitance.
- 8 \_\_\_\_\_ is the difference of electrical potential between two points of an electrical or electronic circuit, expressed in volts.
- 9 A \_\_\_\_\_, or electrical insulator, is a substance that is highly resistant to the flow of an electric current.
- 14 Electric \_\_\_\_\_ is the positional energy per unit of charge associated with a static electric field, typically measured in volts.
- 15 A \_\_\_\_\_ charge is an idealized model of a charged particle as being located within a mathematical point with no dimensions.
- 16 \_\_\_\_\_'s law states that the magnitude of the electrostatic force between two point electric charges is directly proportional to the product of the magnitudes of each charge and inversely proportional to the square of the distance between the charges.

## DOWN

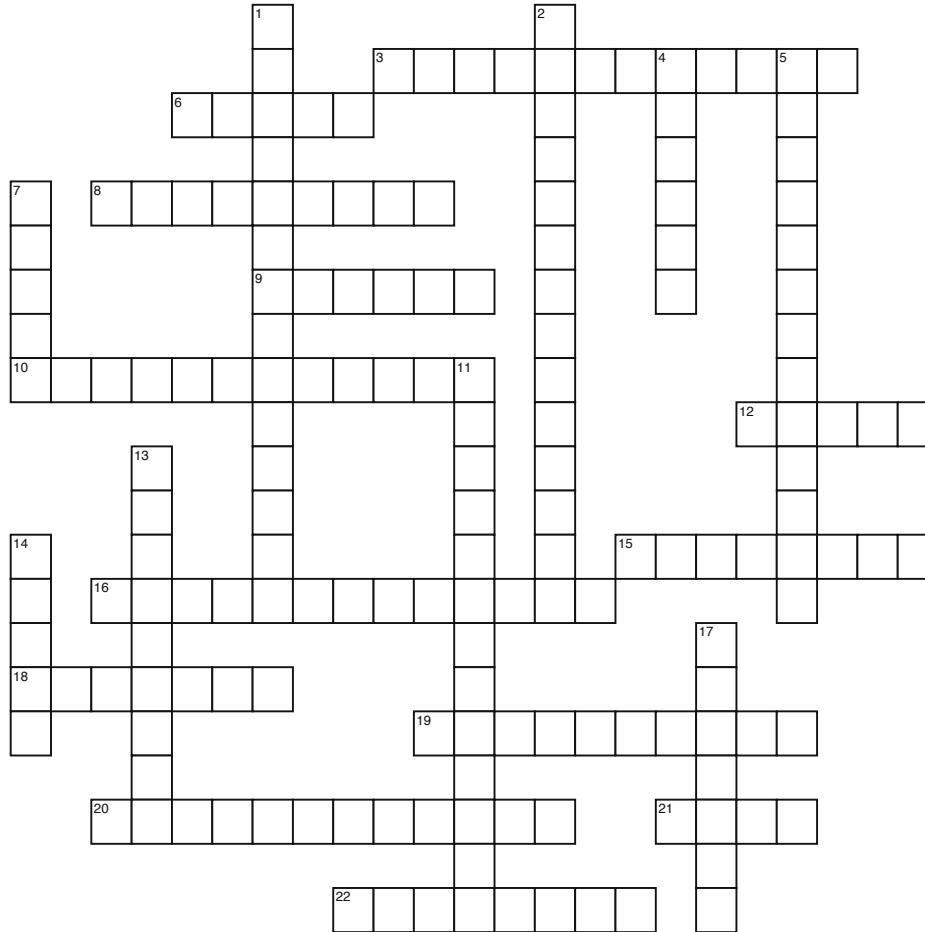
- 1 \_\_\_\_\_ is the branch of physics that deals with the electrical phenomena which can be observed with stationary electric charges.
- 2 Electric \_\_\_\_\_ is a fundamental conserved property of some subatomic particles, which determines their electromagnetic interaction.
- 4 A \_\_\_\_\_ is an electrical device that can store energy in the electric field between a pair of closely spaced conductors.
- 5 The linear, surface, or volume charge \_\_\_\_\_ is the amount of electric charge in a line, surface, or volume, measured in coulombs per metre, square metre, or cubic metre, respectively.
- 6 The \_\_\_\_\_ is the SI derived unit of electric potential difference or electromotive force.
- 10 Electrical \_\_\_\_\_ difference is the voltage present between two points, or the voltage drop transversely over an impedance.
- 11 Michael \_\_\_\_\_ was an English chemist and physicist who contributed significantly to the fields of electromagnetism and electrochemistry. He established the basis for the magnetic field concept in physics.
- 12 The space surrounding a charged particle or in the presence of a time-varying magnetic field has a property called a \_\_\_\_\_ field, which exerts force on other charged particles.
- 13 The \_\_\_\_\_ is the SI unit of electric charge.

**ACROSS**

- 1 \_\_\_\_\_'s circuit laws are a pair of laws that deal with the conservation of charge and energy in electrical circuits.
- 5 \_\_\_\_\_ current is the constant flow of electric charge.
- 6 Conduction is the movement of electrically charged particles through a transmission medium which can form an electric current in response to an electric field.
- 9 A \_\_\_\_\_ source is any device or system that produces an electromotive force between its terminals OR derives a secondary potential from a primary source of the electromotive force.
- 12 \_\_\_\_\_'s law states that, in an electrical circuit, the current passing through a conductor between two points is proportional to the potential difference across the two points, and inversely proportional to the resistance between them.
- 13 A \_\_\_\_\_ is an electrical instrument that measures electrical resistance, the opposition to the flow of an electric current.

**DOWN**

- 2 Electrical \_\_\_\_\_ is a measure of how strongly a type of material opposes the flow of electric current.
- 3 A \_\_\_\_\_ is a solid that has electrical conductivity in between that of a conductor and that of an insulator, and can be controlled over a wide range, either permanently or dynamically.
- 4 Electrical or specific \_\_\_\_\_ is a measure of a material's ability to conduct an electric current.
- 6 Electric \_\_\_\_\_ is the flow of electric charge.
- 7 Conductors, such as copper or aluminum, are materials with atoms having loosely held valence electrons.
- 8 A \_\_\_\_\_ is a very high resistance ammeter used for measuring the electrical potential difference between two points in an electric circuit.
- 10 The \_\_\_\_\_ is the SI unit of electric current.
- 11 Voltage \_\_\_\_\_ is the reduction in voltage in an electrical circuit between the source and load.



## ACROSS

- 3 A \_\_\_\_\_ is an electromechanical transducer that produces a rotary deflection, through a limited arc, in response to electric current flowing through its coil.
- 6 The \_\_\_\_\_ point of a ferromagnetic material is the temperature above which it loses its characteristic ferromagnetic ability.
- 8 A \_\_\_\_\_ is a type of particle accelerator in which a perpendicular magnetic field causes the particles to spiral almost in a circle so that they re-encounter the accelerating voltage many times.
- 9 \_\_\_\_\_'s circuital law relates the circulating magnetic field in a closed loop to the electric current passing through the loop.
- 10 Resulting from changes in the orbital motion of electrons, \_\_\_\_\_ is a weak repulsion from a magnetic field only exhibited by a substance in the presence of an externally applied magnetic field.
- 12 The \_\_\_\_\_ is the cgs unit of magnetic field.
- 15 A closed circulation of electric current creates a \_\_\_\_\_ dipole.
- 16 \_\_\_\_\_ is a form of magnetism which occurs only in the presence of an

externally applied magnetic field, but unlike ferromagnetism, does not result in any retained magnetization.

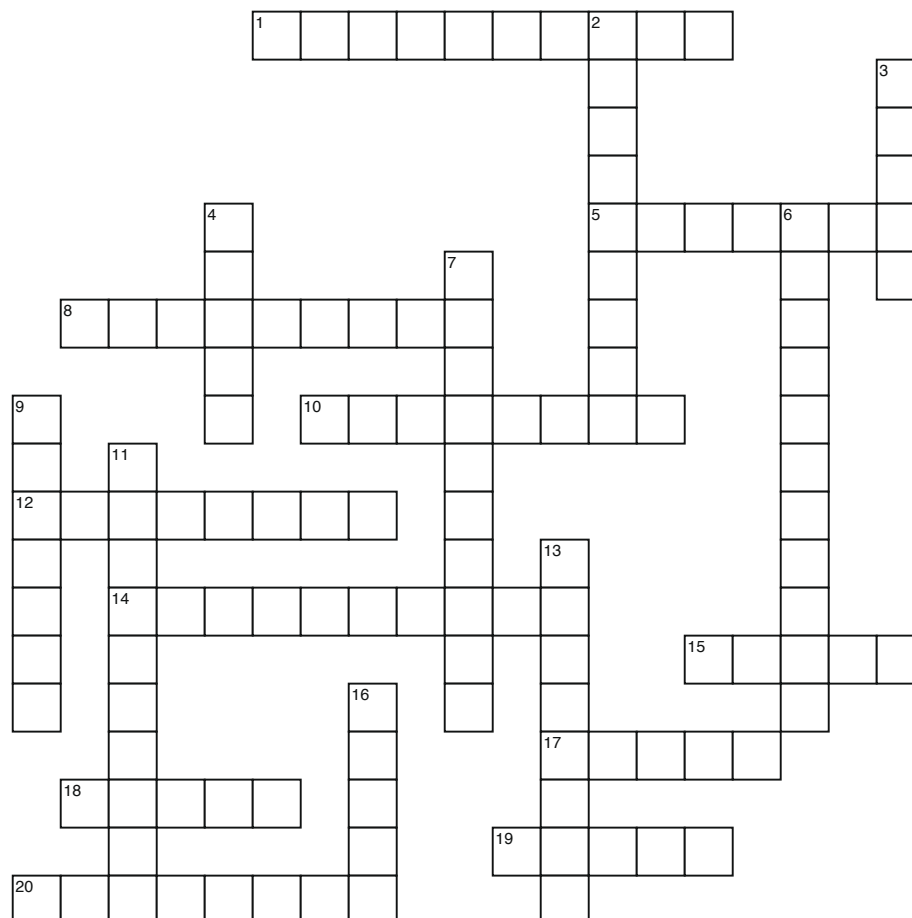
- 18 Force The \_\_\_\_\_ is the force exerted on a charged particle in an electromagnetic field referring to the combined effects of any electric field and magnetic field.
- 19 \_\_\_\_\_ is the state when the material cannot absorb a stronger magnetic field, such that an increase of magnetization force produces no significant change in magnetic flux density.
- 20 \_\_\_\_\_ is the degree of magnetization of a material that responds linearly to an applied magnetic field.
- 21 The \_\_\_\_\_-Savart Law is an equation in electromagnetism that describes the magnetic field vector  $B$  in terms of the magnitude and direction of the source electric current, the distance from the current, and the magnetic permeability.
- 22 The \_\_\_\_\_ constant is equal to the vacuum permeability, also known as the permeability of free space.

## DOWN

- 1 \_\_\_\_\_ is defined as the phenomenon by which materials, such as iron, in an external magnetic field become magnetized and remain magnetized for a

period after the material is no longer in the field.

- 2 \_\_\_\_\_ is the study of static magnetic fields.
- 4 The magnetic dipole \_\_\_\_\_ is a measure of the strength of a magnetic source.
- 5 A \_\_\_\_\_ is a type of magnet in which the magnetic field is produced by the flow of an electric current.
- 7 Magnetic \_\_\_\_\_s permeate space around electric currents, magnetic dipoles, and changing electric fields, exerting a magnetic force on moving electric charges and magnetic dipoles.
- 11 \_\_\_\_\_ is a property of some materials that describes to what extent they are affected by magnetic fields and what magnetic field the material itself creates.
- 13 \_\_\_\_\_ is the magnetization left behind in a medium after an external magnetic field is removed.
- 14 The \_\_\_\_\_ is the SI derived unit of magnetic field.
- 17 The \_\_\_\_\_ center is a point around which the motion in a magnetic field of an electrically charged particle can be treated as the superposition of a relatively fast circular motion and a relatively slow drift of this point.

**ACROSS**

- 1 \_\_\_\_\_ is the phenomenon that the phase velocity of a wave depends on its frequency.
- 5 \_\_\_\_\_ reflection is the reflection of light from an uneven or granular surface such that an incident ray is seemingly reflected at a number of angles.
- 8 \_\_\_\_\_s are a subcategory of radio waves with wavelengths shorter than one meter and longer than one millimeter.
- 10 \_\_\_\_\_ radiation is electromagnetic radiation of a wavelength longer than that of visible light, but shorter than that of radio waves. The name means below red.
- 12 The electromagnetic \_\_\_\_\_ is the range of all possible electromagnetic radiation.
- 14 \_\_\_\_\_ is the change in direction of a wave front at an interface between two dissimilar media so that the wave front returns into the medium from which it originated.
- 15 \_\_\_\_\_'s law is a formula used to describe the relationship between the angles of incidence and refraction for waves passing through a boundary between two different isotropic media.
- 17 \_\_\_\_\_ waves are electromagnetic

waves occurring within the portion of the electromagnetic spectrum which is a lower frequency than infrared radiation.

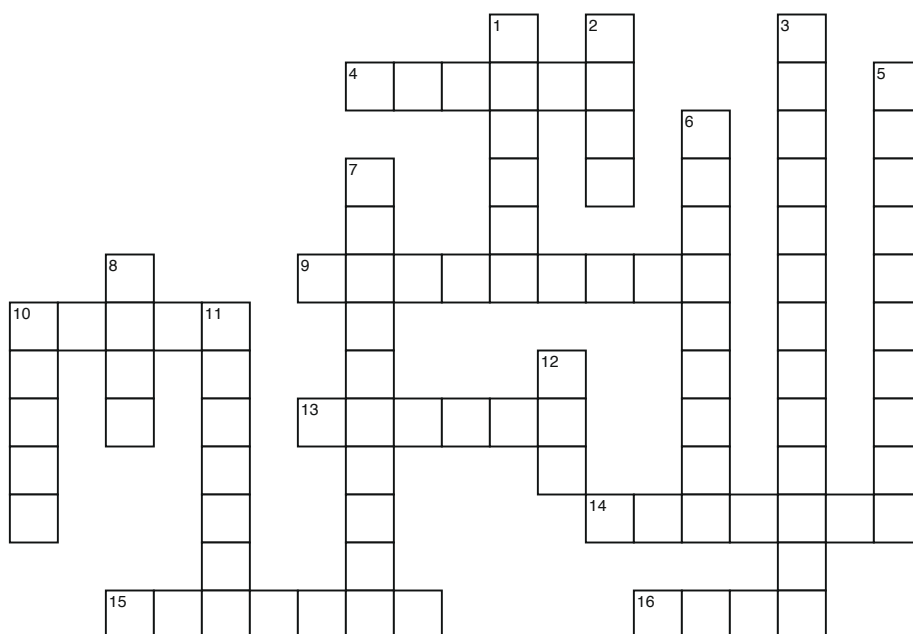
- 18 \_\_\_\_\_ is electromagnetic radiation.
- 19 \_\_\_\_\_ rays are forms of electromagnetic radiation or light emissions of a specific frequency produced from sub-atomic particle interaction, such as electron-positron annihilation and radioactive decay.
- 20 \_\_\_\_\_ reflection is the perfect, mirror-like reflection of light from a surface, in which light from a single incoming direction is reflected into a single outgoing direction.

**DOWN**

- 2 The angle of \_\_\_\_\_ is a measure of deviation of a ray to a surface from straight on.
- 3 An optical \_\_\_\_\_ is a glass or plastic strand of material designed to guide light along its length.
- 4 \_\_\_\_\_s are a form of electromagnetic radiation with a wavelength in the range of 10 to 0.01 nanometers. They are a form of ionizing radiation.
- 6 \_\_\_\_\_ light is electromagnetic radiation with a wavelength shorter than that of visible light, but longer than soft X-rays.

- 7 \_\_\_\_\_ is the change in direction of a wave due to a change in its speed.
- 9 The \_\_\_\_\_ spectrum is the portion of the electromagnetic spectrum that can be detected by the human eye.
- 11 The \_\_\_\_\_ index of a medium is a measure for how much the speed of light is reduced inside the medium.
- 13 Total \_\_\_\_\_ reflection is an optical phenomenon that occurs when a ray of light strikes a medium boundary at an angle larger than the critical angle with respect to the normal to the surface.
- 16 A \_\_\_\_\_ is a device that produces coherent radiation, typically in the form of a narrow, low-divergence beam and with a well-defined wavelength.



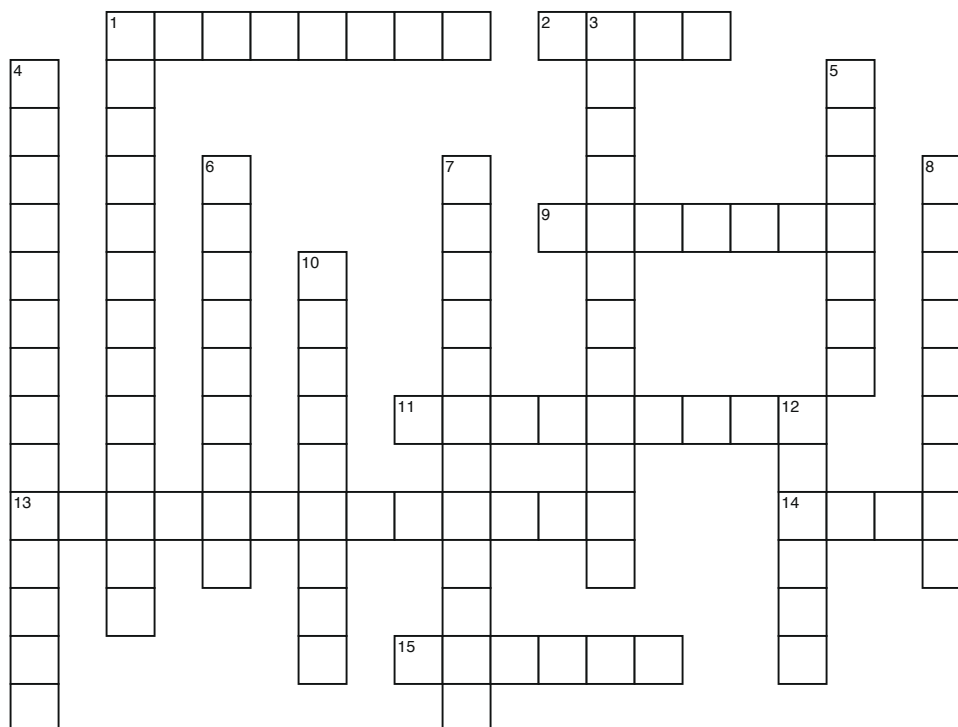


## ACROSS

- 4 A \_\_\_\_\_ or singlet lens consists of a single uncomplicated element. Examples include a magnifying glass or a lens in a pair of simple reading glasses.
- 9 A \_\_\_\_\_ is an instrument designed for the observation of remote objects and the collection of electromagnetic radiation.
- 10 The \_\_\_\_\_ of view is the angular extent of the observable world that is seen at any given moment.
- 13 Also called near- or short-sightedness, \_\_\_\_\_ is a refractive defect of the eye with image focus in front of the retina when accommodation is relaxed.
- 14 Ray \_\_\_\_\_ is a general technique from geometrical optics of modeling the path taken by light by following rays of light as they interact with optical surfaces.
- 15 A \_\_\_\_\_ image is an image in which the outgoing rays from a point on the object never actually intersect at a point.
- 16 A \_\_\_\_\_ lens is a lens with a thickness that is negligible compared to the focal length of the lens.

## DOWN

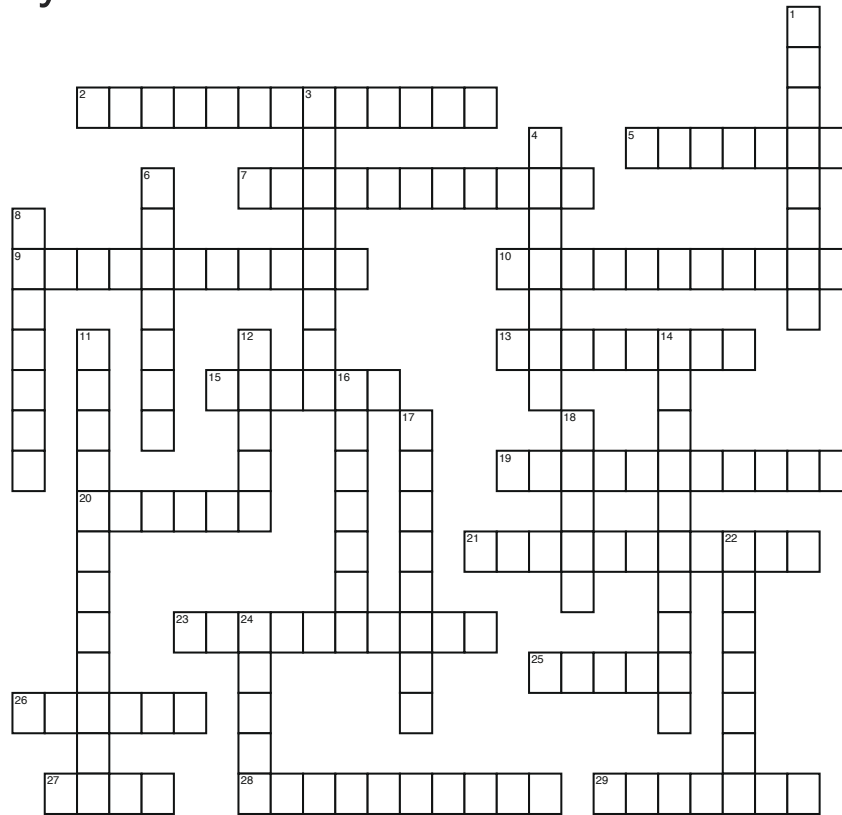
- 1 \_\_\_\_\_ is a branch of physics that describes the behavior and properties of light and the interaction of light with matter.
- 2 A \_\_\_\_\_ image is a representation of an actual object formed by rays of light passing through the image.
- 3 \_\_\_\_\_ is the process of enlarging something only in appearance, not in physical size.
- 5 A \_\_\_\_\_ or refractor telescope is a dioptric telescope that uses a lens as its objective to form an image.
- 6 Also known as hypermetropia, farsightedness or longsightedness, \_\_\_\_\_ is a defect of vision caused by an imperfection in the eye causing inability to focus on near objects.
- 7 \_\_\_\_\_ is the eye's diminished ability to focus that occurs with aging.
- 8 A \_\_\_\_\_ is an optical device with perfect or approximate axial symmetry which transmits and refracts light, concentrating or diverging the beam.
- 10 The \_\_\_\_\_ length of an optical system is a measure of how strongly it converges or diverges light.
- 11 A \_\_\_\_\_ is a unit of measurement of the optical power of a lens or curved mirror, which is equal to the reciprocal of the focal length measured in meters.
- 12 A \_\_\_\_\_ is an idealized narrow beam of light.

**ACROSS**

- 1 At the angle of incidence known as \_\_\_\_\_'s angle, light for which the electric field of the light waves lies in the same plane as the incident ray and the surface normal cannot be reflected with polarization.
- 2 The \_\_\_\_\_ disc is the diffraction pattern resulting from a uniformly illuminated circular aperture.
- 9 A diffraction \_\_\_\_\_ is an optical component with a surface covered by a regular pattern of parallel lines, typically with a distance between the lines comparable to the wavelength of light.
- 11 The \_\_\_\_\_ interferometer is a common configuration for optical interferometry in which an interference pattern is produced by splitting a beam of light into two paths, bouncing the beams back and recombining them.
- 13 \_\_\_\_\_ refers to electromagnetic radiation of a single wavelength.
- 14 Physical or \_\_\_\_\_ optics, is the branch of optics which studies interference, diffraction, polarization, and other phenomena for which the ray approximation of geometric optics is not valid.
- 15 In the \_\_\_\_\_-slit experiment, light is shone at a solid thin plate that has two slits cut into it. A photographic plate is set up to record what comes through those slits.

**DOWN**

- 1 \_\_\_\_\_ is the decomposition of a ray of light into an ordinary ray and an extraordinary ray when it passes through certain types of material, such as calcite crystals or boron nitride, depending on the polarization of the light.
- 3 \_\_\_\_\_ is the superposition of two or more waves that results in a new wave pattern.
- 4 \_\_\_\_\_ is the technique of superposing two or more waves, to detect differences between them.
- 5 The \_\_\_\_\_-Fresnel principle recognizes that each point of an advancing wave front is in fact the center of a fresh disturbance and the source of a new train of waves.
- 6 \_\_\_\_\_ is the property of wave-like states that enables them to exhibit interference. It is a measure of how perfectly the waves can cancel due to destructive interference.
- 7 \_\_\_\_\_ is the property of electromagnetic waves that describes the direction of the transverse electric field.
- 8 A \_\_\_\_\_ is a device that converts an unpolarized or mixed-polarization beam of electromagnetic waves into a beam with a single polarization state.
- 10 A \_\_\_\_\_ is the locus of points in a wave having the same phase.
- 12 The phenomenon of \_\_\_\_\_'s rings is an interference pattern caused by the reflection of light between two surfaces - a spherical surface and an adjacent flat surface.



## ACROSS

- 2 The \_\_\_\_\_ effect is a quantum electronic phenomenon in which electrons are emitted from matter after the absorption of energy from electromagnetic radiation.
- 5 Einstein's \_\_\_\_\_ theory of relativity not only widened the postulate of relativity but added the second postulate - that all observers will always measure the speed of light to be the same no matter what their state of uniform linear motion is.
- 7 Length \_\_\_\_\_, according to the special theory of relativity, is the physical phenomenon of a decrease in length detected by an observer in objects that travel at any non-zero velocity relative to that observer.
- 9 The Heisenberg \_\_\_\_\_ principle gives a lower bound on the product of the standard deviations of position and momentum for a system, implying that it is impossible for a particle to have an arbitrarily well-defined position and momentum simultaneously.
- 10 Electron \_\_\_\_\_ is a technique used to study matter by firing electrons at a sample and observing the resulting interference pattern.
- 13 The \_\_\_\_\_ is the antiparticle of the electron.
- 15 The \_\_\_\_\_ constant is a physical constant that is used to describe the sizes of quanta, which plays a central role in the theory of quantum mechanics.
- 19 Mass-energy \_\_\_\_\_ is the concept that any mass has an

associated energy and vice versa.

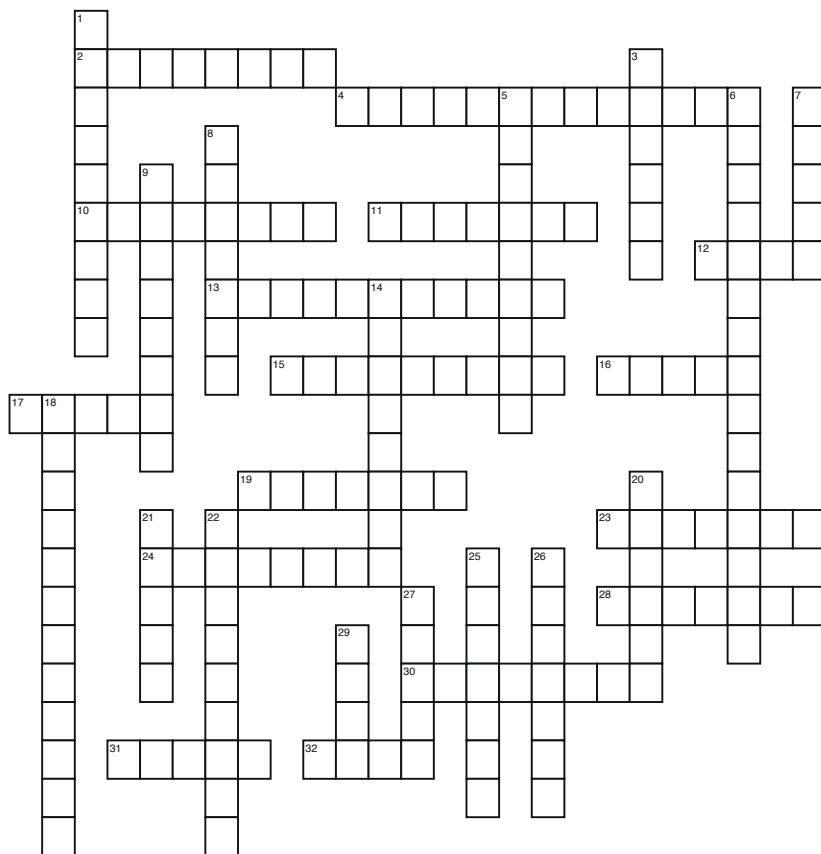
- 20 \_\_\_\_\_'s law describes the spectral radiance of electromagnetic radiation at all wavelengths from a black body at a certain temperature.
- 21 Of central importance in non-relativistic quantum mechanics, the \_\_\_\_\_ equation describes the space and time dependence of quantum mechanical systems.
- 23 A \_\_\_\_\_ particle or fundamental particle is a particle not known to have substructure; that is, it is not known to be made up of smaller particles.
- 25 The speed of \_\_\_\_\_ in vacuum is the speed in a vacuum of anything having zero rest mass.
- 26 A \_\_\_\_\_ is a volume of space that is essentially empty of matter, such that its gaseous pressure is much less than standard atmospheric pressure.
- 27 The \_\_\_\_\_ interaction is one of the four fundamental interactions of nature. It is due to the exchange of the heavy W and Z bosons. Its most familiar effect is beta decay.
- 28 The \_\_\_\_\_ of simultaneity is the concept that simultaneity is not absolute, but dependent on the observer.
- 29 The de \_\_\_\_\_ hypothesis is the statement that all matter (any object) has a wave-like nature, in other words, wave-particle duality.

## DOWN

- 1 Time \_\_\_\_\_ is the phenomenon whereby an observer finds that another's clock which is physically identical to their own is ticking at a

slower rate as measured by their own clock.

- 3 Albert \_\_\_\_\_ (1879 - 1955) was a German-born theoretical physicist. He is best known for his theory of relativity and, specifically, mass-energy equivalence.
- 4 The event \_\_\_\_\_ is a general term for a boundary in spacetime, such as an area surrounding the black hole, beyond which events cannot affect an outside observer.
- 6 The \_\_\_\_\_ transformation converts between two different observers' measurements of space and time in a manner consistent with special relativity, where one observer is in constant motion with respect to the other.
- 8 \_\_\_\_\_ theory is the branch of physics which is based on quantization, which began in 1900 when Max Planck published his theory explaining the emission spectrum of black bodies.
- 11 Corresponding to most kinds of particles is an associated \_\_\_\_\_ with the same mass and opposite charges.
- 12 A \_\_\_\_\_ hole is a region of space in which the gravitational field is so powerful that nothing can escape after having fallen past the event horizon.
- 14 A principle of \_\_\_\_\_ is a criterion for judging physical theories, stating that they are inadequate if they do not prescribe the exact same laws of physics in certain similar situations.
- 16 \_\_\_\_\_ scattering is the decrease in energy of an X-ray or gamma ray photon, when it interacts with matter.
- 17 The \_\_\_\_\_ Model of particle physics is a quantum field theory developed between 1970 and 1973 which describes three of the four known fundamental interactions between the elementary particles that make up all matter.
- 18 The \_\_\_\_\_ is one of the two basic constituents of matter in particle physics (the other is the lepton).
- 22 \_\_\_\_\_ relativity is the geometrical theory of gravitation published by Albert Einstein in 1915-16.
- 24 In the late 19th century, luminiferous \_\_\_\_\_ was the term used to describe a medium for the propagation of light. Today this theory is regarded as a superseded scientific theory.



## ACROSS

- 2 Proton \_\_\_\_\_, also known as proton radioactivity, is a type of radioactive decay in which a proton is ejected from a nucleus.
- 4 Nuclear \_\_\_\_\_ is the conversion of one chemical element or isotope into another, which occurs through nuclear reactions.
- 10 \_\_\_\_\_ uranium is a sample of uranium in which the percent composition of uranium-235 has been increased through the process of isotope separation.
- 11 \_\_\_\_\_ physics is the branch of physics concerned with the nucleus of the atom.
- 12 In nuclear physics, \_\_\_\_\_ decay is a type of radioactive decay in which an electron or a positron is emitted.
- 13 A quantity is said to be subject to \_\_\_\_\_ decay if it decreases at a rate proportional to its value.
- 15 \_\_\_\_\_ in nuclear physics describes energy in the form of waves or moving subatomic particles.
- 16 \_\_\_\_\_ water is water which contains a higher

proportion than normal of the isotope deuterium as deuterium oxide or as deuterium protium oxide.

- 17 \_\_\_\_\_ rays are forms of electromagnetic radiation of a specific frequency produced from sub-atomic particle interaction, such as electron-positron annihilation and radioactive decay.
- 19 \_\_\_\_\_ is a radioactive isotope of hydrogen with a nucleus containing one proton and two neutrons.
- 23 The \_\_\_\_\_ force or residual strong force is the force between two or more nucleons. It is responsible for binding of protons and neutrons into atomic nuclei.
- 24 \_\_\_\_\_ capture, sometimes called inverse beta decay, is a decay mode for isotopes that will occur when there are too many protons in the nucleus of an atom and insufficient energy to emit a positron.
- 28 In nuclear engineering, a \_\_\_\_\_ material is one that is capable of sustaining a chain reaction of nuclear fission.
- 30 \_\_\_\_\_ emission is a type of beta decay, sometimes

referred to as beta plus decay.

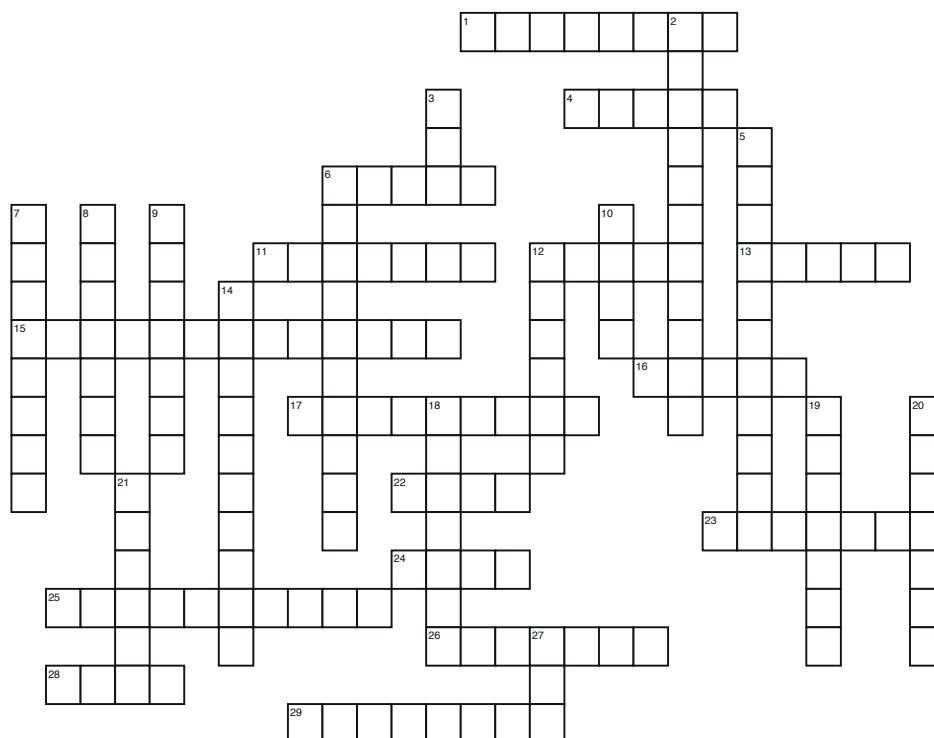
- 31 The \_\_\_\_\_ is a unit of radioactivity which is roughly the activity of 1 gram of the radium isotope 226Ra.
- 32 \_\_\_\_\_ particles are high-energy, high-speed electrons or positrons emitted by certain types of radioactive nuclei.

## DOWN

- 1 The \_\_\_\_\_ is the SI derived unit of radioactivity equal to one nucleus decay per second.
- 3 The \_\_\_\_\_ interaction is today understood to represent the interactions between quarks and gluons as detailed by the theory of quantum chromodynamics.
- 5 In nuclear engineering, a neutron \_\_\_\_\_ is a medium which reduces the velocity of fast neutrons, thereby turning them into thermal neutrons capable of sustaining a nuclear chain reaction.
- 6 \_\_\_\_\_ is the process of creating new atomic nuclei from preexisting nucleons.
- 7 \_\_\_\_\_ particles consist of

two protons and two neutrons bound together into a particle identical to a helium nucleus.

- 8 A \_\_\_\_\_ is a collective name for two baryons: the neutron and the proton.
- 9 A \_\_\_\_\_ mass is the smallest amount of fissile material needed for a sustained nuclear chain reaction.
- 14 Neutron \_\_\_\_\_ is a type of radioactive decay in which an atom contains excess neutrons and a neutron is simply ejected from the nucleus.
- 18 \_\_\_\_\_s, the antiparticles of neutrinos, are neutral particles produced in nuclear beta decay.
- 20 Nuclear \_\_\_\_\_ is the process by which multiple atomic particles join together to form a heavier nucleus.
- 21 Radioactive \_\_\_\_\_ is the process in which an unstable atomic nucleus loses energy by emitting radiation in the form of particles or electromagnetic waves.
- 22 \_\_\_\_\_, also called heavy hydrogen, is a stable isotope of hydrogen with a natural abundance in the oceans of Earth of approximately one atom in 6500 of hydrogen.
- 25 Nuclear \_\_\_\_\_ is the splitting of the nucleus of an atom into lighter nuclei often producing photons in the form of gamma rays, free neutrons and other subatomic particles as by-products.
- 26 A \_\_\_\_\_ rod is a rod made of chemical elements capable of absorbing many neutrons without fissioning themselves. They are used in nuclear reactors to affect the rate of fission.
- 27 \_\_\_\_\_ decay is a type of radioactive decay in which an atomic nucleus emits two protons and two neutrons bound together into a particle identical to a helium nucleus.
- 29 The half-\_\_\_\_\_ of a quantity, subject to exponential decay, is the time required for the quantity to decay to half of its initial value.



## ACROSS

- 1 An element's emission \_\_\_\_\_ is the relative intensity of electromagnetic radiation of each frequency it emits when it is excited.
- 4 A \_\_\_\_\_ body is an object that absorbs all electromagnetic radiation that falls onto it. No radiation passes through it and none is reflected.
- 6 An electron \_\_\_\_\_, also known as a main energy level, is a group of atomic orbitals with the same value of the principal quantum number.
- 11 \_\_\_\_\_ mechanics is the study of the relationship between energy quanta and matter, in particular between photons and valence shell electrons.
- 12 \_\_\_\_\_ particles consist of two protons and two neutrons bound together into a particle identical to a helium nucleus.
- 13 The \_\_\_\_\_ exclusion principle explains why matter occupies space exclusively for itself and does not allow other material objects to pass through it, while at the same time allowing light and radiation to pass.
- 15 The electron \_\_\_\_\_ is the arrangement of electrons in an atom, molecule, or other physical structure such as a crystal.
- 16 The quantum \_\_\_\_\_ of a system corresponds to a set of numbers that fully describe a quantum system.
- 17 The \_\_\_\_\_ quantum number has the greatest correlation to energy of the quantum numbers describing the unique quantum state of an electron in an atom.
- 22 A \_\_\_\_\_ is the smallest particle still characterizing a chemical element
- 23 \_\_\_\_\_s are any of the several different forms of an element with nuclei having the same number of protons but

different numbers of neutrons.

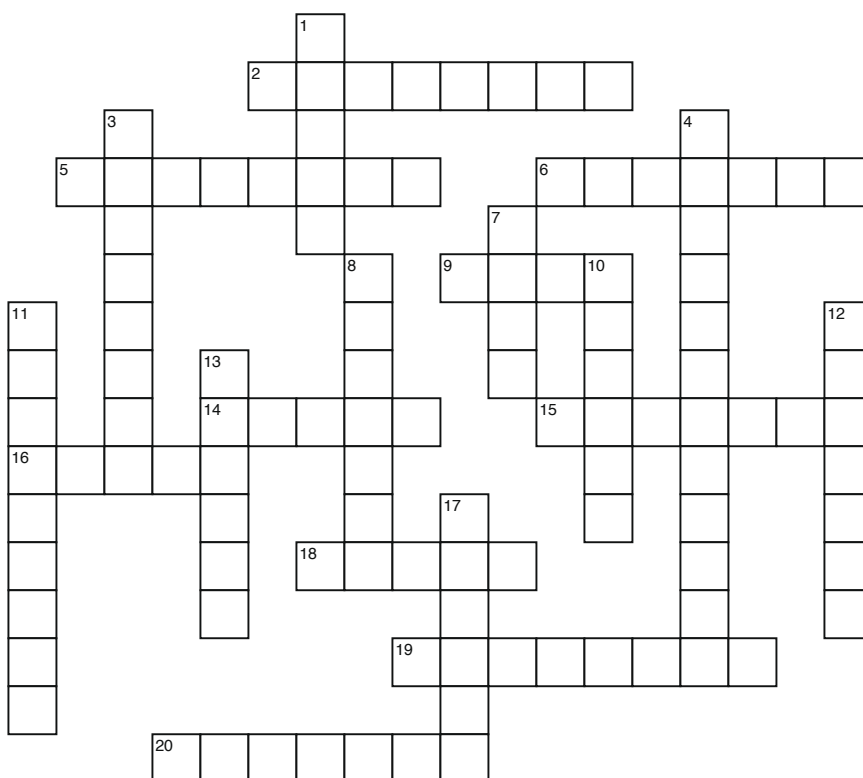
- 24 The \_\_\_\_\_ model depicts the atom as a small, positively charged nucleus surrounded by electrons that travel in circular orbits around the nucleus.
- 25 The \_\_\_\_\_ model showed that the plum pudding model of the atom of J. J. Thomson was incorrect, presenting the atom as containing a central charge concentrated into a very small volume in comparison to the rest of the atom.
- 26 A \_\_\_\_\_ state of a system is any quantum state of the system that has a higher energy than the ground state.
- 28 \_\_\_\_\_'s rules are a simple set of rules used to determine the term symbol that corresponds to the ground state of a multi-electron atom.
- 29 \_\_\_\_\_ is a chemical element represented by the symbol H and an atomic number of 1.

## DOWN

- 2 The Heisenberg \_\_\_\_\_ principle gives a lower bound on the product of the standard deviations of position and momentum for a system, implying that it is impossible to have a particle that has an arbitrarily well-defined position and momentum simultaneously.
- 3 The purpose of Robert Millikan and Harvey Fletcher's \_\_\_\_\_-drop experiment (1909) was to measure the electric charge of the electron.
- 5 The law of definite \_\_\_\_\_ states that a chemical compound always contains exactly the same proportion of elements by mass.
- 6 Observation of the phenomenon of Rutherford \_\_\_\_\_ of alpha particles incident on gold foil led to the development of the orbital theory of the

atom.

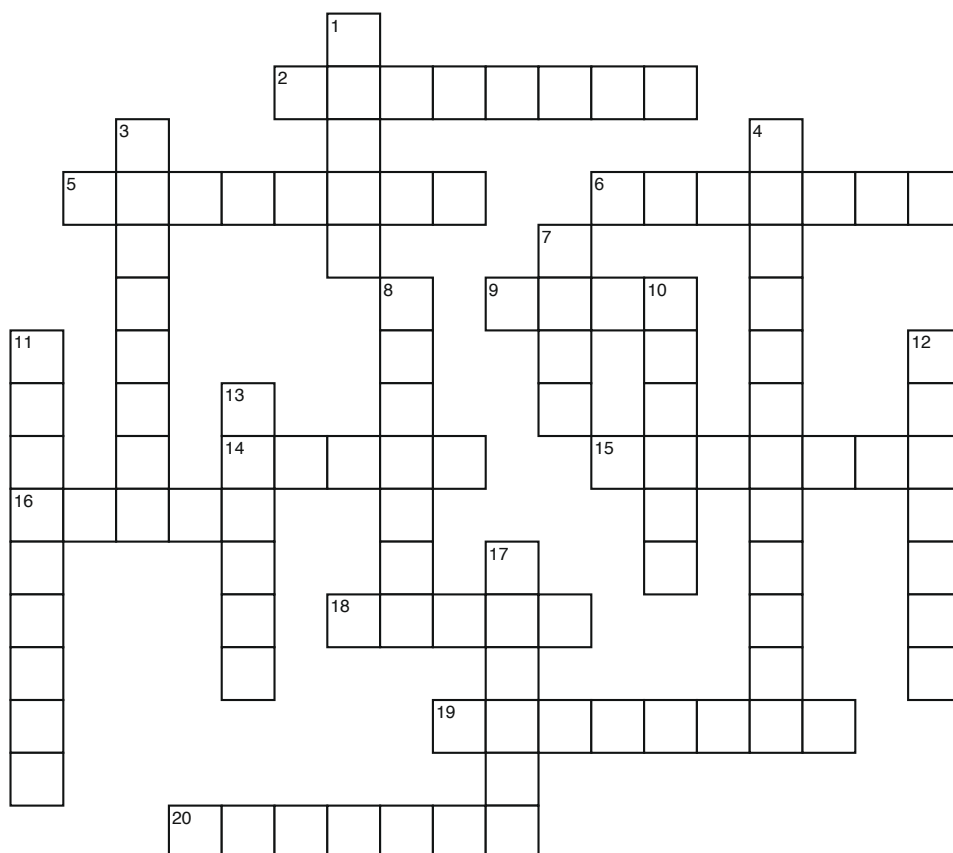
- 7 The \_\_\_\_\_ is a fundamental subatomic particle that carries a negative electric charge.
- 8 A \_\_\_\_\_ leap is a change of an electron from one energy state to another within an atom.
- 9 An atomic \_\_\_\_\_ is a mathematical description of the region in which an electron may be found around a single atom.
- 10 \_\_\_\_\_ is the angular momentum intrinsic to a body, as opposed to orbital angular momentum, which is the motion of its center of mass about an external point.
- 12 The \_\_\_\_\_ is used to determine the electron configuration of an atom, molecule or ion, postulating a hypothetical process in which an atom is built up by progressively adding electrons.
- 14 Ernest \_\_\_\_\_ was a nuclear physicist who pioneered the orbital theory of the atom through his discovery of scattering off the nucleus with his gold foil experiment.
- 18 \_\_\_\_\_ rays are streams of electrons observed in vacuum tubes.
- 19 The \_\_\_\_\_ is a subatomic particle with no net electric charge and a mass that is slightly more than a proton
- 20 \_\_\_\_\_ electrons are the electrons contained in the outermost electron shell of an atom.
- 21 The \_\_\_\_\_ is a subatomic particle with an electric charge of one positive fundamental unit, a diameter of about 1.5 fm femtometer, and a mass that is about 1836 times the mass of an electron.
- 27 A \_\_\_\_\_ is an atom or molecule which has lost or gained one or more electrons, making it negatively or positively charged.

**ACROSS**

- 2 A \_\_\_\_\_ is defined as a sufficiently stable electrically neutral group of at least two atoms in a definite arrangement held together by strong chemical bonds.
- 5 Chemical \_\_\_\_\_ is a concept in chemistry which describes how bonding electrons may or may not be equally shared between atoms.
- 6 A molecular \_\_\_\_\_ is a region in which an electron may be found in a molecule.
- 9 A \_\_\_\_\_ pair is a valence electron pair without bonding or sharing with other atoms.
- 14 The \_\_\_\_\_ rule is a simple chemical rule of thumb that states that atoms tend to combine in such a way that they each have a noble gas configuration in their valence shells.
- 15 Molecular \_\_\_\_\_ theory is a method for determining molecular structure in which electrons are not assigned to individual bonds between atoms, but are treated as under the influence of the nuclei in the whole molecule.
- 16 Bond \_\_\_\_\_ is the number of bonds between a pair of atoms.
- 18 \_\_\_\_\_ structures, also called electron-dot structures or electron-dot diagrams, are diagrams that show the bonding between atoms of a molecule, and the lone pairs of electrons that may exist in the molecule.
- 19 \_\_\_\_\_ bonding is a form of attraction-to-repulsion stability that forms between atoms when they share electrons.
- 20 \_\_\_\_\_ electrons are the electrons contained in the outermost electron shell of an atom.

**DOWN**

- 1 A \_\_\_\_\_ bond (or electrovalent bond) is a type of chemical bond based on electrostatic forces between two oppositely-charged ions.
- 3 A chemical \_\_\_\_\_ is a substance consisting of two or more elements chemically-bonded together in a fixed proportion by mass.
- 4 Bond \_\_\_\_\_ energy is defined as the standard enthalpy change when a bond is cleaved by homolysis at 0K (absolute zero).
- 7 A chemical \_\_\_\_\_ is the physical process responsible for the attractive interactions between atoms and molecules which confers stability to diatomic and polyatomic chemical compounds.
- 8 \_\_\_\_\_ bond theory explains the nature of a chemical bond in a molecule in terms of atomic valencies.
- 10 Bond \_\_\_\_\_ is the enthalpy change involved with breaking up a neutral molecule into substituent neutral elements.
- 11 \_\_\_\_\_ is a tool used to represent and model certain types of non-classical molecular structures arising when no single conventional model showing electrons shared exclusively by two atoms can actually represent the observed molecule.
- 12 \_\_\_\_\_ is a measure of the number of chemical bonds formed by the atoms of a given element.
- 13 A \_\_\_\_\_ charge is a partial charge on an atom in a molecule assigned by assuming that electrons in a chemical bond are shared equally between atoms, regardless of relative electronegativity.
- 17 The bond \_\_\_\_\_ moment is a measure for the polarity of a chemical bond within a molecule.

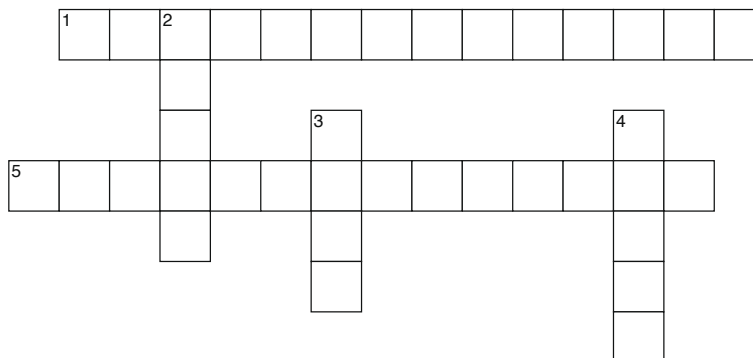


## ACROSS

- 2 A \_\_\_\_\_ is defined as a sufficiently stable electrically neutral group of at least two atoms in a definite arrangement held together by strong chemical bonds.
- 5 Chemical \_\_\_\_\_ is a concept in chemistry which describes how bonding electrons may or may not be equally shared between atoms.
- 6 A molecular \_\_\_\_\_ is a region in which an electron may be found in a molecule.
- 9 A \_\_\_\_\_ pair is a valence electron pair without bonding or sharing with other atoms.
- 14 The \_\_\_\_\_ rule is a simple chemical rule of thumb that states that atoms tend to combine in such a way that they each have a noble gas configuration in their valence shells.
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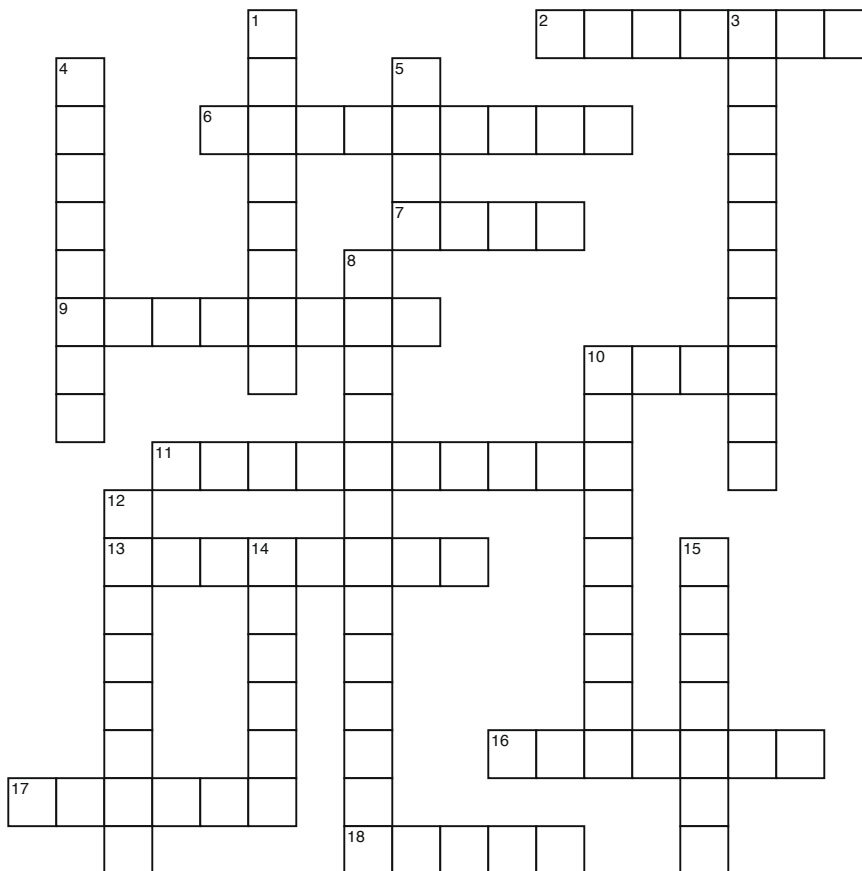
**ACROSS**

- 1 \_\_\_\_\_ refers to the physical property of a molecule that is repelled from a mass of water
- 5 A \_\_\_\_\_ force is a force that acts between stable molecules or between functional groups of macromolecules which are generally much weaker than the chemical bonding forces.

**DOWN**

- 2 The water \_\_\_\_\_ consists of two water molecules loosely bound by a hydrogen bond. It is the smallest water cluster.
- 3 A hydrogen \_\_\_\_\_ is a special type of dipole-dipole interaction that exists between an electronegative atom and a hydrogen atom bonded to another electronegative atom.
- 4 The name van der \_\_\_\_\_ force is sometimes used as a synonym for the totality of non-covalent forces which act between stable molecules.





## ACROSS

- 2 A reactant or \_\_\_\_\_ is a substance consumed during a chemical reaction.
- 6 The \_\_\_\_\_ formula of a chemical compound is a simple expression of the relative number of each type of atom in it.
- 7 The law of conservation of \_\_\_\_\_ states that the total amount of matter within a closed system will remain constant, regardless of the processes acting inside the system.
- 9 The law of \_\_\_\_\_ proportions states that a chemical

- compound always contains exactly the same proportion of elements by mass.
- 10 The \_\_\_\_\_ is the SI base unit that measures an amount of substance, equal to Avogadro's number of entities.
- 11 The \_\_\_\_\_ formula of a chemical compound is a graphical representation of the molecular structure showing how the atoms are arranged.
- 13 A chemical \_\_\_\_\_ is a symbolic representation of a chemical reaction.
- 16 A chemical \_\_\_\_\_ is a concise way of expressing information about the atoms that constitute

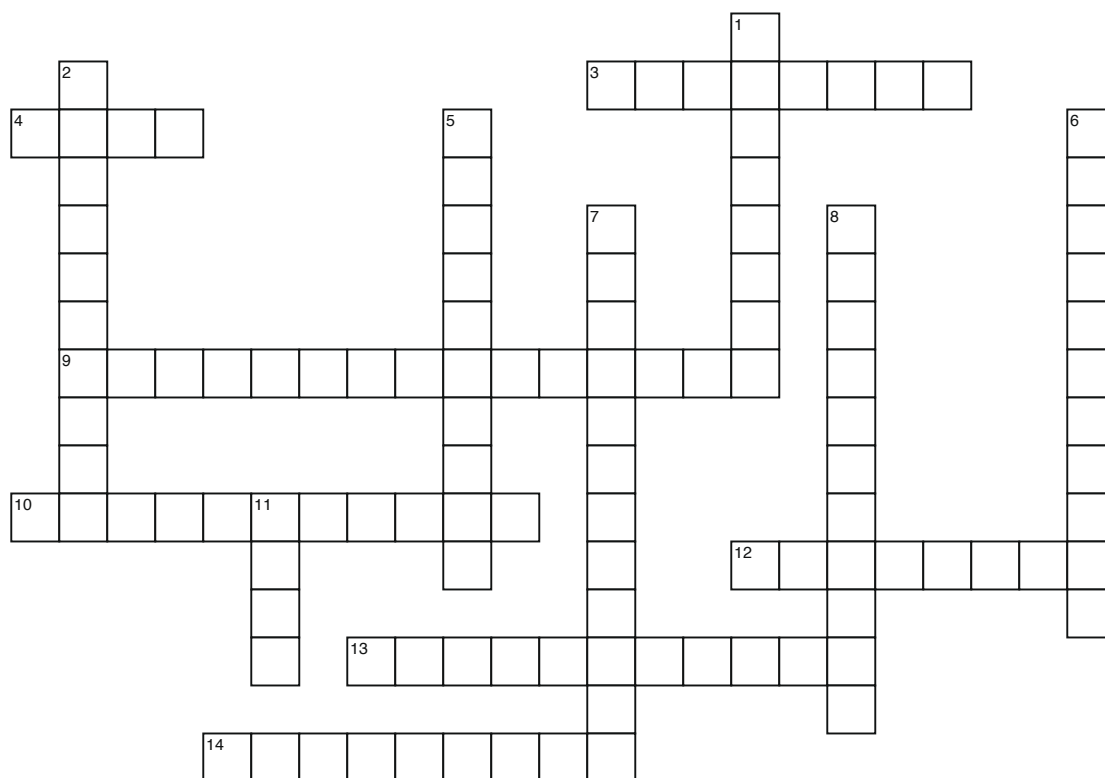
- a particular chemical compound.
- 17 Gram \_\_\_\_\_ mass is the mass in grams of one mole of atoms in an element.
- 18 \_\_\_\_\_ is the amount of product obtained in a chemical reaction.

## DOWN

- 1 The \_\_\_\_\_ reagent is the chemical that determines how far a reaction would go because the chemical in question is the reagent that would get completely used up, causing the reaction to stop.
- 3 The \_\_\_\_\_ is a measurement unit used in chemistry and

the biological sciences, which measures of a substance's ability to combine with other substances, an expression frequently used in the context of normality.

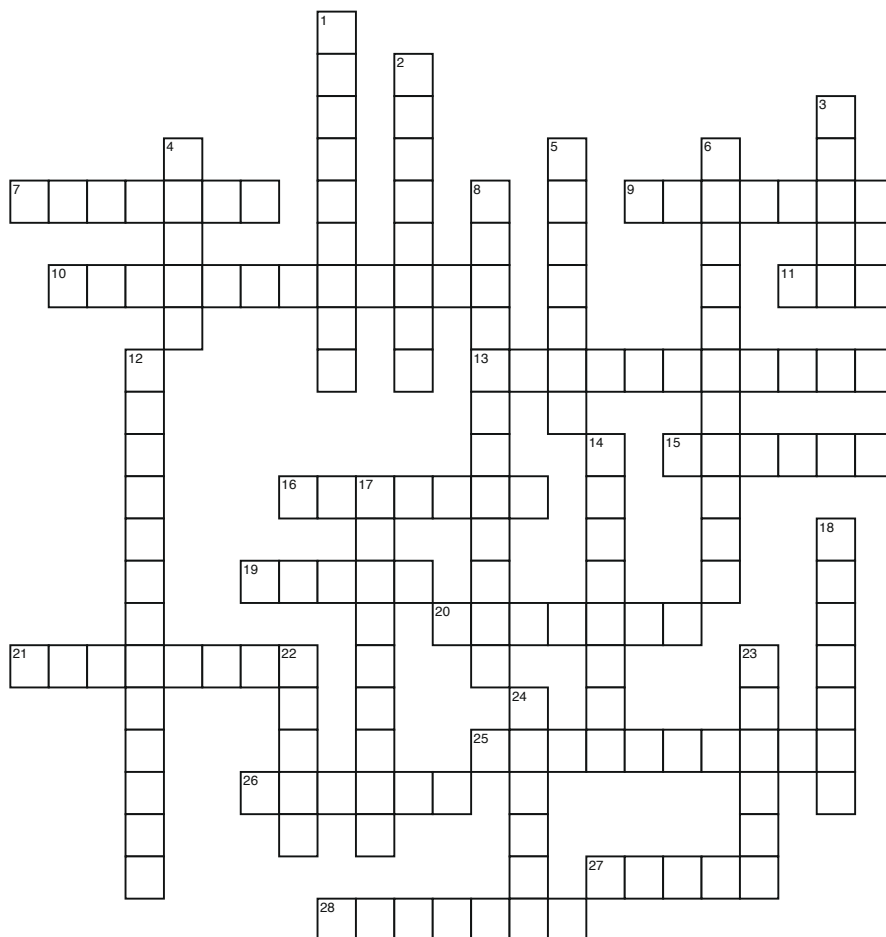
- 4 \_\_\_\_\_'s number is the number of entities in one mole
- 5 Although the definition is more formal now, the \_\_\_\_\_ was originally defined as the absolute weight of a volume of pure water equal to the cube of the hundredth part of a metre, and at the temperature of melting ice.
- 8 \_\_\_\_\_ is the calculation of quantitative relationships of the reactants and products in chemical reactions.
- 10 The \_\_\_\_\_ mass of a substance is the mass of one molecule of that substance, relative to the unified atomic mass unit (equal to 1/12 the mass of one atom of carbon-12).
- 12 A chemical \_\_\_\_\_ is a process that results in the interconversion of chemical substances.
- 14 The \_\_\_\_\_ mass is the mass of an atom at rest, most often expressed in unified amu.
- 15 A \_\_\_\_\_ is a substance that forms as a result of a chemical reaction.

**ACROSS**

- 3 The \_\_\_\_\_ enthalpy of combustion is the change in enthalpy of the total reacting system when one mole of a substance completely reacts with oxygen, and is observed at 298K and 1 atmospheric pressure
- 4 The \_\_\_\_\_-Haber Cycle is an approach to analyzing reaction energies involving the formation of an ionic compound from the reaction of a group I or group II metal with a non-metal.
- 9 \_\_\_\_\_ is the study of the heat evolved or absorbed in chemical reactions.
- 10 \_\_\_\_\_ describes a process or reaction that absorbs energy in the form of heat.
- 12 Standard temperature and \_\_\_\_\_ is a standard set of conditions for experimental measurements, to enable comparisons to be made between sets of data.
- 13 A reaction \_\_\_\_\_ is an instrument that enables the energy being released or absorbed by a reaction to be measured.
- 14 The standard enthalpy of \_\_\_\_\_ of a compound is the change of enthalpy that accompanies forming 1 mole of a substance in its standard state from its constituent elements in their standard states

**DOWN**

- 1 The \_\_\_\_\_ or heat content is a quotient or description of thermodynamic potential of a system equivalent to the sum of the internal energy of the system plus the product of its volume multiplied by the pressure exerted on it by its surroundings.
- 2 The heat of \_\_\_\_\_ is the energy released when a compound undergoes complete combustion with oxygen.
- 5 \_\_\_\_\_ describes a process or reaction that releases energy in the form of heat.
- 6 A \_\_\_\_\_ is a device used for measuring the heat of chemical reactions or physical changes as well as heat capacity.
- 7 Bond \_\_\_\_\_ energy is defined as the standard enthalpy change when a bond is cleaved by homolysis, with reactants and products of the homolysis reaction at 0K (absolute zero).
- 8 \_\_\_\_\_ is the science of measuring the heat of chemical reactions or physical changes.
- 11 Developed through conceptualizing cyclic reaction processes in which the return path is different than the forward path, \_\_\_\_\_'s Law of Heat Summation is used to predict the enthalpy change regardless of the path through which it is to be determined.



## ACROSS

- 7 \_\_\_\_\_ tension is an effect within the surface layer of a liquid that causes that layer to behave as an elastic sheet.
- 9 In a mixture of ideal gases, each gas has a \_\_\_\_\_ pressure which is the pressure which the gas would have if it alone occupied the volume.
- 10 The enthalpy of \_\_\_\_\_ is the energy required to transform a given quantity of a substance into a gas, measured at the boiling point of the substance.
- 11 The \_\_\_\_\_ point is the temperature to which a given parcel of air must be cooled, at constant barometric pressure, for water vapor to condense into water.
- 13 \_\_\_\_\_ is the process by which

molecules in a liquid state spontaneously become gaseous without being heated to boiling point.

- 15 A \_\_\_\_\_ is typically an ionized gas, considered to be a distinct state of matter, apart from gases, because of its unique properties.
- 16 A phase \_\_\_\_\_ is a type of graph used to show the equilibrium conditions between the thermodynamically-distinct phases.
- 19 \_\_\_\_\_ is the gas phase component present along with a solid or liquid sample of matter which does not completely fill its container.
- 20 The \_\_\_\_\_ point of a substance is the maximum temperature at which a liquid can remain a liquid at a given pressure.
- 21 A \_\_\_\_\_ is a

curve in the surface of a liquid and is produced in response to the surface of the container or another object.

- 25 \_\_\_\_\_ is the onset of a phase transition in a small region such as with the formation of a bubble or of a crystal from a liquid.
- 26 A \_\_\_\_\_ is a fluid that can freely form a distinct surface at the boundaries of its bulk material.
- 27 A \_\_\_\_\_ of matter is one of the many ways that matter can interact with itself to form a macroscopic, homogenous phase.
- 28 The \_\_\_\_\_ point of a crystalline solid is the temperature range at which it changes state from solid to liquid.

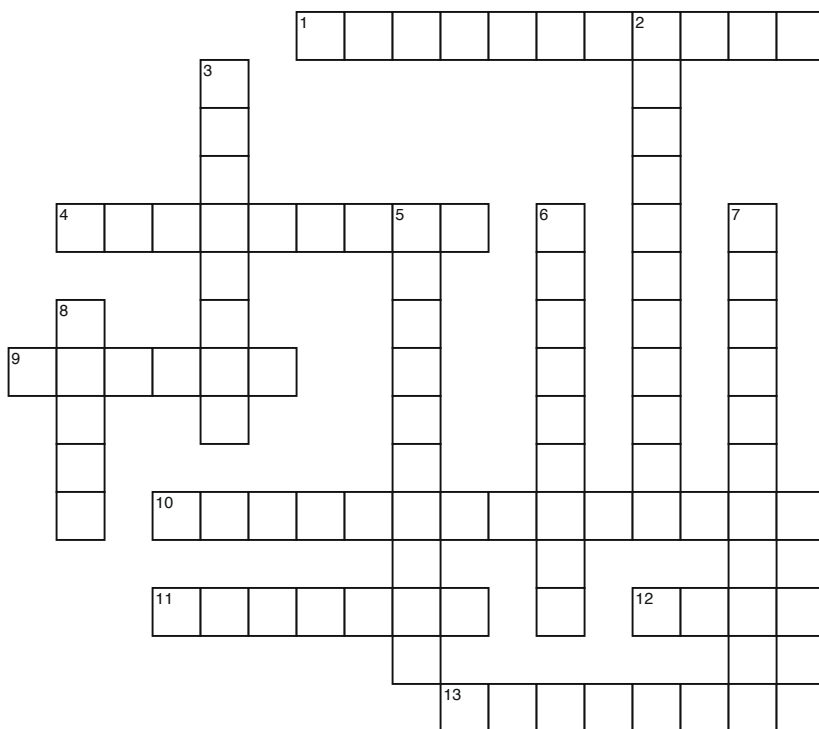
## DOWN

- 1 \_\_\_\_\_ action is the ability of a

substance to draw another substance into it.

- 2 \_\_\_\_\_ is the process whereby a liquid turns to a solid.
- 3 A \_\_\_\_\_ is a set of states of a macroscopic physical system that have relatively uniform chemical composition and physical properties
- 4 \_\_\_\_\_ pressure is the pressure of a gaseous phase in equilibrium with its non-gaseous phases.
- 5 A \_\_\_\_\_ structure is composed of a motif, a set of atoms arranged in a particular way, and a lattice.
- 6 \_\_\_\_\_ solids are a class of solids that have regular or nearly-regular structures, meaning that the atoms in these solids are arranged in an orderly manner

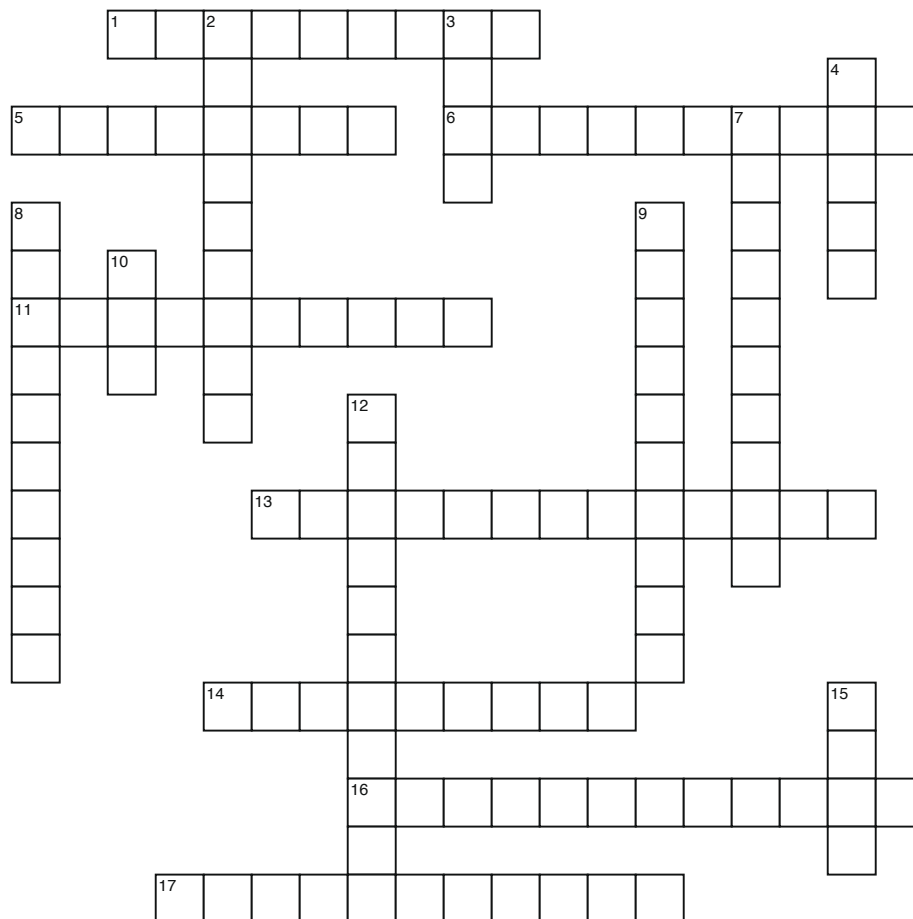
- 8 \_\_\_\_\_ is the change in matter of a substance to a denser phase, such as a gas to a liquid.
- 12 A \_\_\_\_\_ fluid is any substance at a temperature and pressure above its thermodynamic critical point.
- 14 A \_\_\_\_\_ point specifies the conditions (temperature, pressure) at which the liquid state of the matter ceases to exist.
- 17 A \_\_\_\_\_ solid is a solid in which there is no long-range order of the positions of the atoms.
- 18 A \_\_\_\_\_ curve is a line graph that represents the change of phase of matter, typically from either a gas to a solid or from a liquid to a solid.
- 22 A \_\_\_\_\_ object is in the states of matter characterized by resistance to deformation and changes of volume.
- 23 The \_\_\_\_\_ point of a substance is the temperature and pressure at which three phases (gas, liquid, and solid) of that substance may coexist in thermodynamic equilibrium.
- 24 The enthalpy of \_\_\_\_\_ is the amount of thermal energy which must be absorbed or evolved at the melting point for 1 mole of a substance to change states from a solid to a liquid or vice versa.

**ACROSS**

- 1 A \_\_\_\_\_ process is a chemical reaction in which a system releases free energy and moves to a lower, more thermodynamically stable, energy state.
- 4 Le \_\_\_\_\_'s principle states that if a chemical system at equilibrium experiences a change in concentration, temperature, volume, or total pressure, the equilibrium will shift in order to partially counter-act the imposed change.
- 9 The entropy of \_\_\_\_\_ is the change in the entropy when two different chemical substances or components are mixed.
- 10 Chemical \_\_\_\_\_ is the mathematical study of the interrelation of heat and work with chemical reactions or with a physical change of state within the confines of the laws of thermodynamics.
- 11 A \_\_\_\_\_ equilibrium occurs when two reversible processes proceed at the same rate.
- 12 The term thermodynamic \_\_\_\_\_ energy is a measure of the amount of work that can be extracted from a system.
- 13 \_\_\_\_\_ in chemistry is a measure of how different molecules in a non-ideal gas or solution interact with each other, extending the idea of concentration to more complex systems.

**DOWN**

- 2 The \_\_\_\_\_ constant is the reaction quotient describing the state in which the chemical activities or concentrations of the reactants and products have no net change over time.
- 3 The reaction \_\_\_\_\_ is a quantitative measure of the extent of reaction, the relative proportion of products and reactants present in the reaction mixture at some instant of time.
- 5 A \_\_\_\_\_ reaction (also called an unfavorable reaction or a nonspontaneous reaction) is a chemical reaction in which the standard change in free energy is positive.
- 6 A \_\_\_\_\_ reaction is a chemical reaction where the variation of Gibbs free energy is negative.
- 7 An activity \_\_\_\_\_ is a factor used in thermodynamics to account for deviations from ideal behaviour in a mixture of chemical substances.
- 8 The \_\_\_\_\_ free energy is a thermodynamic potential which measures the useful or process-initiating work obtainable from an isothermal, isobaric thermodynamic system.

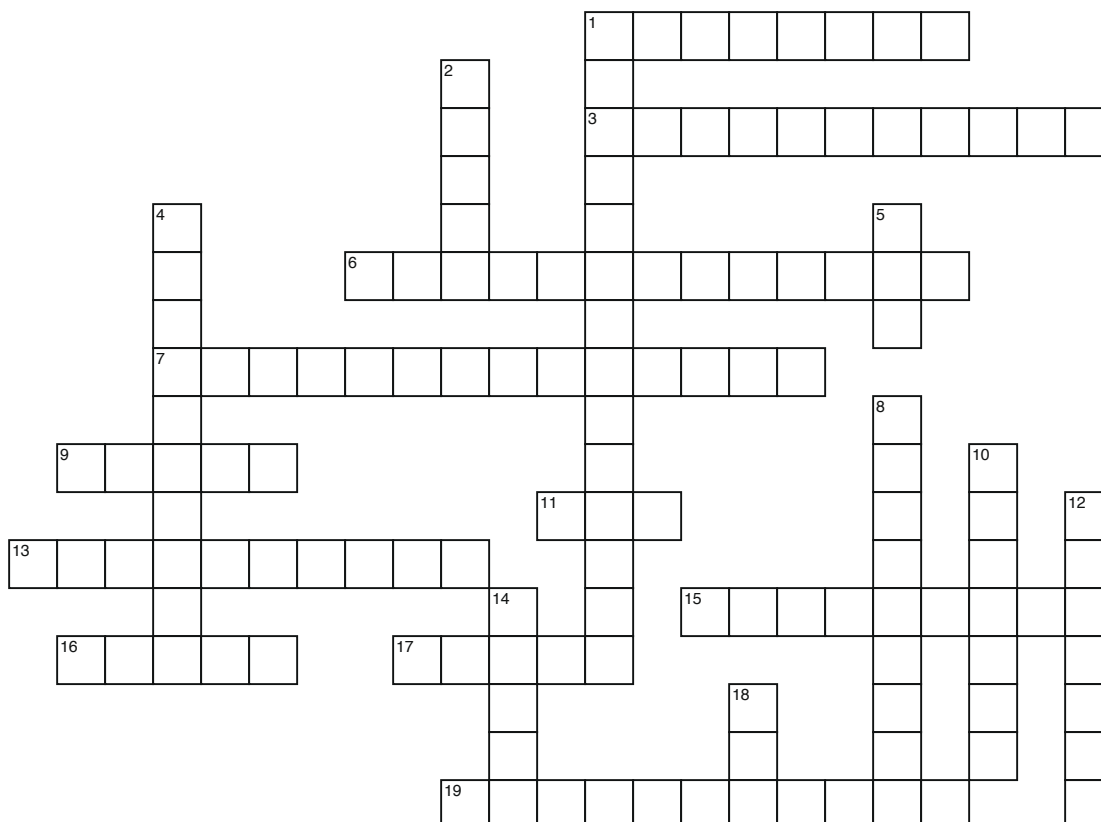


## ACROSS

- 1 A reaction \_\_\_\_\_ is the step by step sequence of elementary reactions by which overall chemical change occurs.
- 5 Chemical \_\_\_\_\_ is the study of reaction rates in a chemical reaction.
- 6 A \_\_\_\_\_ reaction is a chemical reaction in which one or more chemical species react directly to form products in a single reaction step and with a single transition state.
- 11 The \_\_\_\_\_ state of a chemical reaction is a particular configuration along the reaction coordinate defined as the state corresponding to the highest energy along this reaction coordinate.
- 13 \_\_\_\_\_ catalysis describes catalysis where the catalyst is in a different phase to the reactants.
- 14 A \_\_\_\_\_ complex is a transitional structure in a chemical reaction that results from an effective collision between molecules and that persists while old bonds are breaking and new bonds are forming.
- 16 A \_\_\_\_\_ in a chemical reaction is a molecular entity with a lifetime appreciably longer than a molecular vibration that is formed from the reactants and reacts further to give the products of a chemical reaction.
- 17 \_\_\_\_\_ catalysis describes catalysis where the catalyst is in the same phase as the reactants.

## DOWN

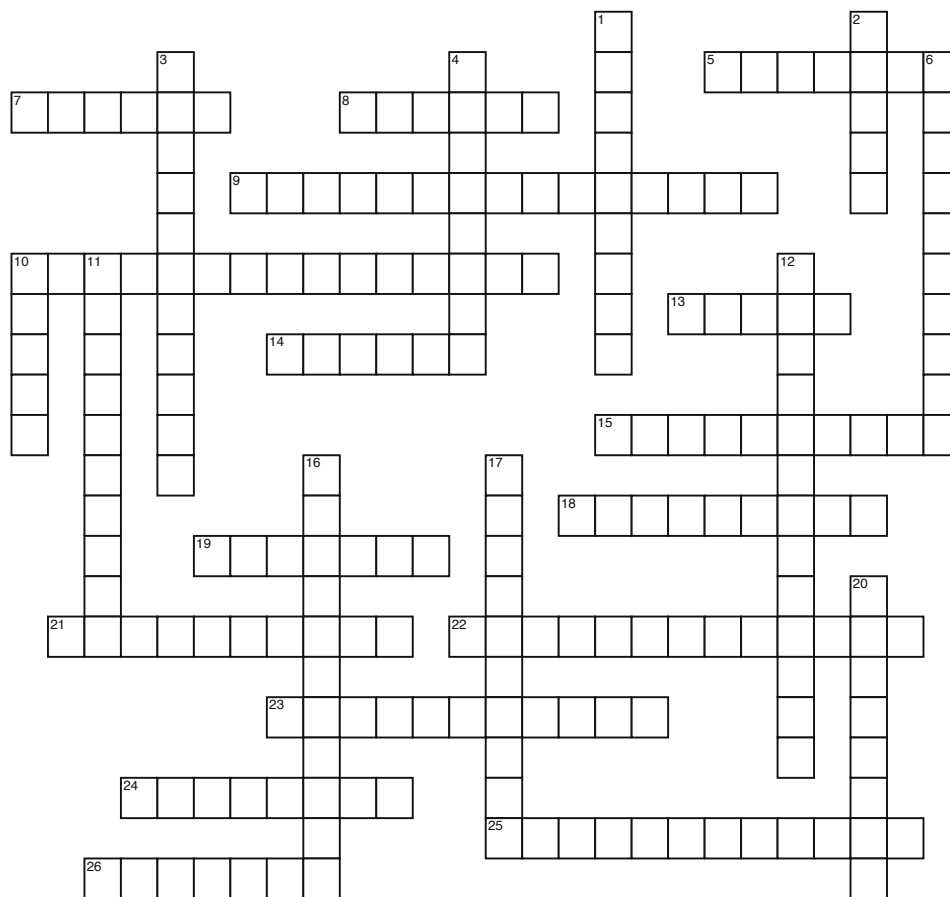
- 2 \_\_\_\_\_ is the increase in rate of a chemical reaction by means of a substance called a catalyst.
- 3 A reaction \_\_\_\_\_ of a chemical reaction is defined as an elementary reaction, constituting one of the stages of a reaction in which a reaction intermediate is converted into the next reaction intermediate in the sequence between reactants and products.
- 4 The \_\_\_\_\_ of reaction with respect to a certain reactant is defined, in chemical kinetics, as the power to which its concentration term in the rate equation is raised.
- 7 \_\_\_\_\_ state theory is a conception of chemical reactions or other processes involving rearrangement of matter as proceeding through a continuous change in the relative positions and potential energies of the constituent atoms and molecules.
- 8 \_\_\_\_\_ energy, also called threshold energy, is a term defined as the energy that must be overcome in order for a chemical reaction to occur.
- 9 A reaction \_\_\_\_\_ is an abstract one-dimensional trajectory representing progress along a reaction pathway.
- 10 The rate \_\_\_\_\_ or rate equation for a chemical reaction is an equation which links the reaction rate with concentrations or pressures of reactants and constant parameters.
- 12 The rate-\_\_\_\_\_ step is a chemistry term for the slowest step in a chemical reaction.
- 15 The reaction \_\_\_\_\_ for a reactant or product in a particular reaction tells you how fast a reaction takes place.

**ACROSS**

- 1 A \_\_\_\_\_ bond is a special type of dipole-dipole bond that exists between an electronegative atom and a hydrogen atom bonded to another electronegative atom.
- 3 \_\_\_\_\_ (hypohydration) is the removal of water from a substance.
- 6 \_\_\_\_\_ is any product of the condensation of atmospheric water vapor that is deposited on the earth's surface.
- 7 \_\_\_\_\_ refers to the physical property of a molecule that is repelled from a mass of water.
- 9 Water \_\_\_\_\_ is the gas phase of water.
- 11 \_\_\_\_\_ is the name given to any one of the 14 known solid phases of water.
- 13 The self-\_\_\_\_\_ of water is the chemical reaction in which two water molecules react to produce a hydronium and a hydroxide ion.
- 15 \_\_\_\_\_ is the common name for the cation derived from protonation of water.
- 16 In physical chemistry, and in engineering, \_\_\_\_\_ refers to vaporized water.
- 17 \_\_\_\_\_ water is water which contains a higher proportion than normal of the isotope deuterium, as deuterium oxide, or as deuterium protium oxide.
- 19 \_\_\_\_\_ is water located beneath the ground surface in soil pore spaces and in the fractures of lithologic formations.

**DOWN**

- 1 \_\_\_\_\_ refers to a physical property of a molecule that can transiently bond with water through hydrogen bonding.
- 2 The Earth's water is always in movement, and the hydrologic or water \_\_\_\_\_ describes the continuous movement of water on, above, and below the surface of the Earth.
- 4 A \_\_\_\_\_ is a chemical compound possessing both hydrophilic and hydrophobic properties.
- 5 \_\_\_\_\_ is a cloud in contact with the ground.
- 8 \_\_\_\_\_ is the most common name for the diatomic anion, consisting of oxygen and hydrogen atoms, usually derived from the dissociation of a base.
- 10 A \_\_\_\_\_ is an underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, silt, or clay) from which groundwater can be usefully extracted using a water well.
- 12 \_\_\_\_\_ is the net movement of water across a partially permeable membrane from a region of high solvent potential to an area of low solvent potential, up a solute concentration gradient.
- 14 \_\_\_\_\_ is a common chemical substance that is essential to all known forms of life, typically referred to in its liquid form or state, but also having a solid state, ice, and a gaseous state, which are commonly encountered.
- 18 \_\_\_\_\_ is water in the form of droplets that appears on thin, exposed objects in the morning or evening.

**ACROSS**

- 5 A \_\_\_\_\_ solution is a solution in which the solvent is water.
- 7 \_\_\_\_\_'s law states that the vapor pressure of an ideal solution is dependent on the vapor pressure of each chemical component and the mole fraction of the component present in the solution.
- 8 The \_\_\_\_\_-ion effect is a term used to describe the effect on a solution of two dissolved solutes that contain the same ion.
- 9 \_\_\_\_\_ is the natural or artificial process of formation of solid crystals from a uniform solution.
- 10 The term \_\_\_\_\_ refers to a solution that contains more of the dissolved material than could be dissolved by the solvent under normal circumstances.
- 13 \_\_\_\_\_'s law states that at a constant temperature, the amount of a given gas dissolved in a given type and volume of liquid is directly proportional to the partial pressure of that gas in equilibrium with that liquid.
- 14 \_\_\_\_\_'s law states that the total pressure exerted by a gaseous mixture is equal to the sum of the partial pressures of each individual component in a gas mixture.
- 15 \_\_\_\_\_ equilibrium is any chemical equilibrium between solid and dissolved states of a compound at saturation.
- 18 Boiling-point \_\_\_\_\_ is a colligative property that states that a solution will

have a higher boiling point than that of a pure solvent after the addition of a dissolved solute.

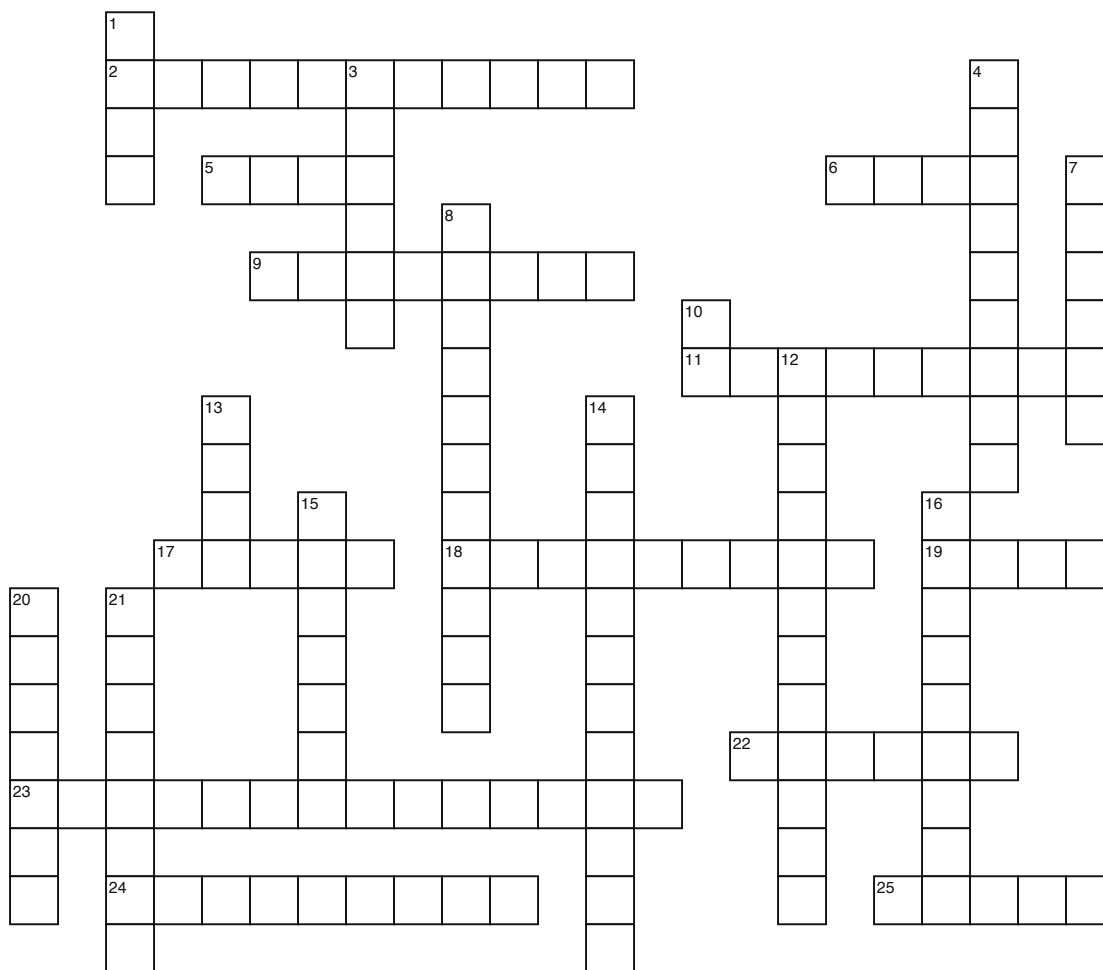
- 19 A \_\_\_\_\_, emulsion or dispersion is a type of heterogeneous mixture consisting of a dispersed phase made of tiny particles or droplets distributed evenly throughout a continuous phase.
- 21 Freezing-point \_\_\_\_\_ is the difference between the freezing points of a pure solvent and a solution mixed with a solute.
- 22 \_\_\_\_\_ is the measure of how much of a given substance there is mixed with another substance.
- 23 \_\_\_\_\_ occurs when carbon dioxide is dissolved in water or an aqueous solution.
- 24 The mole \_\_\_\_\_ of a component in a mixture is the relative proportion of molecules belonging to the component to those in the mixture, by number of molecules.
- 25 \_\_\_\_\_ is a general process in which ionic compounds separate or split into smaller molecules, ions, or radicals, usually in a reversible manner.
- 26 In chemistry, a \_\_\_\_\_ is a substance made by combining two or more different materials in such a way that no chemical reaction occurs.

**DOWN**

- 1 \_\_\_\_\_ or dissolution is the process of attraction and association of molecules of

a solvent with molecules or ions of a solute.

- 2 A \_\_\_\_\_ solution is one that contains one mole of solute per liter.
- 3 A \_\_\_\_\_ is a substance containing free ions that behaves as an electrically conductive medium.
- 4 A \_\_\_\_\_, dispersion or colloid is a mixture of two immiscible substances in which a dispersed phase made of tiny particles or droplets is distributed evenly throughout a continuous phase.
- 6 \_\_\_\_\_ is a physical property referring to the ability for a given substance, the solute, to dissolve in a solvent.
- 10 A solvation \_\_\_\_\_ is a structure of any chemical species acting as a solvent, surrounding a solute species.
- 11 \_\_\_\_\_ solution is a form of concentration expression often preferred to molarity within the biological sciences in which a 1 percent solution would have 1 g of solute dissolved in a final volume of 100 ml of solution.
- 12 \_\_\_\_\_ is the formation of a solid in a solution during a chemical reaction.
- 16 \_\_\_\_\_ properties are properties of solutions that depend on the number of particles in a given volume of solvent and not on the mass of the particles.
- 17 \_\_\_\_\_ water is plain water into which carbon dioxide gas has been dissolved.
- 20 A \_\_\_\_\_ is a homogeneous mixture composed of two or more substances.



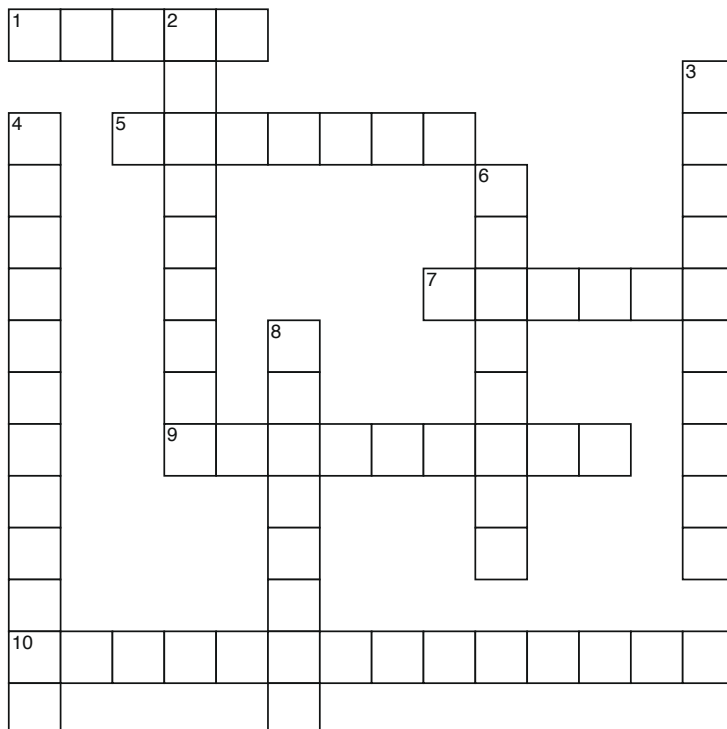
## ACROSS

- 2 The \_\_\_\_\_ point or stoichiometric point occurs during a chemical titration when the amount of titrant added is equivalent, or equal, to the amount of analyte present in the sample.
- 5 A \_\_\_\_\_ acid is an acid that does not ionize in solution to a significant extent.
- 6 A \_\_\_\_\_ is traditionally considered any chemical compound that, when dissolved in water, gives a solution with a pH less than 7.0.
- 9 Hydrogen \_\_\_\_\_ has the formula HCl.
- 11 Sodium \_\_\_\_\_, also known as lye, caustic soda and sodium hydrate, is a caustic metallic base.
- 17 A \_\_\_\_\_ acid can accept a pair of electrons and form a coordinate covalent bond.
- 18 An acid-base \_\_\_\_\_ is a volumetric method in chemistry that allows quantitative analysis of the concentration of an unknown acid or base solution, making use of the neutralization reaction that occurs between acids and bases.
- 19 A \_\_\_\_\_-base reaction is a chemical reaction that occurs between a proton donor and a proton receiver.
- 22 A \_\_\_\_\_ acid is an acid that dissociates completely in an aqueous solution.
- 23 \_\_\_\_\_ is a chemical reaction, also called a water forming reaction, in which an acid and a base react and produce a salt and water.
- 24 A pH \_\_\_\_\_ is a halochromic chemical compound that is added in small amounts to a solution so that the pH of the solution can be determined easily.
- 25 A \_\_\_\_\_ base is any molecule or ion that can form a new coordinate covalent bond, by donating a pair of electrons.

## DOWN

- 1 A \_\_\_\_\_ base is a chemical base that does not ionize fully in an aqueous solution.
- 3 A \_\_\_\_\_ is a basic, ionic salt of a group I or group II element.
- 4 \_\_\_\_\_ is the common name for the cation derived from protonation of water. It is the simplest type of an oxonium ion.
- 7 \_\_\_\_\_ solutions are solutions that resist change in Hydronium ion and the hydroxide ion concentration (and consequently pH) upon addition of small amounts of acid or base, or upon dilution.
- 8 \_\_\_\_\_ is the addition of a hydrogen ion to an atom, molecule, or ion.
- 10 \_\_\_\_\_ is a measure of the acidity or alkalinity of a solution.
- 12 An acid \_\_\_\_\_ constant is an equilibrium constant for the deprotonation of a weak acid.
- 13 A \_\_\_\_\_ is most commonly thought of as a substance that can accept protons.
- 14 \_\_\_\_\_ acid is the aqueous solution of hydrogen chloride gas.
- 15 A \_\_\_\_\_ acid is an acid derived from inorganic substances by chemical reaction as opposed to organic acids.
- 16 Sodium \_\_\_\_\_ is a sodium salt of carbonic acid.
- 20 \_\_\_\_\_ is a compound consisting of one nitrogen atom singly bound to three hydrogen atoms, normally encountered as a gas with a characteristic pungent odor.
- 21 \_\_\_\_\_ acid is a strong mineral acid once known as oil of vitriol. Each molecule contains a sulfur atom, two hydrogen atoms and four oxygen atoms.



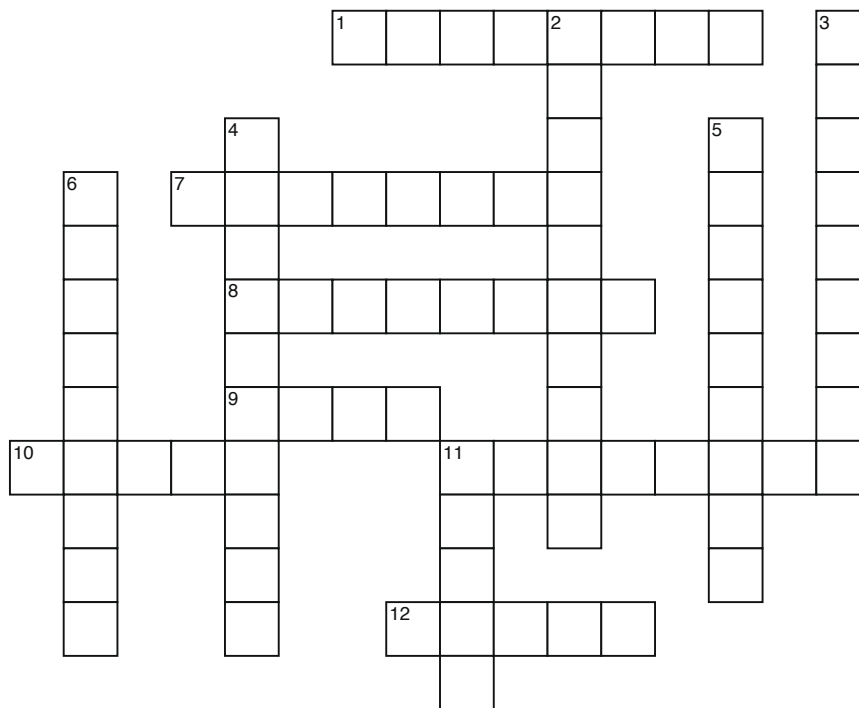


## ACROSS

- 1 A \_\_\_\_\_ base is any molecule or ion that can form a new coordinate covalent bond, by donating a pair of electrons.
- 5 A \_\_\_\_\_ is a molecule or ensemble formed by the combination of ligands and metal ions.
- 7 A \_\_\_\_\_ is an atom, ion, or molecule donating one or more of its electrons through a coordinate covalent bond to one or more central atoms or ions
- 9 \_\_\_\_\_ is the binding or complexation of a bi- or multidentate ligand.
- 10 \_\_\_\_\_ chemistry is the study of chemical compounds containing bonds between carbon and a metal.

## DOWN

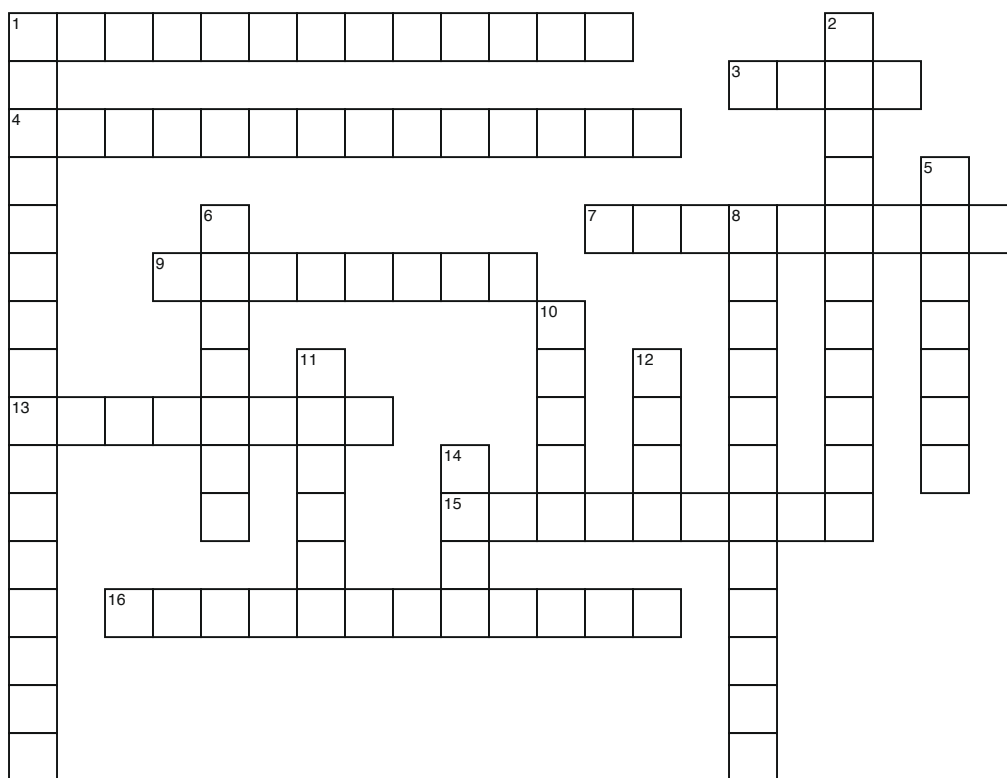
- 2 The field of \_\_\_\_\_ chemistry covers all chemical compounds except the myriad organic compounds, which are the subjects of organic chemistry.
- 3 A \_\_\_\_\_ covalent bond is a type of covalent bonding between two atoms in which both electrons shared in the bond come from the same atom.
- 4 \_\_\_\_\_ number is defined as the total number of neighbors of a central atom in a chemical compound.
- 6 A \_\_\_\_\_ ligand is an atom or a polyatomic entity that connects two or more metal centres in a complex.
- 8 Arising from the size of the valence shell of a transition metal, the 18-\_\_\_\_\_ rule is a rule of thumb used primarily in transition metal chemistry for characterizing and predicting the stability of metal complexes.

**ACROSS**

- 1 Electron \_\_\_\_\_ is the process by which an electron moves from one atom or molecule to another atom or molecule.
- 7 A \_\_\_\_\_ is a compound containing an oxygen-oxygen single bond.
- 8 A terminal electron \_\_\_\_\_ is a compound that receives or accepts an electron during cellular respiration or photosynthesis.
- 9 A \_\_\_\_\_ reaction is either the oxidation or reduction reaction component of a redox reaction.
- 10 The oxidation \_\_\_\_\_ is an indicator of the degree of oxidation of an atom in a chemical compound. It is usually numerically equal to the oxidation number.
- 11 A \_\_\_\_\_ agent is the element or a compound that reduces another species in a redox reaction. It is the electron donor in the redox.
- 12 In general terms, an electron \_\_\_\_\_ gives up an electron during cellular respiration.

**DOWN**

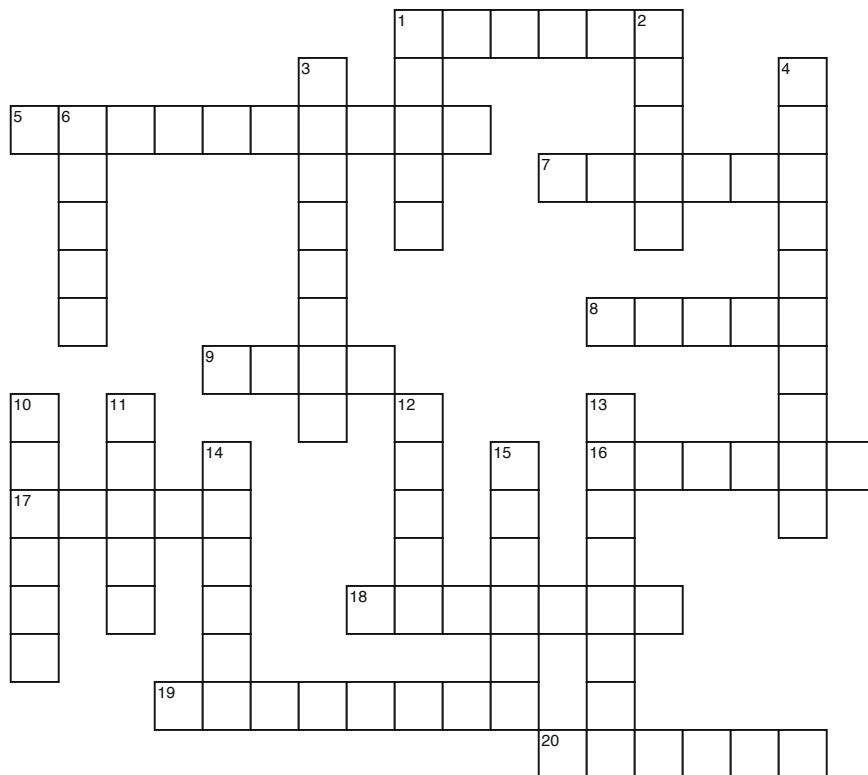
- 2 \_\_\_\_\_ is the free radical product of the one-electron reduction of dioxygen.
- 3 A \_\_\_\_\_ agent is a substance that gains electrons in a redox chemical reaction.
- 4 \_\_\_\_\_ is a bimolecular process involving the exchange of bonds between the two reacting chemical species, which results in the creation of products with similar or identical bonding affiliations.
- 5 Within a molecule or complex, the \_\_\_\_\_ number of an element is the charge that it would have if the compound were composed of ions, with assignment of shared electrons based on electronegativity.
- 6 Standard reduction \_\_\_\_\_ is the tendency of a chemical species to acquire electrons and thereby be reduced.
- 11 \_\_\_\_\_, shorthand for reduction/oxidation reaction, is a term used to describe chemical reactions in which atoms have their oxidation state changed.

**ACROSS**

- 1 \_\_\_\_\_ force or potential of a body is the work done in joules to bring a unit electric charge from infinity to the body.
- 3 A \_\_\_\_\_ cell is a structure that contains a conductive electrode and a surrounding conductive electrolyte separated by a naturally-occurring Helmholtz double layer.
- 4 \_\_\_\_\_ is the process of using electrical current to coat an electrically conductive object with a relatively thin layer of metal.
- 7 The standard electrode \_\_\_\_\_ is the measure of individual voltage of any electrode at standard ambient conditions, which is at a temperature of 298K, solutes at a concentration of 1 M, and gases at a pressure of 1 bar.
- 9 A \_\_\_\_\_ cell (or voltaic cell) consists of two different metals connected by a salt bridge or a porous disk between the individual half-cells.
- 13 The standard \_\_\_\_\_ electrode is a redox electrode which forms the basis of the thermodynamic scale of oxidation-reduction potentials.
- 15 A \_\_\_\_\_ is an electrical conductor used to make contact with a nonmetallic part of a circuit.
- 16 \_\_\_\_\_ is a method of separating chemically bonded elements and compounds by passing an electric current through them.

**DOWN**

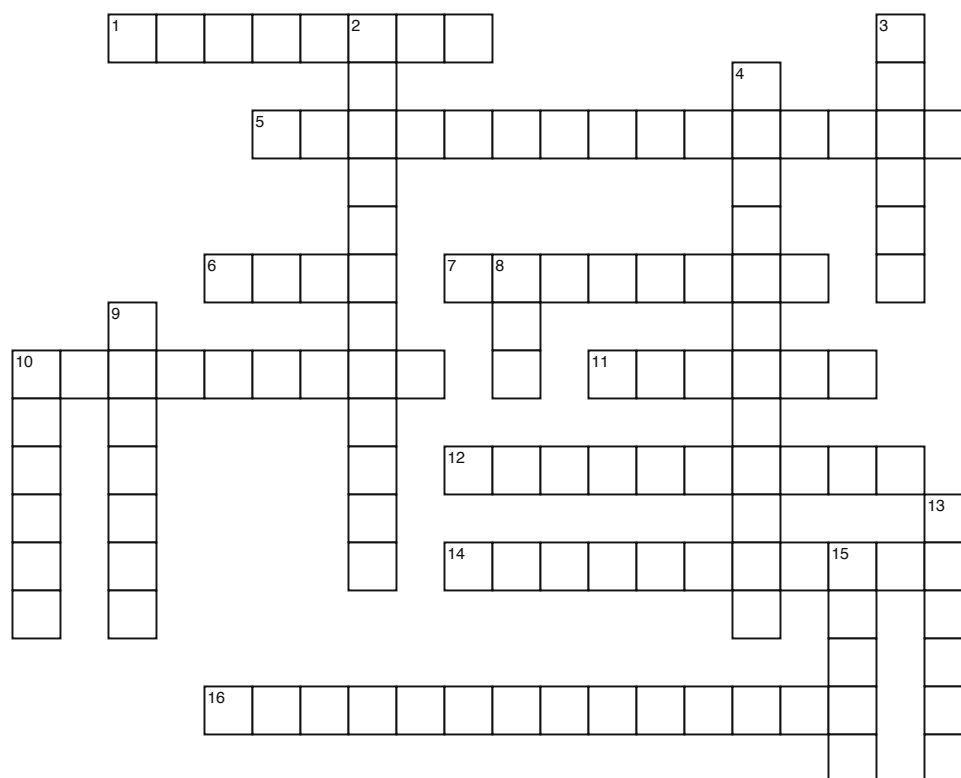
- 1 \_\_\_\_\_ is a branch of chemistry that studies the reactions which take place at the interface of an electronic conductor and an ionic conductor.
- 2 A \_\_\_\_\_ is a substance containing free ions that behaves as an electrically conductive medium.
- 5 The \_\_\_\_\_ constant is the amount of electric charge in one mole of electrons.
- 6 A \_\_\_\_\_ is an electrode through which the positive direction of electric current flows out of a polarized electrical device.
- 8 \_\_\_\_\_ cells are composed of a vessel used to perform electrolysis and a cathode and anode.
- 10 A \_\_\_\_\_ is an electrode through which the positive direction of electric current flows into a polarized electrical device.
- 11 The \_\_\_\_\_ equation gives the electrode potential relative to the standard electrode potential of the electrode couple as a function of component concentrations.
- 12 A \_\_\_\_\_ bridge is a laboratory device used to connect the oxidation and reduction half-cells of a galvanic cell.
- 14 An electrochemical \_\_\_\_\_ is a device used for creating an electromotive force and current from chemical reactions.

**ACROSS**

- 1 A \_\_\_\_\_, olefin, or olefine is an unsaturated chemical compound containing at least one carbon-to-carbon double bond.
- 5 \_\_\_\_\_ acids are organic acids characterized by the presence of a carboxyl group.
- 7 The \_\_\_\_\_ group consists of six carbon atoms arranged in a cyclic ring structure. A member of the aromatic family, this functional group is highly stable.
- 8 A \_\_\_\_\_ is a compound that contains the functional group composed of a sulfur atom and a hydrogen atom. Often referred to as mercaptans, these compounds are the sulfur analogues of alcohols.
- 9 A \_\_\_\_\_ halide (also known as an acid halide) is a chemical compound derived from an acid by replacing a hydroxyl group with a halide group.
- 16 Traditionally known as acetylenes or the acetylene series, the \_\_\_\_\_s are hydrocarbons that have at least one triple bond between two carbon atoms.
- 17 \_\_\_\_\_s are a class of chemical compounds and functional groups consisting of an inorganic or organic acid in which at least one - hydroxyl group is replaced by an alkoxy group.
- 18 A \_\_\_\_\_ is any organic compound in which a hydroxyl group (-OH) is bound to a carbon atom of an alkyl or substituted alkyl group.
- 19 A \_\_\_\_\_ is an organic compound containing a terminal carbonyl group.
- 20 \_\_\_\_\_s, also known as Paraffins, are chemical compounds that consist only of the elements carbon and hydrogen linked together exclusively by single bonds.

**DOWN**

- 1 \_\_\_\_\_s are organic compounds and a type of functional group that contain nitrogen as the key atom, structurally resembling ammonia, but one or more hydrogen atoms is replaced by alkyl and aryl groups.
- 2 \_\_\_\_\_ is the general name for a class of chemical compounds which contain an oxygen atom connected to two alkyl or aryl groups.
- 3 \_\_\_\_\_ in chemistry stands for a molecule consisting of an oxygen atom and a hydrogen atom connected by a covalent bond. When the oxygen atom is linked to a larger molecule it is a functional group.
- 4 The \_\_\_\_\_s (also known as halogenoalkanes or alkyl halides) are a group of chemical compounds, consisting of alkanes, such as methane or ethane, with one or more halogens linked, such as chlorine or fluorine, making them a type of organic halide.
- 6 A \_\_\_\_\_ is an organic functional group characterized by a carbonyl group linked to a nitrogen atom.
- 10 \_\_\_\_\_ (ethanoyl), is the term for a functional group which is the acyl of acetic acid.
- 11 A carbonate \_\_\_\_\_ is a functional group in organic chemistry consisting of a carbonyl group flanked by two alkoxy groups.
- 12 \_\_\_\_\_ is a four-carbon alkyl substituent derived from either of the two isomers of the alkane called butane.
- 13 A \_\_\_\_\_ group is a functional group composed of a carbon atom double-bonded to an oxygen atom.
- 14 \_\_\_\_\_ is the substituent form of the alkane propane.
- 15 A \_\_\_\_\_ is either the functional group characterized by a carbonyl group linked to two other carbon atoms or a chemical compound that contains this functional group.

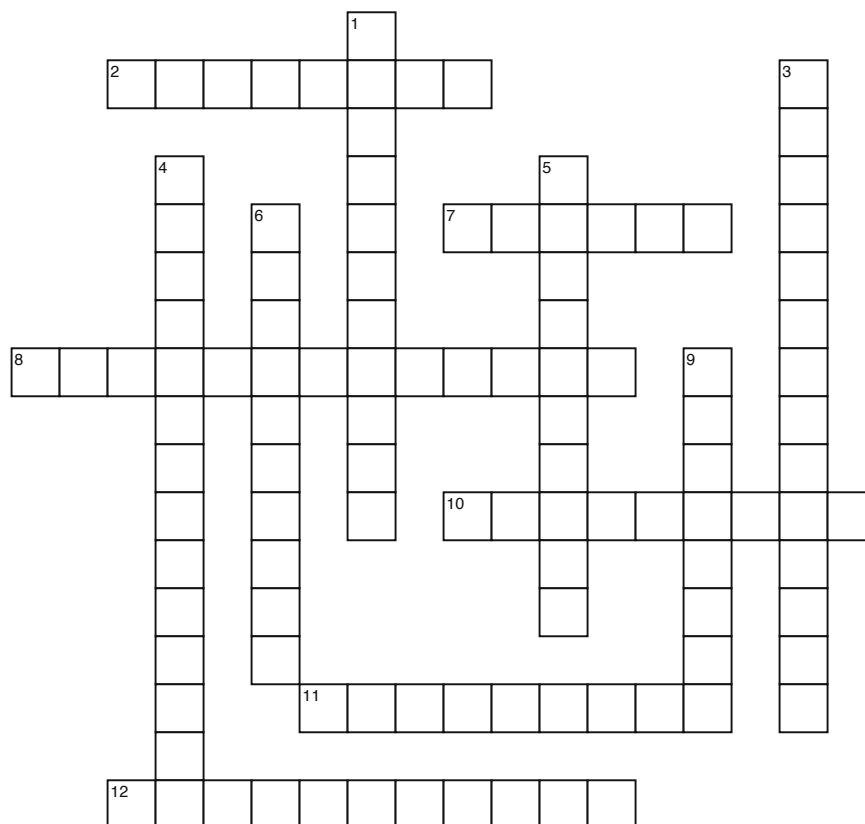


## ACROSS

- 1 A \_\_\_\_\_ conformation is a chemical conformation that exists in any open chain single chemical bond connecting two  $sp^3$  hybridised atoms as a conformational energy maximum.
- 5 \_\_\_\_\_ involves the study of the relative spatial arrangement of atoms within molecules.
- 6 A \_\_\_\_\_ compound is a chemical compound with molecules that contain 2 or more stereocenters but which is optically achiral because it contains an internal plane of symmetry.
- 7 Optical rotation or optical \_\_\_\_\_ is the rotation of linearly polarized light as it travels through certain materials.
- 10 A \_\_\_\_\_ conformation is a chemical conformation that exists in any open chain single chemical bond connecting two  $sp^3$  hybridised atoms as a conformational energy minimum.
- 11 The term \_\_\_\_\_ is used to describe an object that is non-superimposable on its mirror image.
- 12 \_\_\_\_\_s are stereoisomers that are nonsuperimposable complete mirror images of each other.
- 14 \_\_\_\_\_ is a cycloalkane containing 6 carbons and 12 hydrogens, which has the lowest angle and torsional strain of all the cycloalkanes.
- 16 \_\_\_\_\_ isomerism is a form of stereoisomerism involving molecules with the same structural formula existing as different conformers due to atoms rotating about a bond.

## DOWN

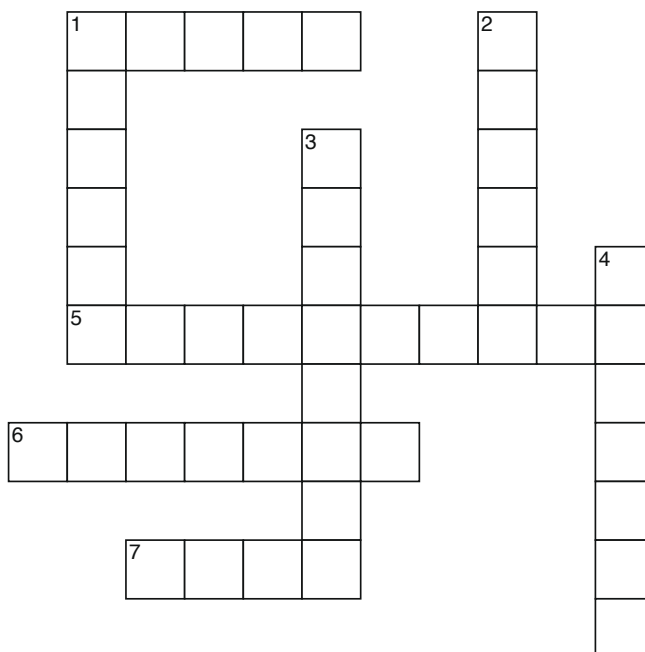
- 2 A \_\_\_\_\_ is any atom in a molecule bearing groups such that an interchanging of any two groups leads to a stereoisomer.
- 3 Van der Waals \_\_\_\_\_ results from van der Waals repulsion when two substituents in a molecule approach each other with a distance less than the sum of their van der Waals radii.
- 4 \_\_\_\_\_s are stereoisomers that are not enantiomers.
- 8 \_\_\_\_\_-trans isomerism is a form of stereoisomerism describing the orientation of functional groups typically around double bonds which cannot rotate.
- 9 A \_\_\_\_\_ mixture is one that has equal amounts of left- and right-handed enantiomers of a chiral molecule.
- 10 \_\_\_\_\_ effects arise from the fact that if atoms are brought too close together, there is an associated cost in energy due to overlapping electron clouds.
- 13 A \_\_\_\_\_ projection visualizes chemical conformations of a carbon-carbon chemical bond from front to back, with the front carbon represented by a dot and the back carbon as a circle.
- 15 The presence of \_\_\_\_\_ strain in a molecule indicates that in a specific chemical conformation bond angles are deviating from the ideal bond angles required to achieve maximum bond strength.

**ACROSS**

- 2 \_\_\_\_\_ organic compounds (VOCs) are organic chemical compounds that have high enough vapour pressures under normal conditions to significantly vaporize and enter the atmosphere.
- 7 A \_\_\_\_\_ solvent is a solvent that carries a hydrogen bond between an oxygen as in a hydroxyl group or a nitrogen as in an amine group.
- 8 \_\_\_\_\_ refers to the ability of a chemical compound to dissolve in fats, oils, lipids, and non-polar solvents such as hexane or toluene.
- 10 \_\_\_\_\_ compounds are organic compounds in which carbon atoms are joined together in straight or branched chains or in rings, that can be either saturated or unsaturated, but not aromatic.
- 11 A \_\_\_\_\_ or distribution coefficient is the ratio of concentrations of a compound in the two phases of a mixture of two immiscible solvents at equilibrium.
- 12 A \_\_\_\_\_ is an organic compound consisting entirely of hydrogen and carbon.

**DOWN**

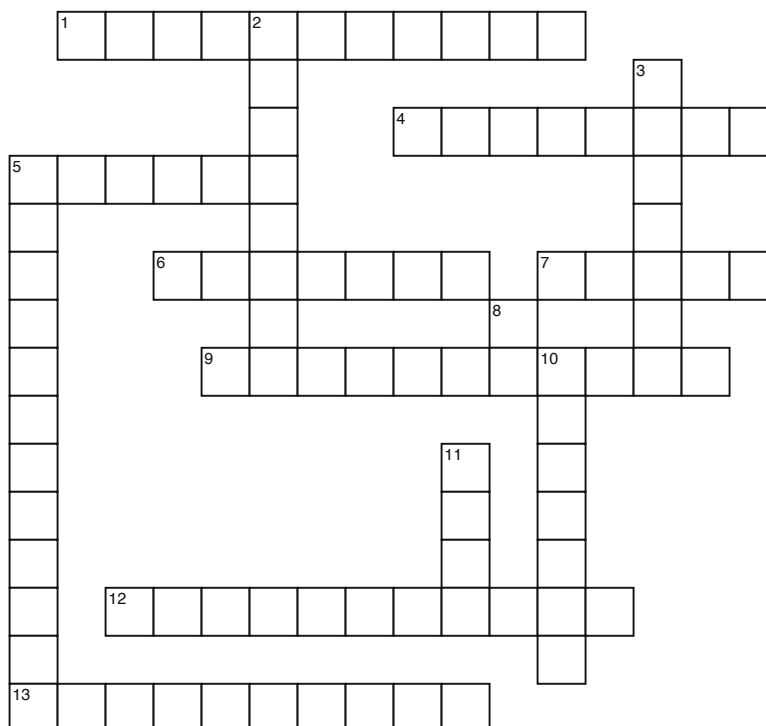
- 1 \_\_\_\_\_ is a term in chemistry that refers to the property of liquids to mix, forming a homogeneous solution.
- 3 \_\_\_\_\_ refers to the physical property of a molecule that is repelled from a mass of water.
- 4 \_\_\_\_\_ refers to a physical property of a molecule that can transiently bond with water through hydrogen bonding.
- 5 \_\_\_\_\_ is a measure of the speed at which a substance turns into a vapor from a solid or liquid state.
- 6 \_\_\_\_\_ is a term describing a chemical compound possessing both hydrophilic and hydrophobic properties.
- 9 \_\_\_\_\_ is a common name for the group of alkane hydrocarbons.

**ACROSS**

- 1 \_\_\_\_\_s are organic compounds and a type of functional group that contain nitrogen as the key atom. Structurally they resemble ammonia, wherein one or more hydrogen atoms are replaced by alkyl and aryl groups.
- 5 \_\_\_\_\_ acids are organic acids characterized by the presence of a carboxyl group.
- 6 \_\_\_\_\_ acid is a colorless crystalline solid and the simplest aromatic carboxylic acid.
- 7 Amines and nitrogen-containing heterocyclic compounds are organic \_\_\_\_\_s.

**DOWN**

- 1 \_\_\_\_\_ acid, also known as ethanoic acid, is an organic chemical compound best recognized for giving vinegar its sour taste and pungent smell.
- 2 \_\_\_\_\_, also known under an older name of carbolic acid, possesses a structure consisting of a hydroxyl group bonded to a phenyl ring.
- 3 A \_\_\_\_\_ is the conjugate base of an alcohol and therefore consists of an organic group bonded to a negatively charged oxygen atom.
- 4 A \_\_\_\_\_, or ethanoate, is a salt or ester of acetic acid.

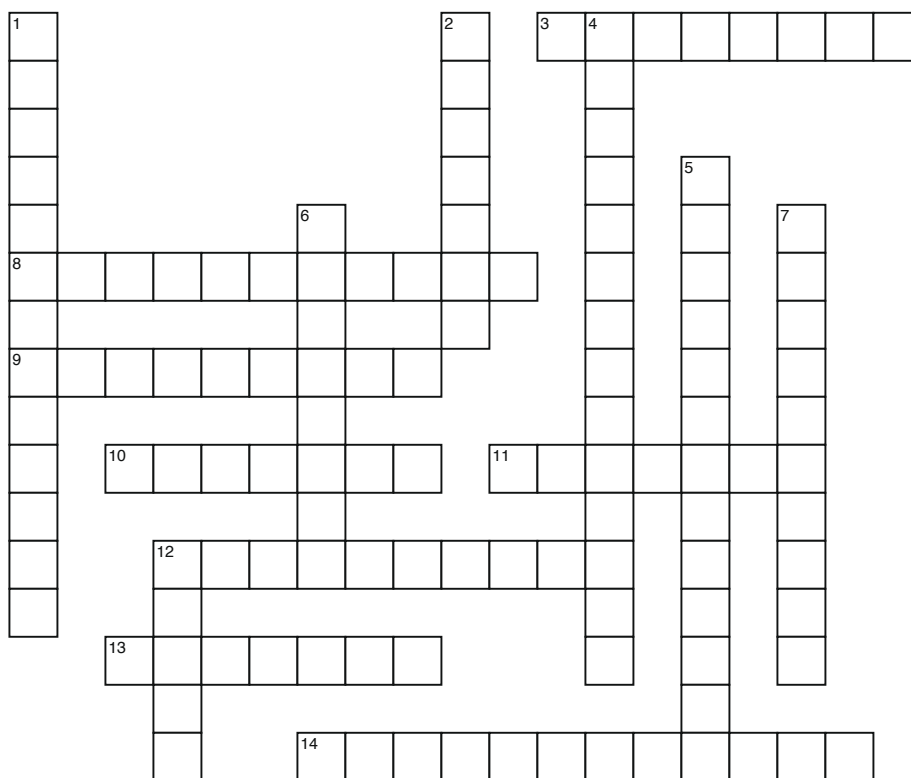
**ACROSS**

- 1 \_\_\_\_\_ electrons are electrons in a molecule that are not associated with a single atom or to a covalent bond.
- 4 \_\_\_\_\_ in supramolecular chemistry refers to a stacked arrangement of aromatic molecules, which interact through aromatic interactions.
- 5 \_\_\_\_\_'s rule estimates whether a planar ring molecule will have aromatic properties. It was first expressed succinctly as the  $4n+2$  rule by von Doering in 1951.
- 6 \_\_\_\_\_ is an organic aromatic chemical compound whose molecules contain six carbons and six hydrogens.
- 7 \_\_\_\_\_s are hydrocarbons which contain two double bonds.
- 9 \_\_\_\_\_ is a chemical property in which a conjugated ring of unsaturated bonds, lone pairs, or empty orbitals exhibit a stabilization stronger than would be expected by the stabilization of conjugation alone.
- 12 \_\_\_\_\_ is a crystalline, aromatic, white, solid hydrocarbon, best known as the primary ingredient of mothballs.
- 13 A chemically \_\_\_\_\_ system is a system of atoms covalently bonded with alternating single and multiple bonds in a molecule of an organic compound.

**DOWN**

- 2 A set of points in space is \_\_\_\_\_ if the points all lie in the same geometric plane.
- 3 Often compounds with extended conjugated systems, a \_\_\_\_\_ is a material that changes the color of light it reflects as the result of selective color absorption.
- 5 \_\_\_\_\_ compounds are organic compounds that contain a ring structure containing atoms in addition to carbon, such as sulfur, oxygen or nitrogen, as part of the ring.
- 8 \_\_\_\_\_ bonds are covalent chemical bonds where two lobes of one involved electron orbital overlap two lobes of the other involved electron orbital. Only one of the orbital's nodal planes passes through both of the involved nuclei.
- 10 An aromatic ring \_\_\_\_\_ is an effect observed in aromatic molecules if a magnetic field is directed perpendicular to the plane of the aromatic system.
- 11 In the context of organic molecules, \_\_\_\_\_ refers to any functional group or substituent derived from a simple aromatic ring.



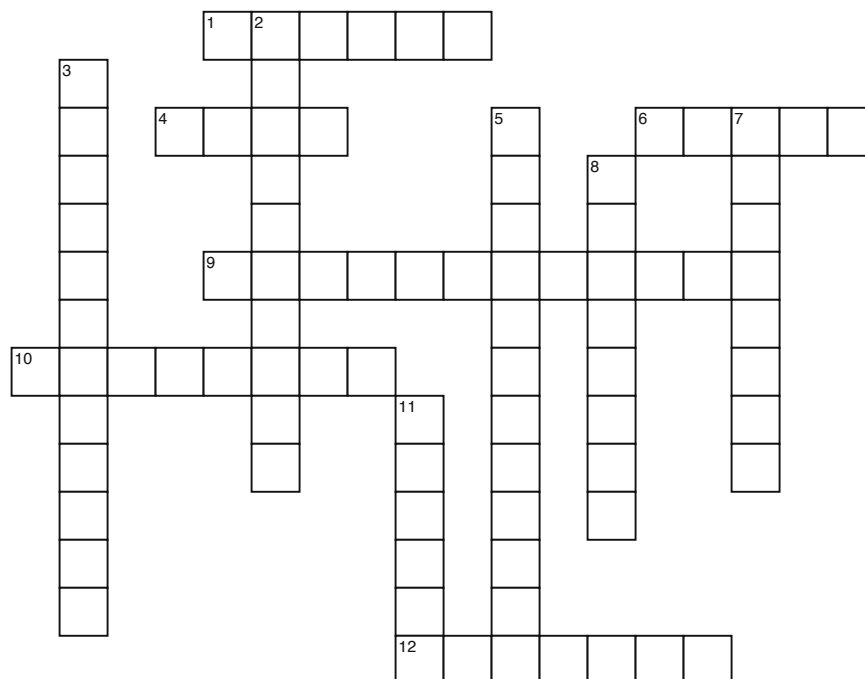


## ACROSS

- 3 An important group of oxidizing agents, the \_\_\_\_\_s are salts of chromic acid.
- 8 Prepared by the reaction of sodium hydride on trimethylborate, sodium \_\_\_\_\_ is a reducing agent often used to reduce aldehydes and ketones into alcohols.
- 9 The reverse of oxidative addition is \_\_\_\_\_ elimination.
- 10 \_\_\_\_\_ is the name given to the negative ion of hydrogen. Although this ion does not exist except in extraordinary conditions, the term is widely applied to describe compounds of hydrogen with other elements.
- 11 \_\_\_\_\_' reagent is usually ammoniacal silver nitrate, an oxidizing agent, which is itself reduced to silver metal. It is used as a test for aldehydes.
- 12 \_\_\_\_\_ is the cleavage of an alkene or alkyne with ozone to form compounds in which the multiple carbon-carbon bond has been replaced by a double bond to oxygen.
- 13 Used for the hydrogenation of alkynes to alkenes, \_\_\_\_\_ catalyst is a heterogeneous catalyst that consists of palladium deposited on calcium carbonate and treated with various forms of lead.
- 14 Potassium \_\_\_\_\_ contains manganese bonded to four oxygens. Often employed for laboratory redox, it is a strong oxidizer with manganese in the +7 oxidation state.

## DOWN

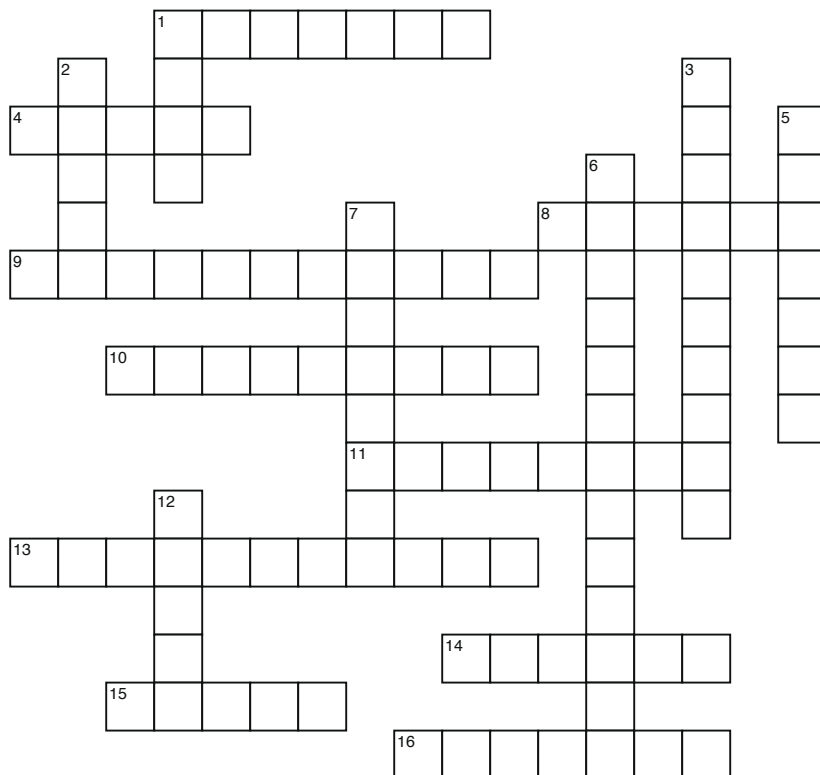
- 1 Employing borane in tetrahydrofuran in the first step, the \_\_\_\_\_-oxidation reaction is a two-step organic chemical reaction that converts an alkene into a neutral alcohol by the net addition of water across the double bond.
- 2 Lithium aluminium \_\_\_\_\_ is a powerful reducing agent used in organic chemistry.
- 4 \_\_\_\_\_ is a catalytic chemical reaction whereby a molecule of hydrogen is added over a carbon-heteroatom single bond, effectively causing a lysis of the bond.
- 5 \_\_\_\_\_ is a class of chemical reactions which result in an addition of hydrogen molecule usually to unsaturated organic compounds.
- 6 Oxidative \_\_\_\_\_ is an important classes of reactions in organometallic chemistry in which a metal complex with vacant coordination sites and a relatively low oxidation state is oxidized by the insertion into a covalent bond.
- 7 \_\_\_\_\_ or burning is a complex sequence of exothermic chemical reactions between a fuel and an oxidant accompanied by the production of heat or both heat and light in the form of either a glow or flames.
- 12 Manganese \_\_\_\_\_ is the chemical compound in which manganese is bound to two oxygens. It is often used to oxidize allylic alcohols to the corresponding aldehydes.

**ACROSS**

- 1 \_\_\_\_\_ precession refers to the precession of the magnetic moments of electrons, atomic nuclei, and atoms about an external magnetic field.
- 4 \_\_\_\_\_ spectrometry is an analytical technique used to measure the mass-to-charge ratio of ions.
- 6 In nuclear magnetic resonance (NMR), the chemical \_\_\_\_\_ describes the dependence of nuclear magnetic energy levels on the electronic environment in a molecule.
- 9 A \_\_\_\_\_ is an optical instrument used to measure properties of light over a specific portion of the electromagnetic spectrum, typically used in spectroscopic analysis to identify materials.
- 10 J-\_\_\_\_\_ describes the interaction between two nuclear spins due to the influence of bonding electrons on the magnetic field running between the two nuclei.
- 12 \_\_\_\_\_ magnetic resonance spectroscopy exploits the magnetic properties of certain nuclei. The most important applications for the organic chemist are proton NMR and carbon-13 NMR spectroscopy.

**DOWN**

- 2 A material's \_\_\_\_\_ spectrum shows the fraction of incident electromagnetic radiation absorbed by the material over a range of frequencies.
- 3 \_\_\_\_\_ is the study of the interaction between radiation and matter.
- 5 The \_\_\_\_\_ ratio of a particle or system is the ratio of its magnetic dipole moment to its angular momentum.
- 7 \_\_\_\_\_ spectroscopy is a form of absorption spectroscopy that develops information about the structure of molecular substances from various covalent bond vibrational modes.
- 8 A mass \_\_\_\_\_ is an intensity versus mass-to-charge ratio plot which represents the distribution of components by mass-to-charge ratio in a sample.
- 11 \_\_\_\_\_ NMR is the application of nuclear magnetic resonance in NMR spectroscopy with respect to hydrogen.

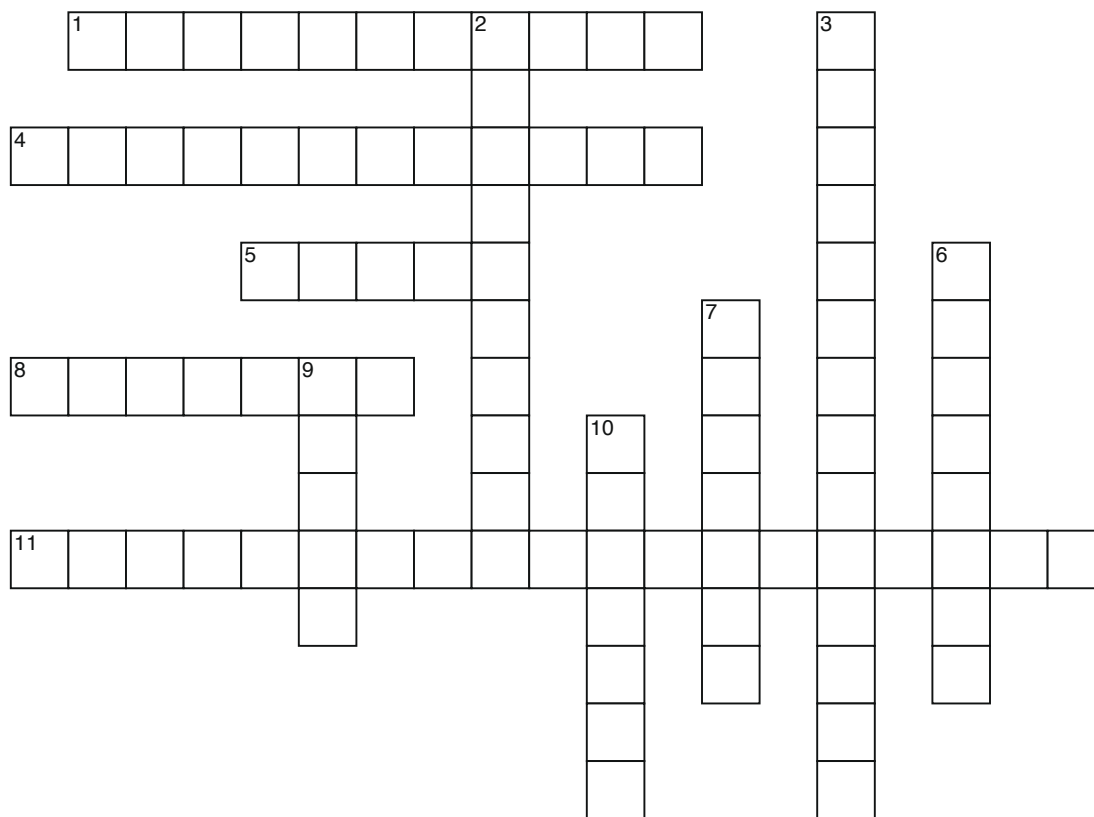
**ACROSS**

- 1 A \_\_\_\_\_ anion is the anion of an enol, formed by loss of a proton from the alpha carbon of a carbonyl group.
- 4 A \_\_\_\_\_ adduct is a beta-hydroxy ketone or aldehyde resulting from the addition of a ketone enolate to an aldehyde.
- 8 A \_\_\_\_\_ is a molecule with two single bonded oxygens are attached to the same carbon atom which is also bonded to an alkyl or aryl group and a hydrogen.
- 9 Keto-enol \_\_\_\_\_ refers to a chemical equilibrium between a keto form and an enol.
- 10 Nucleophilic \_\_\_\_\_ addition occurs by reaction of a nucleophile at the beta position of alpha-beta unsaturated carbonyl compounds.
- 11 In a \_\_\_\_\_ reaction two or more molecules combine to form a larger one.
- 13 The \_\_\_\_\_ reaction is an organic reaction by an aldehyde or ketone with a cyanide anion or a nitrile to form a cyanohydrin.
- 14 A \_\_\_\_\_ base is a functional group that contains a carbon-nitrogen double bond with the nitrogen atom connected to an aryl or alkyl group, but not hydrogen.
- 15 A \_\_\_\_\_ is a molecule with two single bonded oxygens attached to the same carbon atom which is also bonded to two alkyl or aryl groups.
- 16 The Wolff-\_\_\_\_\_ reduction is a chemical

reaction that fully reduces an aldehyde or ketone to an alkane.

**DOWN**

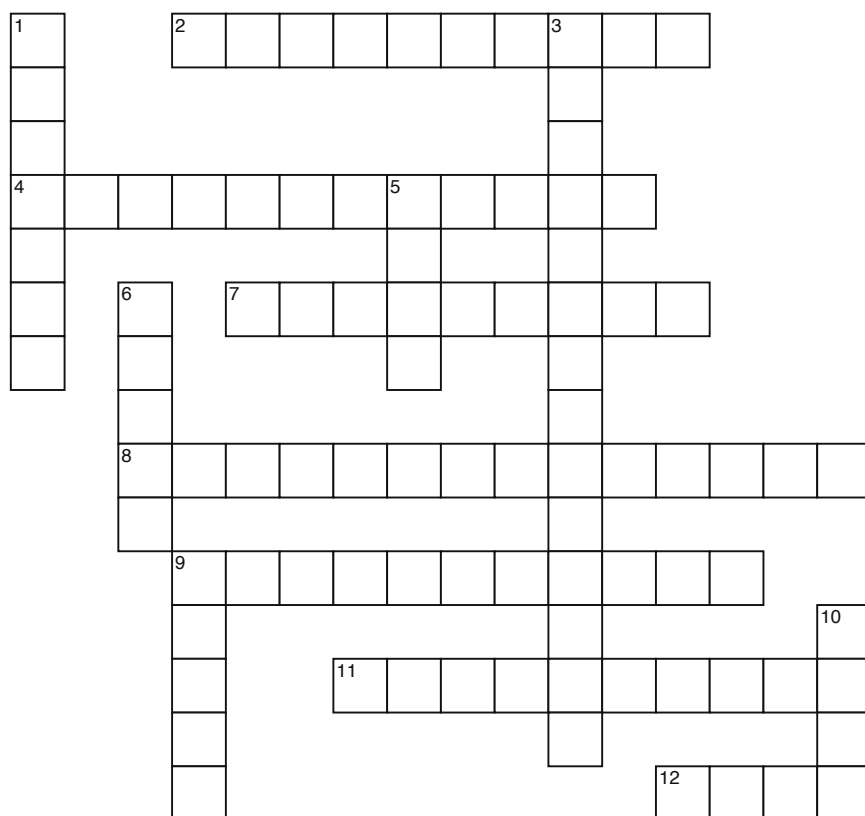
- 1 \_\_\_\_\_s are alkenes with a hydroxyl group affixed to one of the carbon atoms composing the double bond.
- 2 The \_\_\_\_\_ carbon in an aldehyde or ketone refers to the first carbon after the carbonyl carbon.
- 3 A \_\_\_\_\_ group is introduced into a molecule by chemical modification of a functional group in order to obtain chemoselectivity in a subsequent chemical reaction.
- 5 \_\_\_\_\_' reagent is usually ammoniacal silver nitrate, an oxidizing agent, which is itself reduced to silver metal. It is used as a test for aldehydes.
- 6 \_\_\_\_\_ is an organic reaction that involves the formation of an acetal or ketal.
- 7 The \_\_\_\_\_ reaction is an organometallic chemical reaction involving alkyl- or aryl-magnesium halides with electrophiles.
- 12 A \_\_\_\_\_ is an unsaturated chemical compound or functional group consisting of a conjugated system of an alkene and a ketone.

**ACROSS**

- 1** A \_\_\_\_\_ reaction is a chemical reaction that involves the loss of water from the reacting molecule.
- 4** \_\_\_\_\_ substitution is a fundamental class of substitution reaction in which an electron rich nucleophile selectively bonds with or attacks the positive charge of a group or atom called the leaving group.
- 5** \_\_\_\_\_ is the general name for a class of chemical compounds which contain an oxygen atom connected to two alkyl or aryl groups.
- 8** \_\_\_\_\_ esterification is the process of forming an ester by refluxing a carboxylic acid and an alcohol in the presence of an acid catalyst.
- 11** \_\_\_\_\_ is the process of exchanging the alkoxy group of an ester compound by another alcohol.

**DOWN**

- 2** Phosphorus \_\_\_\_\_ is widely used in the laboratory for the conversion of alcohols to alkyl bromides.
- 3** \_\_\_\_\_ is the general name for a chemical reaction in which two chemicals, such as an alcohol and an acid, form an ester as the reaction product.
- 6** A \_\_\_\_\_ is the conjugate base of an alcohol.
- 7** A \_\_\_\_\_ is a cyclic ether with only three ring atoms.
- 9** The Williamson \_\_\_\_\_ synthesis involves the reaction of an alkoxide ion with a primary alkyl halide via an SN2 reaction.
- 10** \_\_\_\_\_ chloride is an inorganic compound often used in chlorination reactions in which sulfur is bound to an oxygen and two chlorine atoms.

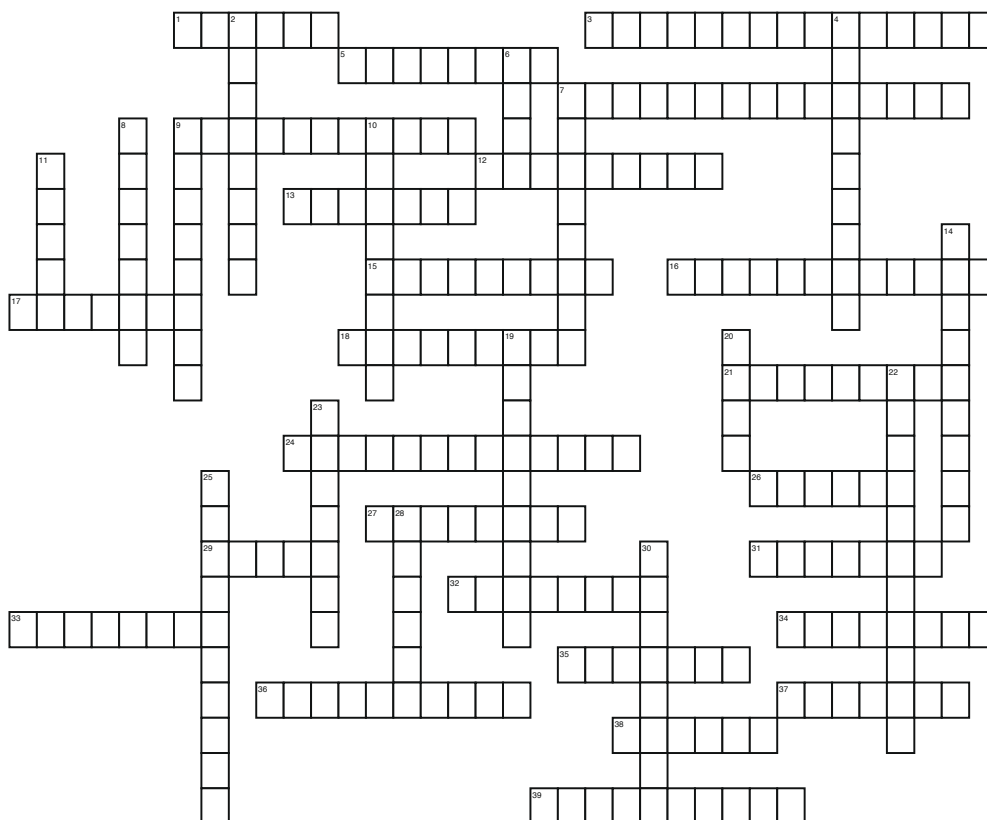


## ACROSS

- 2 \_\_\_\_\_ is a chemical reaction or process in which a chemical compound is broken down by reaction with water.
- 4 A \_\_\_\_\_ reaction is a chemical reaction in which two molecules or moieties combine to form one single molecule, together with the loss of a small molecule.
- 7 An acid \_\_\_\_\_ is an organic compound which has two acyl groups bound to the same oxygen atom.
- 8 \_\_\_\_\_ is the general name for a chemical reaction in which two chemicals, such as an alcohol and an acid, form an ester as the reaction product.
- 9 \_\_\_\_\_ or ethanoylation describes a reaction that introduces an acetyl functional group into an organic compound.
- 11 \_\_\_\_\_ acids are organic acids characterized by the presence of a carboxyl group.
- 12 A \_\_\_\_\_ group is a functional group derived by the removal of one or more hydroxyl group from an oxoacid.

## DOWN

- 1 \_\_\_\_\_ esterification is the process of forming an ester by refluxing a carboxylic acid and an alcohol in the presence of an acid catalyst.
- 3 \_\_\_\_\_ is the hydrolysis of an ester under basic conditions to form an alcohol and the salt of a carboxylic acid.
- 5 Nucleophilic \_\_\_\_\_ substitution describes the substitution reaction involving nucleophiles and carboxylic acid derivatives including esters, amides and acid halides.
- 6 \_\_\_\_\_s are a class of chemical compounds and functional groups which consist of an inorganic or organic acid in which at least one hydroxyl group has been replaced by an alkoxy group.
- 9 \_\_\_\_\_s are a class of chemical compounds and functional groups in which a carbonyl group carbon is linked to a nitrogen atom.
- 10 A \_\_\_\_\_ or acid halide is a chemical compound derived from an acid by replacing a hydroxyl group with a halide group.



## ACROSS

- 1 The \_\_\_\_\_ site of an enzyme contains the catalytic and binding sites.
- 3 \_\_\_\_\_ inhibition is a type of inhibition that reduces the maximum rate of a chemical reaction without changing the apparent binding affinity of the catalyst for the substrate.
- 5 A \_\_\_\_\_ is an enzyme capable of cleaving the phosphodiester bonds between the nucleotide subunits of nucleic acids.
- 7 \_\_\_\_\_ is the addition of a phosphate group to a protein molecule or a small molecule.
- 9 \_\_\_\_\_ inhibition is a form of enzyme inhibition where binding of the inhibitor to the enzyme prevents binding of the substrate and vice versa.
- 12 The \_\_\_\_\_ structure of a protein is the general three-dimensional form of local segments of biopolymers such as proteins and nucleic acids.
- 13 \_\_\_\_\_ proteins, also called scleroproteins, are long filamentous protein molecules that form one of the two main classes of tertiary structure protein, the other being globular proteins.
- 15 Enzyme \_\_\_\_\_s are molecules that bind to enzymes and decrease their activity.
- 16 \_\_\_\_\_s are proteins that contain oligosaccharide chains covalently attached to their polypeptide backbones.
- 17 Protein \_\_\_\_\_ is the physical process by which a polypeptide arranges into its characteristic three-dimensional structure.
- 18 A \_\_\_\_\_ is a molecule upon which an enzyme acts.
- 21 A \_\_\_\_\_ amino acid or indispensable amino acid is an amino acid that cannot be synthesized de novo, and therefore must be supplied in the diet.
- 24 Post-\_\_\_\_\_ modification is the chemical modification of a protein after its initial synthesis on a ribosome. It is one of the later steps in protein biosynthesis for many proteins.
- 26 \_\_\_\_\_s are proteins that catalyze chemical reactions.
- 27 The \_\_\_\_\_ structure of a protein or any other macromolecule is its three-dimensional structure, as defined by the atomic coordinates.

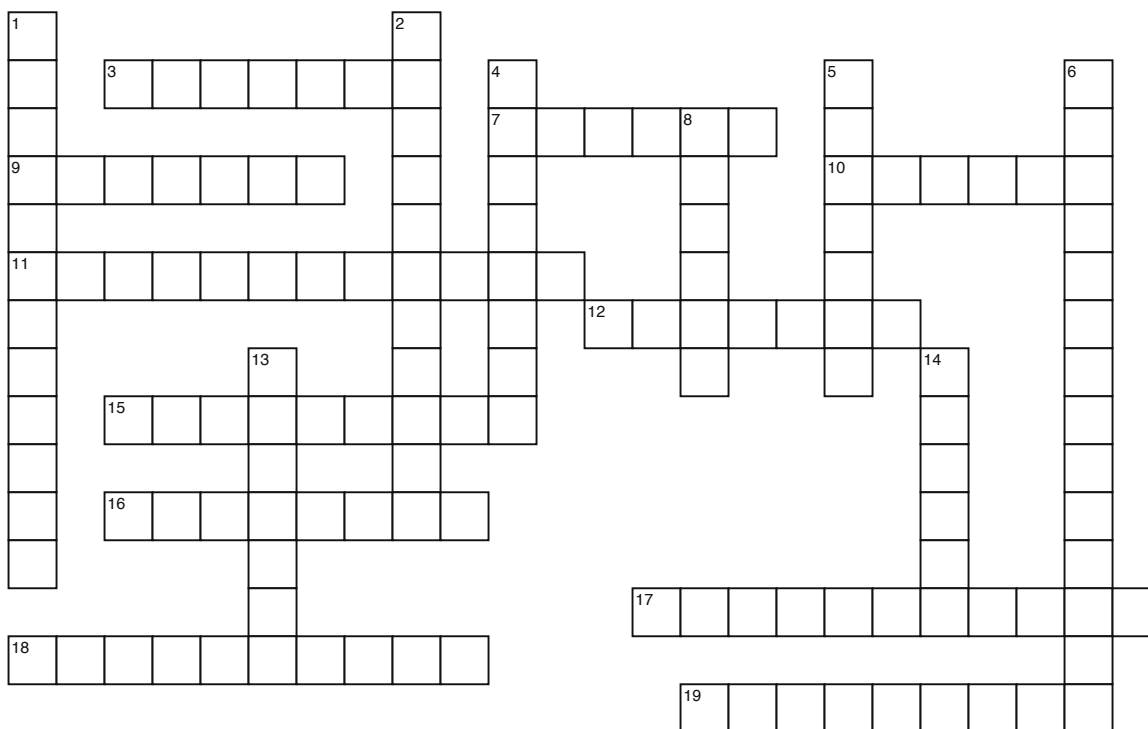
- 29 The \_\_\_\_\_ helix is a common motif in the secondary structure of proteins, a right-handed coiled conformation, resembling a spring, in which every backbone N-H group donates a hydrogen bond to the backbone carbonyl group of the amino acid four residues earlier.
- 31 A protein \_\_\_\_\_ is a group of two or more associated proteins formed by protein-protein interaction that is stable over time.
- 32 \_\_\_\_\_ proteins, or spheroproteins are one of the two main protein classes, comprising globelike proteins that are more or less soluble in aqueous solutions.
- 33 \_\_\_\_\_ feedback feeds part of a system's output, inverted, into the system's input; generally with the result that fluctuations are attenuated.
- 34 Enzyme \_\_\_\_\_ is the study of the rates of chemical reactions that are catalysed by enzymes.
- 35 A \_\_\_\_\_ bond is a chemical bond that is formed between two amino acids when the carboxyl group of one molecule reacts with the amino group of the other molecule, releasing a molecule of water.
- 36 A \_\_\_\_\_ is a chemical compound that is electrically neutral but carries formal positive and negative charges on different atoms.
- 37 \_\_\_\_\_s are short polymers formed from the linking, in a defined order, of alpha-amino acids.
- 38 The \_\_\_\_\_ state of a protein is its operative or functional form.
- 39 \_\_\_\_\_ is the large-scale study of proteins.

## DOWN

- 2 The N- or amino-\_\_\_\_\_ refers to the end of a protein or polypeptide terminated by an amino acid with a free amine group.
- 4 A membrane \_\_\_\_\_ protein is a protein involved in the movement of ions, small molecules, or macromolecules, such as another protein across a biological membrane.
- 6 A \_\_\_\_\_ chain in organic chemistry and biochemistry is a part of a molecule that is attached to a core structure.
- 7 The term \_\_\_\_\_ refers all the expressed proteins in an organism at a given time point under

defined conditions.

- 8 \_\_\_\_\_s are large organic compounds made of amino acids arranged in a linear chain and joined together by peptide bonds between the carboxyl and amino groups of adjacent amino acid residues.
- 9 \_\_\_\_\_ is the main protein of connective tissue in animals and the most abundant protein in mammals, making up about 25% of the total protein content.
- 10 The C- or carboxyl-\_\_\_\_\_ of a protein or polypeptide is the end of the amino acid chain terminated by a free carboxyl group.
- 11 A \_\_\_\_\_ acid is a molecule that contains both amine and carboxyl functional groups. In biochemistry, this term is often used to refer to the select group of specific forms that serve as the building blocks of proteins.
- 14 A \_\_\_\_\_ bond is a single covalent bond derived from the coupling of thiol groups.
- 19 Enzyme \_\_\_\_\_s are molecules that bind to enzymes and increase their activity.
- 20 The \_\_\_\_\_-pleated sheet is a major form of regular secondary structure in proteins along with the alpha helix. This form of secondary structure consists of strands connected laterally by three or more hydrogen bonds, forming a generally twisted, pleated sheet.
- 22 The \_\_\_\_\_ point is the pH at which a particular molecule or surface carries no net electrical charge.
- 23 The \_\_\_\_\_ structure of a biological molecule is the exact specification of its atomic composition and the chemical bonds connecting those atoms, including stereochemistry.
- 25 The \_\_\_\_\_ structure of a protein is the arrangement of multiple folded protein molecules in a multi-subunit complex.
- 28 \_\_\_\_\_ catalysis is the catalysis of chemical reactions by proteins.
- 30 A \_\_\_\_\_ is any enzyme that conducts proteolysis, that is, begins protein catabolism by hydrolysis of the peptide bonds that link amino acids together in the polypeptide chain.



## ACROSS

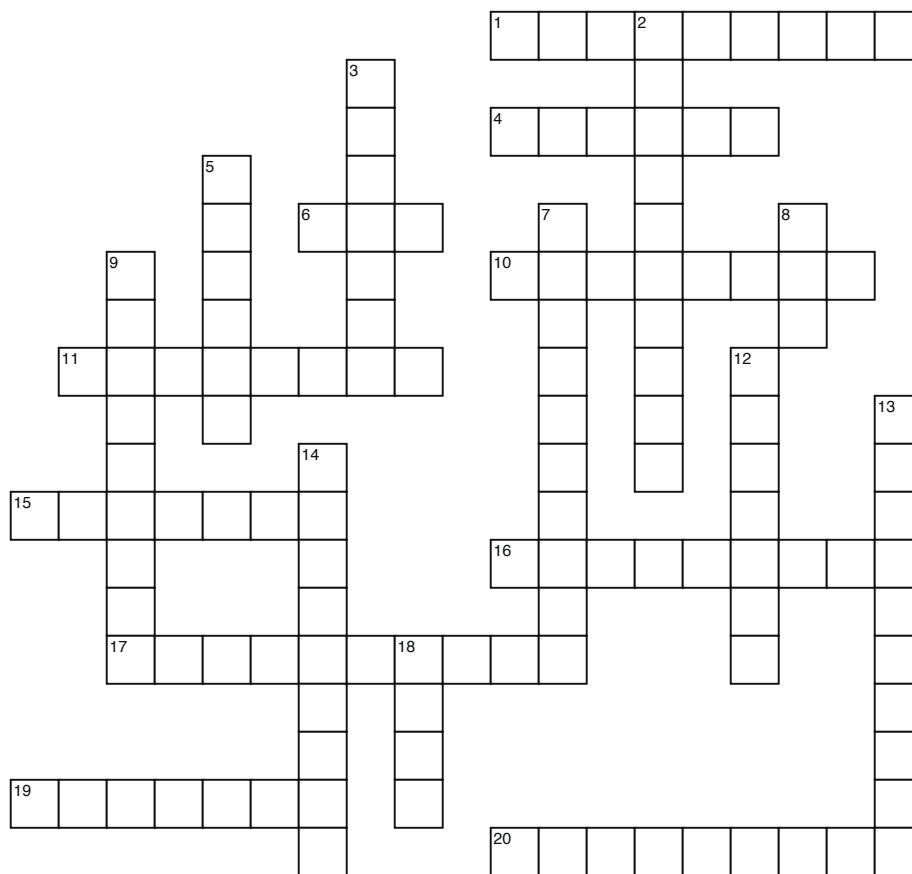
- 3 \_\_\_\_\_, or malt sugar, is a disaccharide formed from two units of glucose joined with an alpha(1 - 4) linkage.
- 7 \_\_\_\_\_ is simple pentose sugar which is a component of RNA.
- 9 \_\_\_\_\_ is a linear polymer of glucose linked with mainly alpha (1 - 4) bonds which can consist of several thousand glucose units. It is one of the two components of starch, the other being amylopectin.
- 10 \_\_\_\_\_ is a long-chain polymer of beta-glucose that forms a hard, semitransparent material found throughout the natural world, for example, in fungi, the exoskeletons of arthropods, the radula of molluscs and the beaks of cephalopods.
- 11 \_\_\_\_\_s or saccharides are a major class of biomolecules which are simple compounds, aldehydes or ketones with many hydroxyl groups added, usually one on each carbon atom that is not part of the aldehyde or ketone functional group.
- 12 \_\_\_\_\_ is a disaccharide that consists of beta-D-galactose and beta-D-glucose monomers connected by a beta-1-4 glycosidic linkage.
- 15 \_\_\_\_\_ is a polysaccharide derived from beta-glucose. It is the primary structural component of green plants.
- 16 \_\_\_\_\_ is a polysaccharide of glucose which functions as the primary short term energy storage in animal cells.
- 17 \_\_\_\_\_ is a highly branched polymer of glucose found in plants. It is one of the two components of

starch, the other being amylose.

- 18 A \_\_\_\_\_ is a hexose with an aldehyde group on one end.
- 19 Also called brain sugar, \_\_\_\_\_, is a type of simple sugar which is less sweet than glucose and not very water-soluble.

## DOWN

- 1 A \_\_\_\_\_ is a sugar composed of two monosaccharides.
- 2 \_\_\_\_\_ is a deoxy sugar derived from the pentose sugar ribose by the replacement of the hydroxyl group at the 2 position with hydrogen
- 4 \_\_\_\_\_ (or levulose) is a simple sugar found in many foods and is one of the three most important blood sugars along with glucose and galactose.
- 5 \_\_\_\_\_ (table sugar) is a disaccharide formed by the condensation of glucose and fructose.
- 6 \_\_\_\_\_s are the simplest carbohydrates. They cannot be hydrolyzed into simpler sugars.
- 8 \_\_\_\_\_ is a mixture of amylose and amylopectin. These are both complex carbohydrate polymers of glucose.
- 13 \_\_\_\_\_, a monosaccharide, is an important carbohydrate in biology, used by the living cell as a source of energy and metabolic intermediates. It is one of the main products of photosynthesis and starts cellular respiration in both prokaryotes and eukaryotes.
- 14 A \_\_\_\_\_ is a monosaccharide with six carbon atoms, twelve hydrogens, and six oxygens.

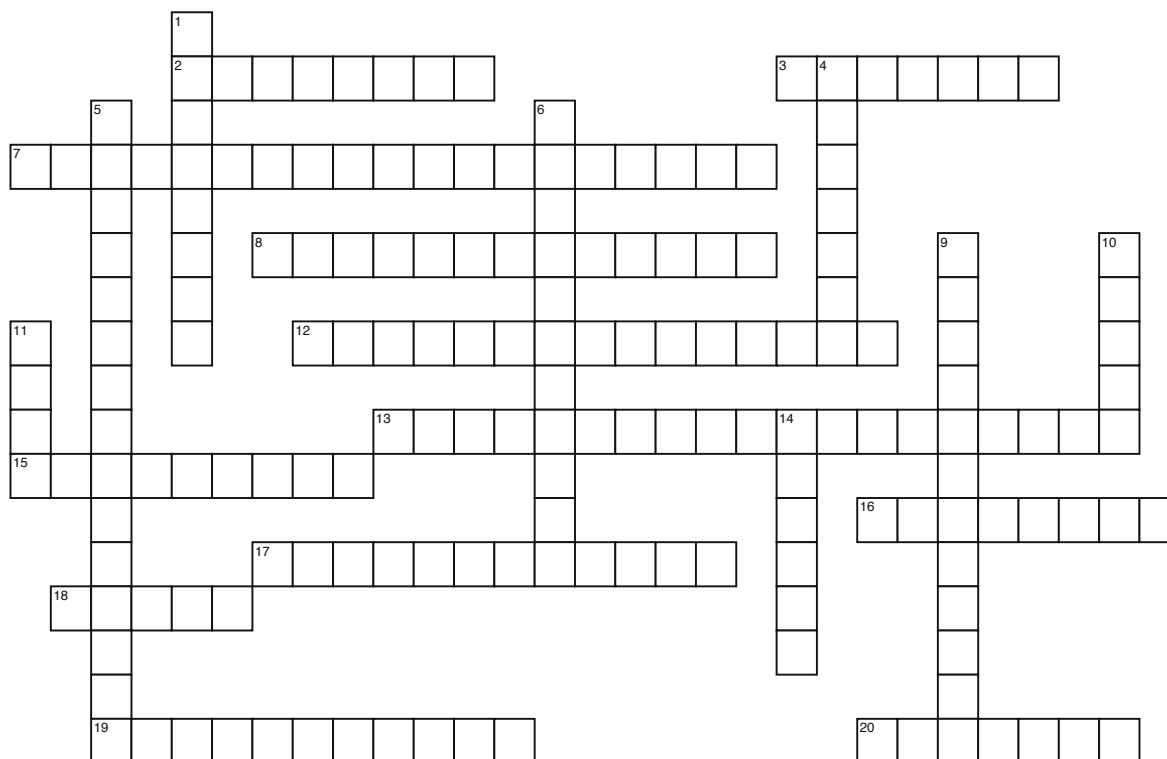
**ACROSS**

- 1 \_\_\_\_\_ triphosphate is a multifunctional nucleotide that is most important as a molecular currency of intracellular energy transfer.
- 4 The pyrimidine \_\_\_\_\_ base pairs with adenine in RNA and is replaced by thymine in DNA
- 6 \_\_\_\_\_ is a nucleic acid that contains the genetic instructions used in the development and functioning of all known living organisms.
- 10 \_\_\_\_\_ is one of the five main nucleobases found in the nucleic acids DNA and RNA. It is a pyrimidine derivative. In Watson-Crick base pairing, it forms three hydrogen bonds with guanine.
- 11 \_\_\_\_\_ RNA (abbreviated tRNA) is a small RNA chain that transfers a specific amino acid to a growing polypeptide chain at the ribosomal site of protein synthesis during translation.
- 15 \_\_\_\_\_ is one of the five main nucleobases found in the nucleic acids DNA and RNA. In base-pairing it binds to cytosine through three hydrogen bonds.
- 16 \_\_\_\_\_ RNA (rRNA), a type of RNA synthesized in the nucleolus, is the central component of the ribosome, the protein manufacturing machinery of all living cells.
- 17 \_\_\_\_\_s are the parts of RNA and DNA that may be involved in pairing. These include cytosine, guanine, adenine, thymine, uracil, xanthine and hypoxanthine.
- 19 \_\_\_\_\_ is one of the four bases in the nucleic acid of DNA along with adenine, guanine, and cytosine. It always base-pairs with adenine.
- 20 \_\_\_\_\_ is a nucleoside composed of adenine attached to a ribose moiety via a beta-N9-glycosidic bond.

**DOWN**

- 2 A \_\_\_\_\_ is a chemical compound that consists of 3 portions: a heterocyclic base, a sugar, and one or more phosphate groups.
- 3 \_\_\_\_\_ is a purine with a variety of roles in biochemistry including cellular respiration, as part of ATP, NAD, and FAD, and protein synthesis, as a chemical component of DNA and RNA
- 5 \_\_\_\_\_ is a heterocyclic aromatic organic compound, consisting of a pyrimidine ring fused to an imidazole ring.
- 7 \_\_\_\_\_ is a heterocyclic aromatic organic compound similar to benzene and pyridine, containing two nitrogen atoms at positions 1 and 3 of the six-member ring
- 8 Ribonucleic acid or \_\_\_\_\_ is a nucleic acid polymer consisting of nucleotide monomers, which plays a number of important roles in the processes of translating genetic information from DNA into proteins.
- 9 \_\_\_\_\_ is the complex of DNA and protein that makes up chromosomes
- 12 \_\_\_\_\_s are the chief protein components of chromatin, acting as spools around which DNA winds, and playing a role in gene regulation.
- 13 \_\_\_\_\_s are glycosylamines made by attaching a nucleobase to a ribose or deoxyribose ring.
- 14 \_\_\_\_\_ Ribonucleic Acid (mRNA) is a molecule of RNA encoding a chemical blueprint for a protein product.
- 18 Two nucleotides on opposite complementary DNA or RNA strands that are connected via hydrogen bonds are called a \_\_\_\_\_ pair.





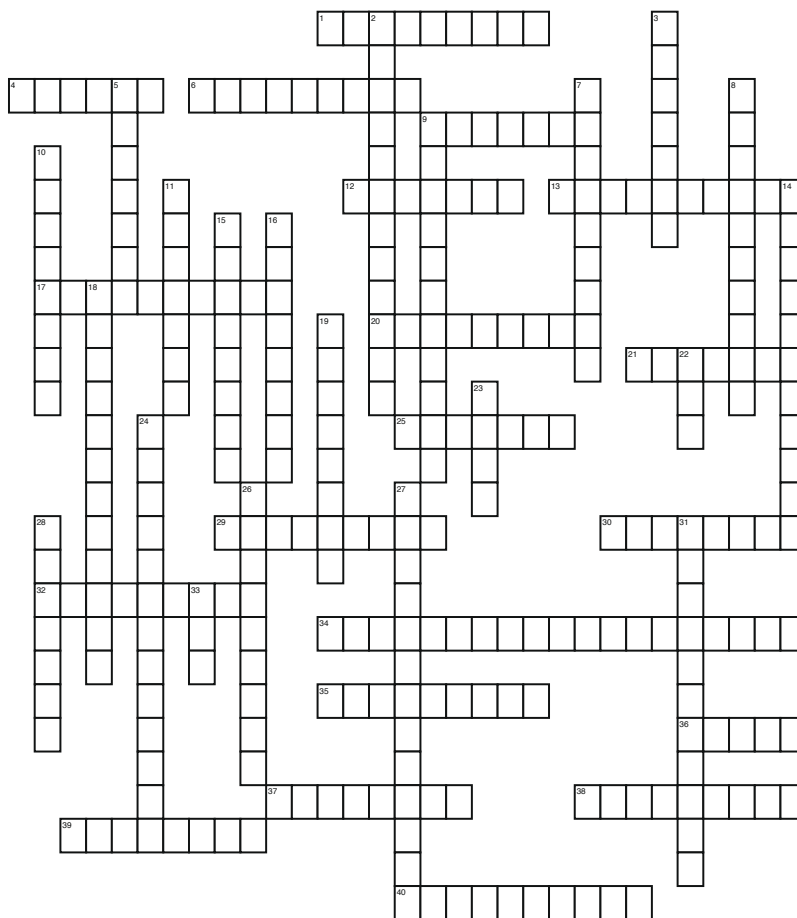
## ACROSS

- 2 \_\_\_\_\_ is the triterpene which is the biochemical precursor to the whole family of steroids
- 3 A \_\_\_\_\_ is a terpenoid lipid characterized by a carbon skeleton with four fused rings generally arranged in a 6-6-6-5 fashion.
- 7 \_\_\_\_\_ is a phospholipid which is a major constituent of cell membranes. This lipid is such a major component of lecithin that in some contexts the terms are used as synonyms.
- 8 A \_\_\_\_\_ is any member of a group of lipid compounds having 20 carbon atoms, including a 5-carbon ring which are derived enzymatically from fatty acids, having important functions in the animal body especially in immunity.
- 12 \_\_\_\_\_ fats are fatty acids having more than one double bond present in the fatty acid chain.
- 13 \_\_\_\_\_s or phosphoglycerides are glycerol-based phospholipids. They are the main component of biological membranes.
- 15 A \_\_\_\_\_ fat is a fat that consists of triglycerides containing fatty acids with no double bonds between the carbon atoms of the fatty acid chain
- 16 \_\_\_\_\_ is mostly a mixture of glycolipids, triglycerides, and phospholipids. However, in biochemistry, the term is usually used as a synonym for pure phosphatidylcholine.
- 17 \_\_\_\_\_s are a class of lipids which are a major component of all biological membranes, along with glycolipids, cholesterol and proteins.
- 18 A \_\_\_\_\_ acid is a carboxylic acid often with a long unbranched aliphatic tail, which is either saturated or unsaturated
- 19 A \_\_\_\_\_, more formally known as a diacylglycerol, is a glyceride consisting of two fatty acid chains covalently bonded to a glycerol molecule through ester linkages.
- 20 \_\_\_\_\_ fatty acids are a family of polyunsaturated fatty acids which have in common a double bond in the third carbon-carbon bond from the terminal end.
- 5 \_\_\_\_\_ fats are fatty acids having a single double bond present in the fatty acid chain, with all of the carbons in the chain single bonded
- 6 \_\_\_\_\_ is a sterol found in the cell membranes of all physiological tissues and transported in the blood plasma of all animals.
- 9 A \_\_\_\_\_ consists of glycerol esterified with three fatty acids, although slightly more formally, the form is known as triacylglycerol or triacylglyceride.
- 10 \_\_\_\_\_s can be broadly defined as any fat-soluble (hydrophobic), naturally-occurring molecules.
- 11 A wide group of molecules, \_\_\_\_\_ are generally triesters of glycerol and fatty acids.
- 14 \_\_\_\_\_s, or steroid alcohols are a subgroup of steroids with a hydroxyl group in the 3-position of the A-ring.

## DOWN

- 1 \_\_\_\_\_ is a common synonym for the chemical compound 2-methylbuta-1,3-diene. It is an important biological material, being a precursor for many important classes such as the terpenes and steroids.
- 4 Including the essential oils of many plants, \_\_\_\_\_s are a large and varied class of hydrocarbons which are derived biosynthetically

# Biological Membranes



## ACROSS

- 1 A \_\_\_\_\_ solution has the lower osmotic pressure of two fluids. The term also describes a cell environment with a lower concentration of solutes than the cytoplasm of the cell.
- 4 \_\_\_\_\_ transport is the mediated transport of biochemicals, and other atomic/molecular substances, across a membrane which specifically requires the expenditure of cellular energy to move molecules against a gradient.
- 6 \_\_\_\_\_ is the spontaneous net movement of particles from an area of high concentration to an area of low concentration.
- 9 \_\_\_\_\_ transport means moving biochemicals and other atomic or molecular substances across membranes in a process that does not require chemical energy.
- 12 Sodium \_\_\_\_\_s are integral membrane proteins that conduct sodium ions through a cell's plasma membrane.
- 13 A \_\_\_\_\_ is a chemical compound possessing both hydrophilic and hydrophobic properties.
- 17 A \_\_\_\_\_ cell environment has a higher concentration of solutes than inside the animal or plant cell.
- 20 Sodium/\_\_\_\_\_ -ATPase is an enzyme located in the plasma membrane of virtually every human cell and is common to all cellular life. It helps maintain cell potential and regulate cellular volume.

- 21 \_\_\_\_\_ active transport is directly coupled to ATP cleavage to transport molecules across a membrane.
- 25 A lipid \_\_\_\_\_ is a membrane or zone of a membrane composed of lipid molecules two molecules thick, a structure which is a critical component of all biological membranes.
- 29 In \_\_\_\_\_ active transport there is no direct coupling of ATP. Instead the energy derives from the electrochemical potential difference created by pumping ions out of the cell.
- 30 \_\_\_\_\_ junctions are protein complexes that occur at cell-cell junctions in epithelial tissues. They are usually more basal than tight junctions.
- 32 A second \_\_\_\_\_ system is a method of cellular signalling where the signalling molecule does not enter the cell but instead utilizes a cascade of events to transduce the signal into a change inside the cell.
- 34 \_\_\_\_\_ is a phospholipid which is a major constituent of cell membranes. It is such a major component of lecithin that in some contexts the terms are used as synonyms.
- 35 Membrane \_\_\_\_\_ is the electrical voltage across a plasmalemma.
- 36 \_\_\_\_\_ junctions, or zonula occludens, are the closely associated areas of two cells whose membranes join together forming a virtual impermeable barrier to fluid.

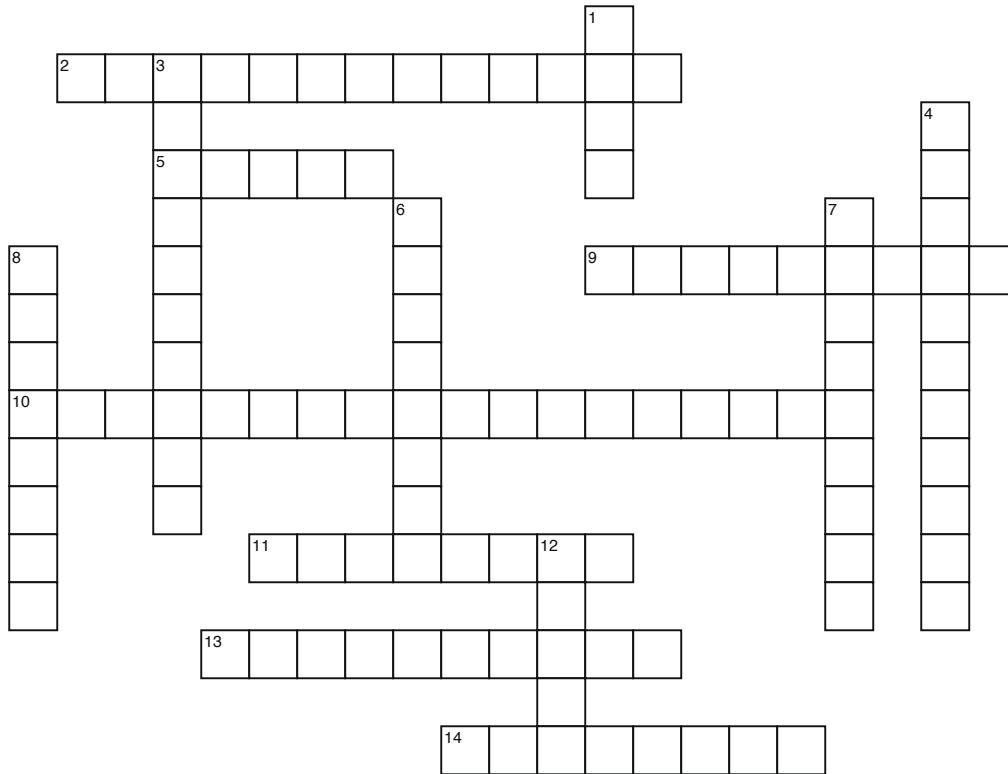
- 37 A \_\_\_\_\_ membrane protein is a protein molecule, or assembly of proteins, that is permanently attached to the biological membrane.
- 38 \_\_\_\_\_ channels are the most common type of ion channel, forming pores selective for that ion spanning cell membranes.
- 39 Transmembrane \_\_\_\_\_s are integral membrane proteins that bind to a signalling molecule or sometimes to a pair of such molecules on one side of the membrane and initiate a response on the other side.
- 40 \_\_\_\_\_ is the process by which a cell directs secretory vesicles to the cell membrane and releases their contents.

## DOWN

- 2 \_\_\_\_\_s are a class of lipids, and a major component of all biological membranes, along with glycolipids, cholesterol and proteins.
- 3 \_\_\_\_\_ pressure is the hydrostatic pressure produced by a solution in a space divided by a semipermeable membrane due to a differential in the concentrations of solute.
- 5 \_\_\_\_\_-gated calcium channels are a group of ion channels found in excitable cells such as neurons, glial cells, muscle cells, etc.
- 7 A \_\_\_\_\_, also known as macula adherens, is a cell structure specialized for cell-to-cell adhesion.
- 8 \_\_\_\_\_ membrane proteins are

proteins that adhere only temporarily to the biological membrane with which they are associated.

- 9 \_\_\_\_\_ is a form of endocytosis in which small particles are brought into the cell suspended within small vesicles which subsequently fuse with lysosomes.
- 10 \_\_\_\_\_ is a protein that is the major constituent of the 'coat' of the coated pits and coated vesicles formed during endocytosis of materials at the surface of cells.
- 11 \_\_\_\_\_-gated potassium channels are transmembrane channels specific for potassium and sensitive to changes in the cell's membrane potential.
- 14 \_\_\_\_\_ is a process whereby cells absorb material from the outside by engulfing it with their cell membrane.
- 15 A cell \_\_\_\_\_ is one of a variety of types of structures consisting of protein complexes that provide contact between neighbouring cells, between a cell and the extracellular matrix, or participate in building up the paracellular barrier of epithelia.
- 16 A \_\_\_\_\_ is a protein on the cell membrane, within the cytoplasm, or within the cell nucleus that binds to a specific ligand, such as a neurotransmitter, hormone, or other substance, and initiates a cellular response.
- 18 \_\_\_\_\_ is the cellular process of engulfing solid particles by the cell membrane to form an internal phagosome, or food vacuole.
- 19 The cell \_\_\_\_\_ is a semipermeable lipid bilayer found in all cells.
- 22 \_\_\_\_\_ channels are pore-forming proteins that help to establish and control the small voltage gradient across the plasma membrane of all living cells.
- 23 A cell \_\_\_\_\_ is a fairly rigid layer surrounding the cells of plants, bacteria, archaea, fungi, and algae, located external to the cell membrane, which provides the cell with structural support, protection, and acts as a filtering mechanism.
- 24 A \_\_\_\_\_ membrane is a membrane which will allow certain molecules or ions to pass through it by diffusion and occasionally specialized facilitated diffusion.
- 26 The \_\_\_\_\_ pathway is a series of steps a cell uses to move proteins out of the cell.
- 27 A \_\_\_\_\_ protein is a protein that spans the entire biological membrane.
- 28 \_\_\_\_\_ is the spontaneous net movement of water across a partially permeable membrane from a region of high solvent potential to an area of low solvent potential, up a solute concentration gradient.
- 31 Receptor-mediated \_\_\_\_\_ is a process by which cells internalize molecules into a cell by the inward budding of plasma membrane vesicles which contain proteins with receptor sites specific to the molecules being internalized.
- 33 A \_\_\_\_\_ junction or nexus is a junction between certain animal cell-types that allows different molecules and ions, mostly small intracellular signaling molecules, to pass freely between cells.

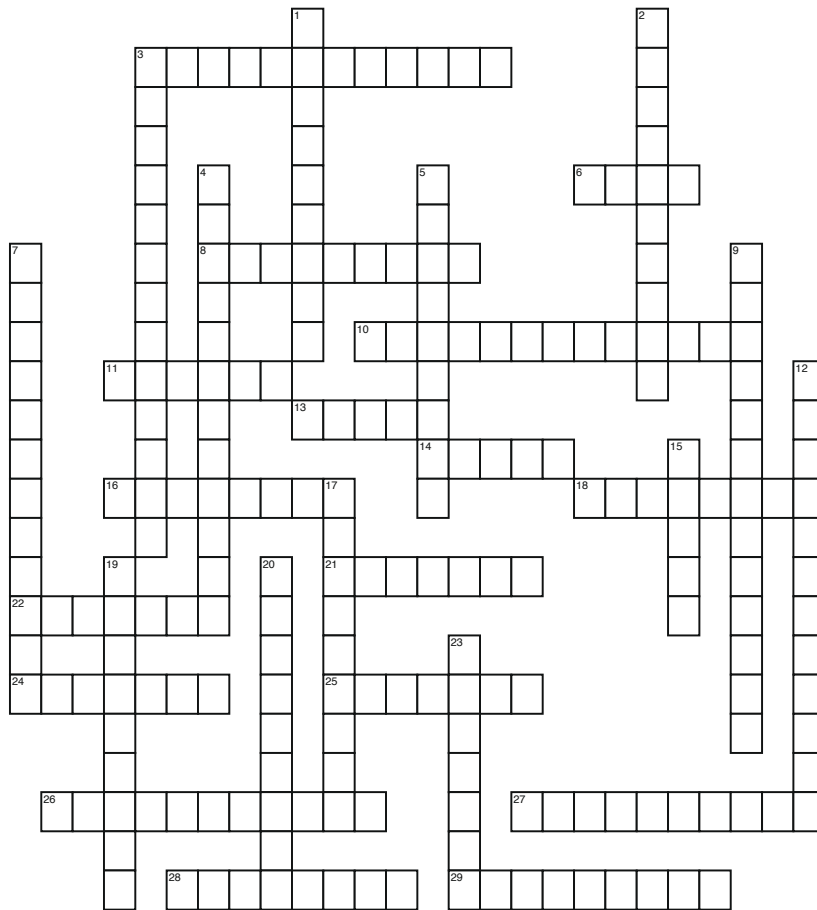


## ACROSS

- 2 \_\_\_\_\_, also known as murein, is a polymer consisting of sugars and amino acids that forms a mesh-like layer outside the plasma membrane of eubacteria.
- 5 The \_\_\_\_\_ membrane refers to the outside membranes of Gram-negative bacteria.
- 9 \_\_\_\_\_ is a protein that arranges itself in a hollow cylinder to form the filament in bacterial flagellum
- 10 A \_\_\_\_\_ is a large molecule consisting of a lipid and a polysaccharide (carbohydrate) joined by a covalent bond.
- 11 The cell \_\_\_\_\_ is the cell membrane and cell wall plus an outer membrane, if one is present. Most fall into two major categories: Gram positive and Gram negative.
- 13 \_\_\_\_\_ is a general term referring to extracellular polymeric material produced by some bacteria, epithelia and other cells.
- 14 Gram-\_\_\_\_\_ bacteria are those that retain a crystal violet dye during the Gram stain process.

## DOWN

- 1 A cell \_\_\_\_\_ is a fairly rigid layer surrounding a prokaryotic cell, located external to the cell membrane, which provides the cell with structural support, protection, and acts as a filtering mechanism.
- 3 \_\_\_\_\_s are a group of organisms that lack a cell nucleus, or any other membrane-bound organelles.
- 4 The \_\_\_\_\_ space is the space seen between the plasma membrane and the outer membrane in the gram-negative bacteria.
- 6 A \_\_\_\_\_ is a small, dense, functional structure found in most known cells that assembles proteins and polypeptides used in cell division.
- 7 A \_\_\_\_\_ is a long, slender projection from the cell body, composed of microtubules and surrounded by the plasma membrane.
- 8 In prokaryotes, the \_\_\_\_\_ (also known as the nuclear region, nuclear body or chromatin body) is an irregularly shaped region where the genetic material is localized.
- 12 A \_\_\_\_\_ is a hairlike appendage found on the surface of many bacteria. This term and fimbria are often used interchangeably.



## ACROSS

- 3 The \_\_\_\_\_ system is the system of internal membranes within eukaryotic cells that divide the cell into functional and structural compartments, or organelles.
- 6 Nuclear \_\_\_\_\_s are large protein complexes that cross the nuclear envelope, which is the double membrane surrounding the eukaryotic cell nucleus.
- 8 \_\_\_\_\_ is a gelatinous, semi-transparent fluid that fills most cells.
- 10 \_\_\_\_\_s are the thinnest filaments of the cytoskeleton found in the cytoplasm of all eukaryotic cells. These linear polymers of actin subunits are flexible and relatively strong.
- 11 A \_\_\_\_\_ is an organelle found in eukaryotic cells. It is a thin, tail-like projection extending approximately 5-10 micrometers outward from the cell body.
- 13 A \_\_\_\_\_ body is an organelle formed from a centriole, a short cylindrical array of microtubules. It is found at the base of a eukaryotic undulipodium (cilium or flagellum) and serves as a nucleation site for the growth of the axoneme microtubules.
- 14 \_\_\_\_\_ is the protein which serves as the monomeric subunit of microfilaments, one of the three major components of the cytoskeleton, and of thin filaments which are part of the contractile apparatus in muscle cells.
- 16 A \_\_\_\_\_ comprises a flattened

membrane disk which makes up the Golgi apparatus.

- 18 \_\_\_\_\_s are organelles that contain digestive enzymes to digest excess or worn out organelles, food particles, and engulfed viruses or bacteria.
- 21 \_\_\_\_\_s are major organelles found in plants and algae responsible for photosynthesis, storage of products like starch and for the synthesis of many classes of molecules such as fatty acids and terpenes.
- 22 A \_\_\_\_\_ is one of several members of a small family of globular proteins. The most common members this family are the proteins which makes up microtubules.
- 24 The \_\_\_\_\_ is a membrane-enclosed organelle found in most eukaryotic cells which contains the cell's genetic material.
- 25 The \_\_\_\_\_ is the inner cytoskeletal structure of eukaryotic cilia or flagella.
- 26 \_\_\_\_\_s are organelles found in plant cells and eukaryotic algae that conduct photosynthesis. They are generally considered to have originated as endosymbiotic cyanobacteria.
- 27 \_\_\_\_\_s are ubiquitous organelles in eukaryotes that participate in the metabolism of fatty acids and other metabolites. They have enzymes that rid the cell of toxic peroxides.
- 28 The nuclear \_\_\_\_\_ or membrane is the double membrane

of the nucleus that encloses genetic material in eukaryotic cells.

- 29 Animals, plants, fungi, and protists are \_\_\_\_\_s, which are organisms whose cells are organized into complex structures by internal membranes and a cytoskeleton.

## DOWN

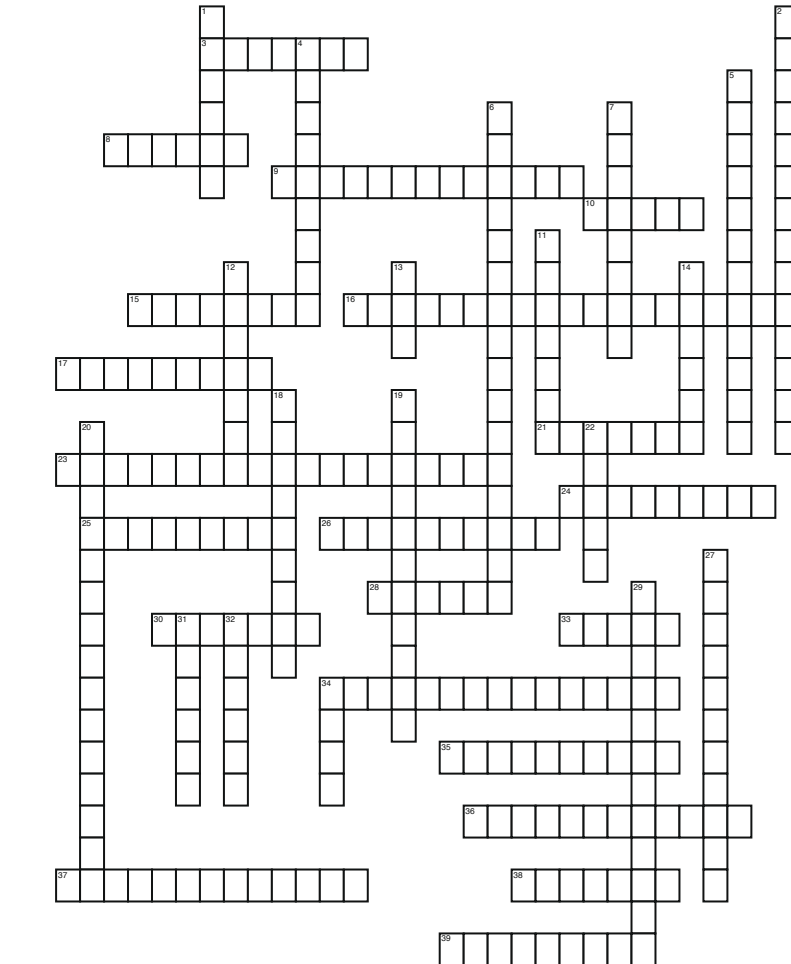
- 1 A \_\_\_\_\_ is a barrel shaped organelle found in most eukaryotic cells with walls usually composed of nine triplets of microtubules.
- 2 The \_\_\_\_\_ is the main microtubule organizing center of the cell as well as a regulator of cell-cycle progression.
- 3 The \_\_\_\_\_ theory concerns the origins of mitochondria and plastids, according to which these organelles originated as separate prokaryotic organisms which were taken inside the cell as endosymbionts.
- 4 A nuclear \_\_\_\_\_ signal is an amino acid sequence which acts like a 'tag' on the exposed surface of a protein to target the protein to the cell nucleus through the nuclear pore complex and to direct it into the nucleus via its recognition by cytosolic nuclear transport receptors.
- 5 \_\_\_\_\_-tubular cluster is an intermediate compartment mediating trafficking between the endoplasmic reticulum and Golgi complex.
- 7 The \_\_\_\_\_ is a cellular scaffolding or skeleton contained within the cytoplasm.
- 9 A \_\_\_\_\_ is a membrane-enclosed organelle that is found in most eukaryotic cells that. In addition to supplying cellular energy, they are involved in a range of other processes.
- 12 \_\_\_\_\_ filaments are cytoskeletal structures formed by members of a family of related proteins. These filaments have a diameter between that of actin microfilaments and microtubules.
- 15 The \_\_\_\_\_ apparatus is an organelle found in most eukaryotic cells the primary function of which is to process and package the macromolecules such as proteins and lipids that are synthesized by the cell.
- 17 The spindle \_\_\_\_\_ is a structure of the eukaryotic cytoskeleton involved in mitosis and meiosis, often referred to as the mitotic spindle during mitosis and the meiotic spindle during meiosis.
- 19 The \_\_\_\_\_ is a sub-organelle of the cell nucleus. Its main function is the production and assembly of ribosome components.
- 20 A \_\_\_\_\_ is a specialized subunit within a cell, having a specific function, and separately enclosed within its own lipid membrane.
- 23 A \_\_\_\_\_ is a relatively small and enclosed compartment, separated from the cytosol by at least one lipid bilayer.

# Energy Metabolism

Answer key - pg 108

## ACROSS

- 3 L-\_\_\_\_\_ is constantly produced in animals from pyruvate in a process of fermentation during normal metabolism and exercise.
- 8 The \_\_\_\_\_ of the mitochondrion is the compartment containing soluble enzymes that catalyze the oxidation of pyruvate and other small organic molecules.
- 9 Adenosine \_\_\_\_\_ is an ester of phosphoric acid with the nucleoside adenosine. AMP consists of the phosphate group, the pentose sugar ribose, and the nucleobase adenine.
- 10 The \_\_\_\_\_ mitochondrial membrane encloses the entire mitochondrion.
- 15 An ATP \_\_\_\_\_ is a general term for an enzyme that can synthesize adenosine triphosphate (ATP) from adenosine diphosphate (ADP) and inorganic phosphate by utilizing some form of energy.
- 16 \_\_\_\_\_ 1 is a kinase enzyme which acts upon Fructose 6-phosphate. It is the most important regulatory enzyme of glycolysis.
- 17 Glucose 6-\_\_\_\_\_, also known as Robison ester, is glucose sugar phosphorylated on carbon 6. The vast majority of glucose entering a cell will become phosphorylated in this way.
- 21 \_\_\_\_\_ are the internal compartments formed by the inner membrane of a mitochondrion.
- 23 \_\_\_\_\_ (PEP) has the highest energy phosphate bond found in living organisms. It is formed in glycolysis by the action of the enzyme enolase on 2-phosphoglycerate.
- 24 A \_\_\_\_\_ organism is any organism that does not require oxygen for growth.
- 25 \_\_\_\_\_-level phosphorylation is a type of chemical reaction that results in the formation of ATP by the direct transfer of a phosphate group to ADP from a reactive intermediate.
- 26 \_\_\_\_\_s are generally membrane-bound hemoproteins



- that contain heme groups and carry out electron transport.
- 28 Adenylate \_\_\_\_\_ is a phosphotransferase enzyme that catalyzes the production of ATP from ADP.
- 30 \_\_\_\_\_, a monosaccharide, is an important carbohydrate in biology, used by the living cell as a source of energy and metabolic intermediates. It is one of the main products of photosynthesis and starts cellular respiration in both prokaryotes and eukaryotes.
- 33 An electron transport \_\_\_\_\_ associates electron carriers and mediating biochemical reactions that produce ATP.
- 34 Oxidative \_\_\_\_\_ is a metabolic pathway that uses energy released by the oxidation of nutrients to produce ATP.
- 35 \_\_\_\_\_ is the initial process of most carbohydrate catabolism serving

- the functions of producing ATP and NADH, pyruvate for the citric acid cycle, and a variety of other compounds which are important for biosynthesis.
- 36 Ethanol \_\_\_\_\_ is the biological process by which sugars such as glucose, fructose, and sucrose, are converted into ethanol and carbon dioxide.
- 37 The \_\_\_\_\_ space is the region between the inner membrane and the outer membrane of a mitochondrion or a chloroplast.
- 38 \_\_\_\_\_ acid is an alpha-keto acid which plays an important role in biochemical processes. It is an output of glycolysis.
- 39 Fructose 6-\_\_\_\_\_ (also known as the Neuberger ester) is fructose sugar phosphorylated on carbon 6. The beta-D-form of this compound is very common in cells.

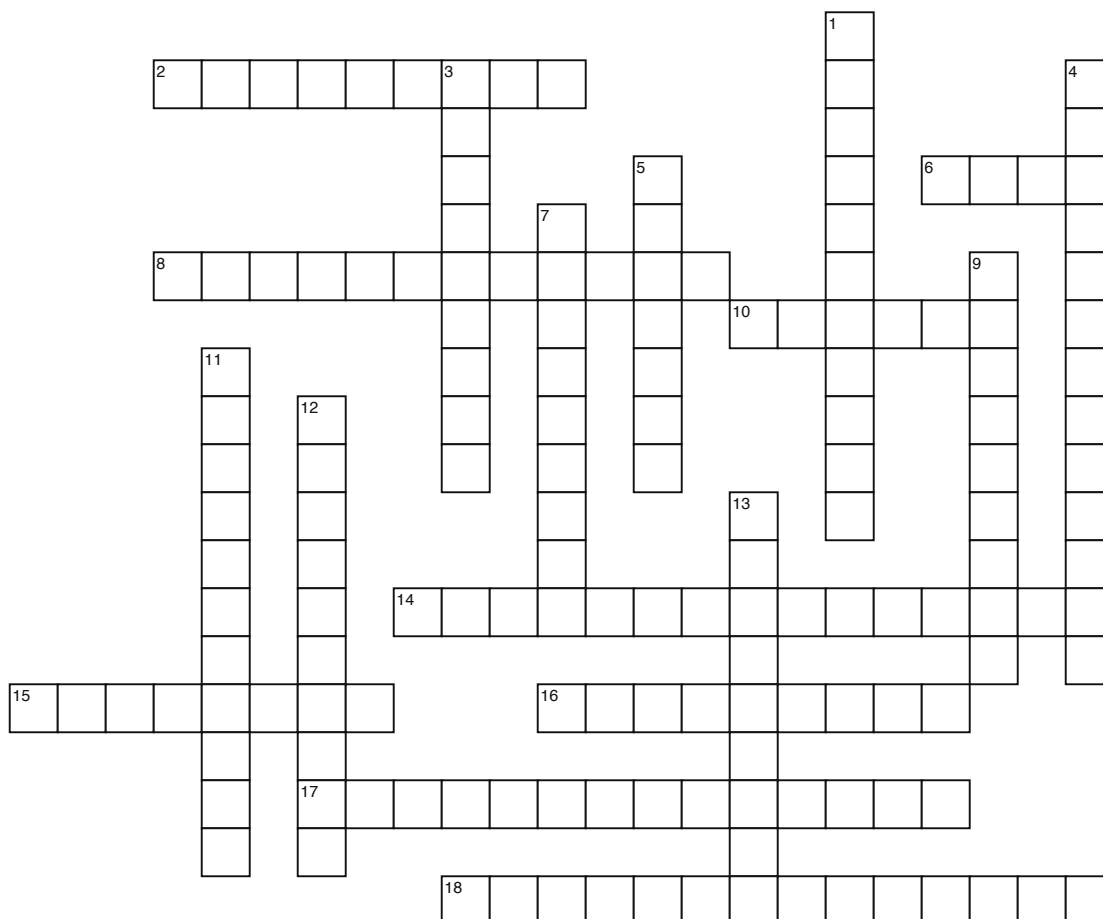
## DOWN

- 1 The electron carrier,

- \_\_\_\_\_ adenine dinucleotide accommodates two equivalents of hydrogen when it is reduced in the citric acid cycle during aerobic respiration.
- 2 \_\_\_\_\_ 3-phosphate is one of the two products of breakdown of fructose 1,6-phosphate in glycolysis, along with dihydroxyacetone phosphate.
- 4 \_\_\_\_\_ triphosphate is a multifunctional nucleotide that is most important as a molecular currency of intracellular energy transfer.
- 5 \_\_\_\_\_ is respiration under anaerobic conditions with no external electron acceptor.
- 6 \_\_\_\_\_ phosphate (DHAP) is one of the two products of breakdown of fructose 1,6-phosphate in glycolysis, along with glyceraldehyde 3-phosphate.
- 7 The \_\_\_\_\_ decarboxylation reaction links the metabolic pathways

- glycolysis and the citric acid cycle.
- 11 A \_\_\_\_\_ organism is an organism that has an oxygen based metabolism.
- 12 The malate-aspartate \_\_\_\_\_ is a biochemical system for translocating electrons produced during glycolysis across the impermeable inner membrane of the mitochondrion for oxidative phosphorylation in eukaryotes.
- 13 Acetyl-\_\_\_\_\_ is an important molecule in metabolism, used in many biochemical reactions. Its main use is to convey the carbon atoms within the acetyl group to the Krebs Cycle to be oxidized for energy production.
- 14 A \_\_\_\_\_, alternatively known as a phosphotransferase, is a type of enzyme that transfers phosphate groups from high-energy donor molecules, such as ATP, to specific target molecules.

- 18 Glucose \_\_\_\_\_ is an enzyme that catalyzes the conversion of glucose into fructose.
- 19 \_\_\_\_\_ is an enzyme that facilitates phosphorylation of glucose to glucose-6-phosphate.
- 20 \_\_\_\_\_ is the addition of a phosphate group to a protein molecule or a small molecule.
- 22 The \_\_\_\_\_ mitochondrial membrane forms internal compartments known as cristae, which allow greater space for the proteins such as cytochromes to function properly and efficiently.
- 27 \_\_\_\_\_s is the diffusion of ions across a selectively-permeable membrane, often specifically with reference to the generation of ATP by the movement of hydrogen ions across a membrane during cellular respiration.
- 29 \_\_\_\_\_ adenine dinucleotide is an important coenzyme found in cells, which plays key roles as a carrier of electrons and a participant in metabolic redox reactions, as well as in cell signaling.
- 31 \_\_\_\_\_ acid fermentation is a form of anaerobic respiration that occurs in some bacteria and animal cells in the absence of oxygen.
- 32 The \_\_\_\_\_ acid cycle, also known as the tricarboxylic acid cycle or Krebs cycle, is a series of enzyme-catalysed chemical reactions of central importance in all living cells that use oxygen as part of cellular respiration.
- 34 A proton \_\_\_\_\_ is an integral membrane protein that is capable of moving protons across the membrane of a cell, mitochondrion, or other subcellular compartment.

**ACROSS**

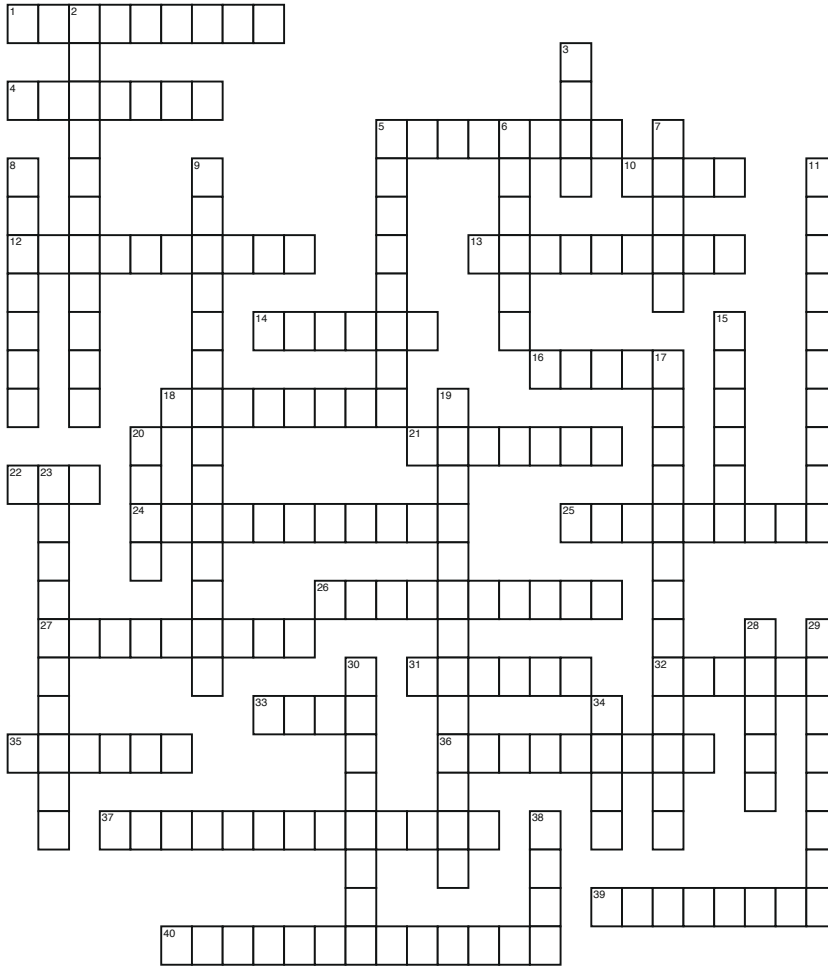
- 2 \_\_\_\_\_ is the process by which an amine group is introduced into an organic molecule.
- 6 The \_\_\_\_\_ cycle (also known as the ornithine cycle) is a cycle of biochemical reactions occurring in many animals that converts ammonia into a less toxic substance.
- 8 \_\_\_\_\_ is the process of glycogen synthesis, in which glucose molecules are added to chains of glycogen.
- 10 A \_\_\_\_\_ cycle is when two metabolic pathways run simultaneously in opposite directions and have no overall effect other than wasting energy.
- 14 \_\_\_\_\_ is the generation of glucose from non-sugar carbon substrates like pyruvate, lactate, glycerol, and glucogenic amino acids.
- 15 The triterpene isoprenoid compound \_\_\_\_\_ is the biochemical precursor to the whole family of steroids.
- 16 The pentose \_\_\_\_\_ pathway is a process that serves to generate NADPH and the synthesis of pentose sugars.
- 17 \_\_\_\_\_ (or aminotransfer) is the reaction between an amino acid and an alpha-keto acid in which the amino group is transferred from the former to the latter.
- 18 \_\_\_\_\_ is the catabolism of glycogen by removal of a glucose monomer and addition of phosphate to produce glucose-1-phosphate.

**DOWN**

- 1 \_\_\_\_\_ pyrophosphate is an intermediate in the mevalonate pathway used by organisms in the biosynthesis of terpenes and terpenoids, and thence a host of other substances such as steroids.
- 3 Glucose \_\_\_\_\_ is an enzyme that catalyzes the conversion of glucose into fructose or the reverse process.
- 4 The enzyme \_\_\_\_\_ connects the pentose phosphate pathway to glycolysis in mammals, feeding excess sugar phosphates into the main carbohydrate metabolic pathways.
- 5 \_\_\_\_\_ diphosphate glucose is a nucleotide that is used as an activated form of glucose, a substrate for glycosyltransferases.
- 7 \_\_\_\_\_ acid is a key organic compound in biochemistry. It is a precursor in the biosynthetic pathway, known as the HMG-CoA reductase pathway, that produces terpenes and steroids.
- 9 HMG-CoA \_\_\_\_\_ is the first enzyme of the mevalonate pathway that produces terpenes, terpenoids, steroids and various other biomolecules.
- 11 Pyruvate \_\_\_\_\_ is an enzyme of the ligase class that catalyzes the irreversible carboxylation of pyruvate to form oxaloacetate. Oxaloacetate can then either proceed to the citric acid cycle or to gluconeogenesis.
- 12 The \_\_\_\_\_ pathway is an important cellular metabolic pathway for the production of dimethylallyl pyrophosphate and isopentenyl pyrophosphate, substances which are the building blocks of a large variety of biomolecules.
- 13 Glucose 6-\_\_\_\_\_ (also known as Robison ester) is glucose sugar phosphorylated on carbon 6.

# Gene Expression Part 1

Answer key - pg 110



## ACROSS

- 1 A protein \_\_\_\_\_, also called a pro-protein or pro-peptide, is an inactive protein that can be turned into an active form by posttranslational modification.
- 4 A gene \_\_\_\_\_ is the biochemical material, either RNA or protein, resulting from expression of a gene.
- 5 Alternative \_\_\_\_\_ is the variation mechanism in which the exons of the primary gene transcript, the pre-mRNA, are separated and reconnected so as to produce alternative ribonucleotide arrangements.
- 10 The genetic \_\_\_\_\_ is the set of rules by which information encoded in genetic material is translated into proteins by living cells.
- 12 RNA \_\_\_\_\_ is an enzyme that makes an RNA copy of a DNA or RNA template.
- 13 A \_\_\_\_\_ protein is any of the proteins that, in conjunction with rRNA, make up the subunits of the ribosome.
- 14 The \_\_\_\_\_ region of a gene is the portion of DNA that is transcribed into mRNA and translated into proteins.
- 16 The codon ATG in DNA, which corresponds to AUG in RNA, is the \_\_\_\_\_ codon or initiation codon which the amino acid methionine in eukaryotes and a modified

methionine in prokaryotes.

- 18 A \_\_\_\_\_ is a small, dense, structure found in most known cells that assembles proteins in a process called translation.
- 21 A \_\_\_\_\_ transcript is an RNA molecule that has not yet undergone any modification after its synthesis.
- 22 A \_\_\_\_\_-regulatory element is a region of DNA or RNA that regulates the expression of genes located on that same strand.
- 24 Messenger RNA is decoded in the process of \_\_\_\_\_ to produce a specific polypeptide according to the rules specified by the genetic code.
- 25 \_\_\_\_\_ ribonucleic acid is a molecule of RNA encoding a chemical blueprint for a protein product.
- 26 A \_\_\_\_\_ gene is a gene that codes for any RNA or protein product other than a regulatory element.
- 27 Enzyme \_\_\_\_\_ is a process in which a molecule, such as a drug, induces the expression of an enzyme.
- 31 The \_\_\_\_\_ recognition particle is a protein-RNA complex that recognizes and transports specific proteins to the endoplasmic reticulum in eukaryotes and the plasma membrane in prokaryotes.
- 32 \_\_\_\_\_s are non-coding sections of DNA which are spliced out once

a DNA sequence has been transcribed as a hnRNA strand.

- 33 A base \_\_\_\_\_ consists of two nucleotides on opposite complementary DNA or RNA strands connected via hydrogen bonds.
- 35 A \_\_\_\_\_ is an enzyme that can catalyse the joining of two large molecules by forming a new chemical bond.
- 36 Protein \_\_\_\_\_ or sorting is the mechanisms by which a cell transports proteins to the appropriate positions in the cell or outside of it.
- 37 \_\_\_\_\_ is a type of eukaryotic gene organization in which genes may not be physically linked, but they are involved in the same process and they are coordinately expressed
- 39 A \_\_\_\_\_ is a regulatory region of DNA located upstream of a gene, providing a control point for regulated gene transcription.
- 40 A \_\_\_\_\_ factor is a protein that binds to specific parts of DNA using DNA binding domains as part of the system that controls the transfer of genetic information from DNA to RNA.

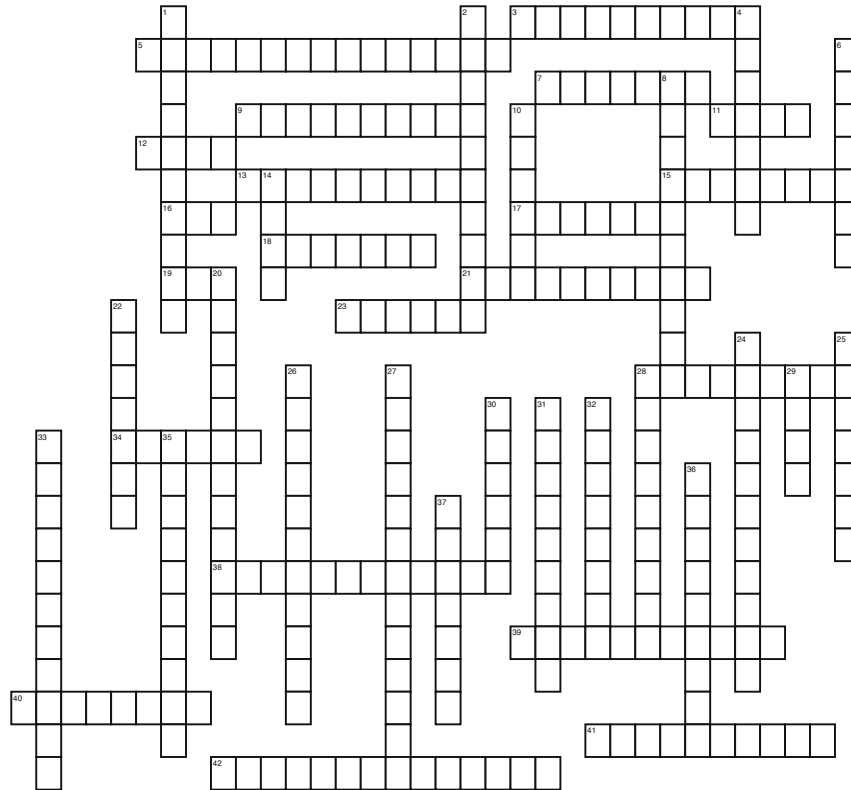
## DOWN

- 2 \_\_\_\_\_s are enzymes that cleave nucleotides one at a time from an end of a polynucleotide

chain.

- 3 A \_\_\_\_\_ is a locatable region of genomic sequence, corresponding to a unit of inheritance.
- 5 A DNA \_\_\_\_\_ is a succession of letters representing the primary structure of a DNA molecule or strand.
- 6 The non-\_\_\_\_\_ or template strand is the DNA strand that is read by the RNA polymerase.
- 7 The central \_\_\_\_\_ of molecular biology is a framework for understanding the transfer of sequence information between sequential information-carrying biopolymers in living organisms.
- 8 A signal \_\_\_\_\_ is a short portion of a protein dedicated to directing the post-translational transport of a protein.
- 9 \_\_\_\_\_ refers to the end-to-end chemical orientation of a single strand of nucleic acid.
- 11 A \_\_\_\_\_ is a section of genetic sequence that marks the end of gene or operon on genomic DNA for transcription.
- 15 A \_\_\_\_\_ is a functioning unit of key nucleotide sequences including an operator, a common promoter, and one or more structural genes, which are controlled as a unit to produce messenger RNA.
- 17 Post-\_\_\_\_\_ modification is the chemical modification of a protein after its translation.
- 19 \_\_\_\_\_ is the process by which genetic information from DNA is transferred into RNA.
- 20 A \_\_\_\_\_ box (also called Goldberg-Hogness box) is a DNA sequence found in the promoter region of most genes in eukaryotes, which is considered to be the core promoter sequence.
- 23 \_\_\_\_\_ factors are proteins that bind to the small subunit of the ribosome during the initiation of protein synthesis.
- 28 A reading \_\_\_\_\_ is a contiguous and non-overlapping set of three-nucleotide codons in DNA or RNA
- 29 A \_\_\_\_\_ is a short region of DNA that can be bound with proteins to enhance transcription levels of genes in a gene-cluster.
- 30 \_\_\_\_\_ RNA is a small RNA chain that plays a role during translation in shuttling a specific amino acid to a growing polypeptide chain at the ribosomal site of protein synthesis.
- 34 A \_\_\_\_\_ codon, or termination codon, is a nucleotide triplet within messenger RNA that signals a termination of translation.
- 38 A \_\_\_\_\_ is any region of DNA within a gene that is transcribed to the final messenger RNA molecule, rather than being spliced out from the transcribed RNA molecule.





## ACROSS

- 3 In prokaryotic cells, the \_\_\_\_\_ refers to a specific regulatory sequence that, when transcribed into RNA, forms hairpin structures to stop translation when certain conditions are not met.
- 5 \_\_\_\_\_ is the covalent linkage of a poly(A) tail to a messenger RNA molecule. It is part of the route to producing mature messenger RNA for translation.
- 7 A \_\_\_\_\_ is a molecule that starts gene expression.
- 9 A \_\_\_\_\_ sequence is a promoter, enhancer or other segment of DNA where proteins such as transcription factors bind preferentially.
- 11 \_\_\_\_\_ DNA is a collective label for the portions of the DNA sequence of a chromosome or a genome for which no function has yet been identified.
- 12 N-Formylmethionine, often abbreviated as \_\_\_\_\_, is a modified form of methionine in which a formyl group has been added to methionine's amino group.
- 13 RNA \_\_\_\_\_ III transcribes DNA to synthesize ribosomal 5S rRNA, tRNA and other small RNAs.
- 15 A \_\_\_\_\_ is an RNA molecule that catalyzes a

- chemical reaction.
- 16 5S ribosomal \_\_\_\_\_ is a component of the large ribosomal subunit in both prokaryotes and eukaryotes.
- 17 The \_\_\_\_\_ factor is a protein that recognises the termination codon or stop codon in a mRNA sequence on the ribosome.
- 18 The term RNA \_\_\_\_\_ describes those molecular processes in which the information content is altered in a RNA molecule through a chemical change in the bases themselves.
- 19 \_\_\_\_\_ receptor also called docking protein, is a dimer composed of 2 different subunits that are associated exclusively with the rough ER in mammalian cells.
- 21 An aminoacyl tRNA \_\_\_\_\_ is an enzyme that catalyzes the esterification of a specific amino acid or its precursor to one of all its compatible cognate tRNAs to form an aminoacyl-tRNA.
- 23 A transcription \_\_\_\_\_ is a molecular structure that occurs during the transcription or replication of DNA when DNA helicase and DNA topoisomerase unzip the DNA double strand.
- 28 A \_\_\_\_\_ is a DNA-binding protein that regulates the expression of one or more genes by decreasing the rate of

- transcription.
- 34 The Trp \_\_\_\_\_ is a functional in certain bacteria that controls the production of gene products to increase the production of tryptophan in the absence of tryptophan in the environment.
- 38 RNA \_\_\_\_\_ is a mechanism for RNA-guided regulation of gene expression in which double-stranded ribonucleic acid inhibits the expression of genes with complementary nucleotide sequences.
- 39 A \_\_\_\_\_ is a protein that decreases gene expression by binding to a transcription factor which contains a DNA binding domain.
- 40 A \_\_\_\_\_ is a collection of genes under regulation by the same stimulus.
- 41 A \_\_\_\_\_ region is a stretch of DNA sequences located between clusters of genes that comprise a large percentage of the human genome but contain few or no genes.
- 42 \_\_\_\_\_ gene expression is the activation of genes within specific tissues of an organism at specific times during development.

## DOWN

- 1 RNA \_\_\_\_\_ I transcribes DNA to synthesize ribosomal RNA.
- 2 Present in eukaryotic cells, RNA \_\_\_\_\_ II catalyzes

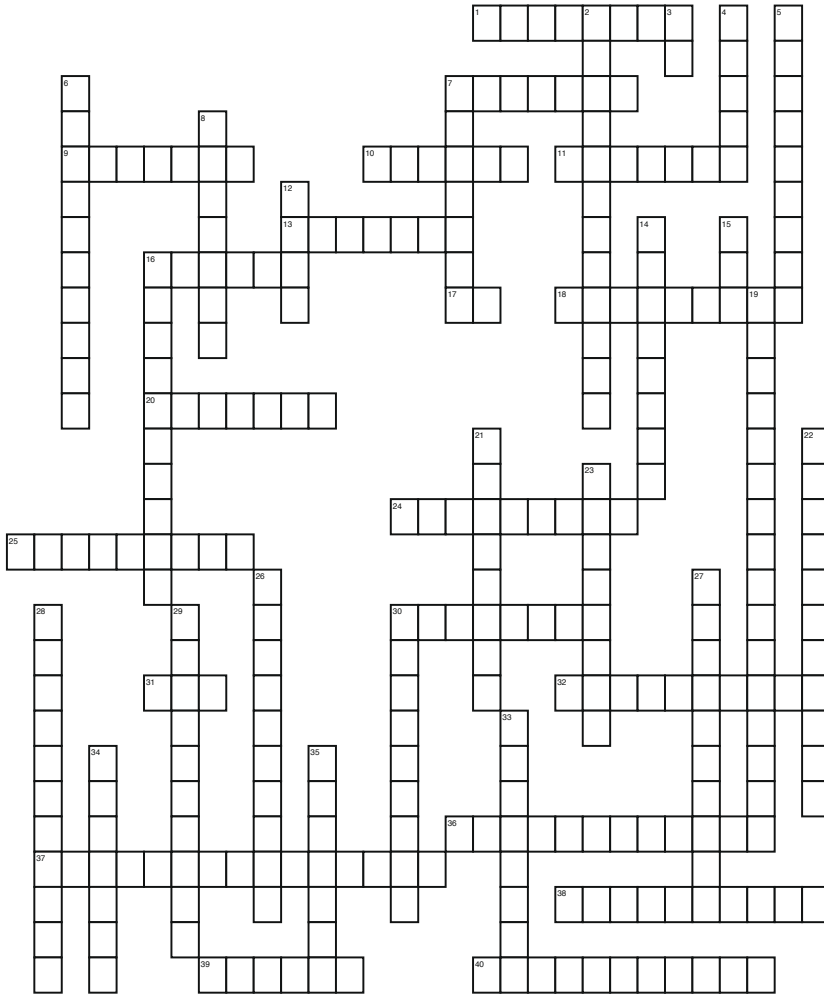
the transcription of DNA to synthesize precursors of mRNA and most snRNA and microRNA.

- 4 A \_\_\_\_\_ is a collection of genes under regulation by the same regulatory protein.
- 6 A \_\_\_\_\_ localizing sequence is an amino acid sequence which acts like a 'tag' on the exposed surface of a protein to target the protein to the cell nucleus through the nuclear pore complex.
- 8 \_\_\_\_\_ refers to the whole set of gene expression in a cell, tissue, organ, organisms, and species.
- 10 The lac \_\_\_\_\_ is a functional unit of nucleotide sequences controlling the production of gene products required for the transport and metabolism of lactose in *Escherichia coli* and some other enteric bacteria.
- 14 A \_\_\_\_\_ reading frame is a portion of an organism's genome which contains a sequence of bases that could potentially encode a protein.
- 20 A single nucleotide \_\_\_\_\_ is a DNA sequence variation occurring when a single nucleotide in the genome differs between members of a species.
- 22 A gene regulatory \_\_\_\_\_ is a collection of DNA segments in a cell which interact with each

other and with other substances in the cell, to govern the rates at which the associated genes are transcribed.

- 24 DNA \_\_\_\_\_ involves the addition of a methyl group to DNA.
- 25 The \_\_\_\_\_ box is the sequence TATAAT of six nucleotides that is an essential part of a promoter site on DNA for transcription to occur in prokaryotes.
- 26 \_\_\_\_\_ refers to features such as chromatin and DNA modifications that are stable over rounds of cell division but do not involve changes in the underlying DNA sequence of the organism.
- 27 The \_\_\_\_\_ is the set of all messenger RNA molecules produced in one or a population of cells.
- 28 Tryptophan \_\_\_\_\_ is a DNA binding protein which silences a set of genes involved in tryptophan production.
- 29 \_\_\_\_\_-loop intramolecular base pairing is a pattern that can occur in single-stranded DNA or, more commonly, in RNA. The structure is also known as a hairpin or hairpin loop.
- 30 \_\_\_\_\_ base pairing is a process of using modified base pairs in the first base of the anti-codon. It describes how the genetic code makes up for the disparity in the number of codons and tRNA molecules.
- 31 A \_\_\_\_\_ is a DNA-binding protein that regulates one or more genes by increasing the rate of transcription by recruiting RNA polymerase to the promoter region.
- 32 Polyribosomes, or \_\_\_\_\_, are a cluster of ribosomes, bound to an mRNA molecule.
- 33 A \_\_\_\_\_ is a protein that increases gene expression by binding to an activator or transcription factor which contains a DNA binding domain.
- 35 \_\_\_\_\_ factors are a set of proteins that facilitate the events of protein synthesis from the formation of the first peptide bond to the formation of the last one.
- 36 The lac \_\_\_\_\_ is a DNA-binding protein which inhibits the expression of genes coding for proteins involved in the metabolism of lactose in bacteria.
- 37 RNA-\_\_\_\_\_ proteins are typically cytoplasmic and nuclear proteins that associate with and facilitate the translation of RNAs.





## ACROSS

- 1 \_\_\_\_\_ over is the process by which two chromosomes, paired up during prophase 1 of meiosis, exchange some portion of their DNA.
- 7 The \_\_\_\_\_ strand is the DNA strand at the opposite side of the replication fork from the lagging strand.
- 9 \_\_\_\_\_ is the process by which one diploid eukaryotic cell divides to generate four haploid cells often called gametes.
- 10 The \_\_\_\_\_ of replication is a particular DNA sequence at which DNA replication is initiated.
- 11 During cell division, the \_\_\_\_\_ apparatus pulls apart the chromosomes into the two daughter cells.
- 13 A \_\_\_\_\_ fragment is a relatively short fragment of DNA, with an RNA primer at the five prime terminus, created on the lagging strand during DNA replication.
- 16 A \_\_\_\_\_ is a nucleic acid strand, or a related molecule, that serves as a starting strand of nucleotides for DNA polymerase to add to.
- 17 The \_\_\_\_\_ phase is a period in the cell cycle during interphase, after cytokinesis and before the S phase.
- 18 \_\_\_\_\_ is the stage of mitosis in the eukaryotic cell cycle in which

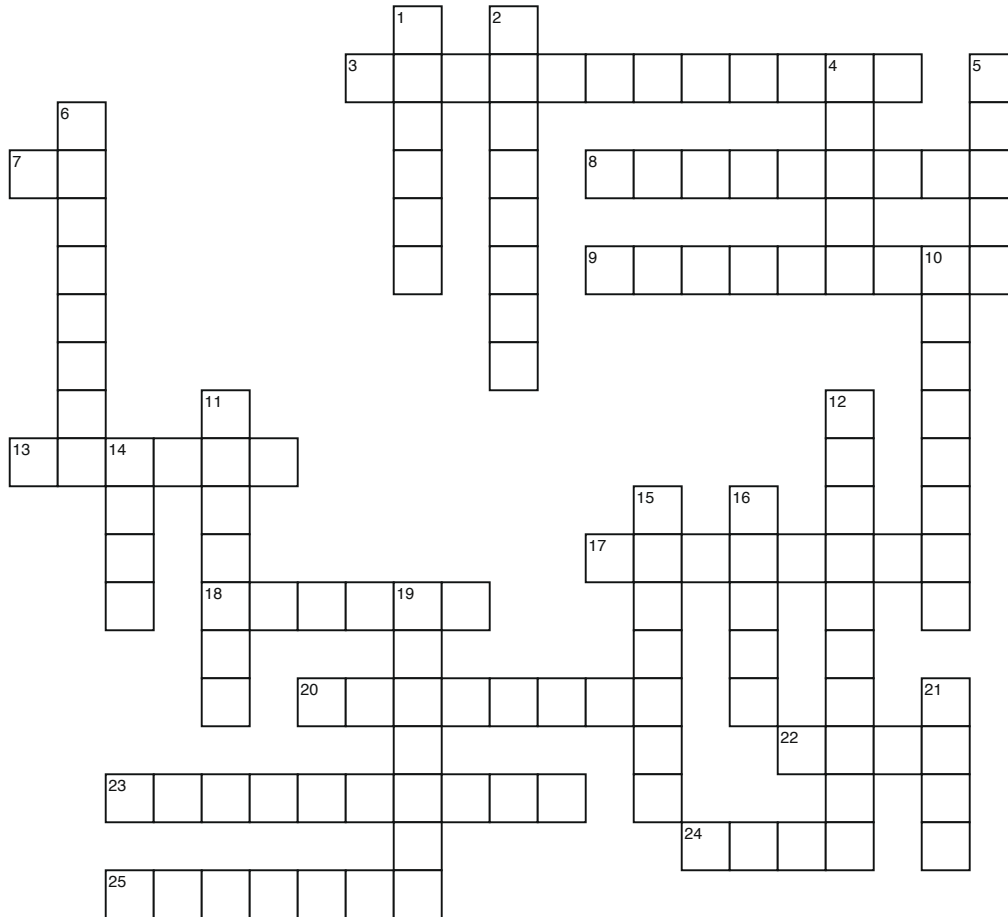
- condensed chromosomes, carrying genetic information, align in the middle of the cell before being separated into each of the two daughter cells.
- 20 \_\_\_\_\_ is the process by which a cell duplicates its genetic information in order to generate two, identical, daughter cells.
  - 24 A \_\_\_\_\_ is one of two identical strands of DNA making up a chromosome that are joined at their centromeres, for the process of nuclear division.
  - 25 The \_\_\_\_\_ is made up of two DNA polymerase III core enzymes, which are each made up of three subunits: one with polymerization activity, one with proofreading ability and one that stimulates the proofreading.
  - 30 \_\_\_\_\_, also called syngesis, is the pairing of two homologous chromosomes that occurs during meiosis.
  - 31 \_\_\_\_\_ is the DNA sequence that signals for the origin of replication, sometimes referred to simply as origin.
  - 32 DNA \_\_\_\_\_ III holoenzyme is the primary enzyme complex involved in prokaryotic DNA replication.
  - 36 \_\_\_\_\_ is the phase of mitosis following prophase and preceding metaphase, in eukaryotic somatic cells.

- 37 \_\_\_\_\_ is a tightly packed form of DNA. Its major characteristic is that transcription is limited.
- 38 DNA \_\_\_\_\_ I is an enzyme that mediates the process of DNA replication in prokaryotes, an example of a processive enzyme - an enzyme which catalyzes a series of polymerisations.
- 39 \_\_\_\_\_ chromatids are identical copies of a chromosome.
- 40 DNA \_\_\_\_\_ is the process of copying a double-stranded DNA molecule.

## DOWN

- 2 The \_\_\_\_\_ complex is a protein structure that forms between two homologous chromosomes during meiosis which is thought to mediate chromosome pairing, synapsis, and recombination.
- 3 The \_\_\_\_\_ phase is the third, final, and usually the shortest subphase during interphase within the cell cycle in which the cell undergoes a period of rapid growth to prepare for mitosis.
- 4 The cell \_\_\_\_\_ is the series of events that take place in a eukaryotic cell leading to its replication.
- 5 \_\_\_\_\_ is a stage in either meiosis or mitosis in which nuclei reform and chromatin loses its condensed state.

- 6 \_\_\_\_\_ chromosomes are non-identical chromosomes that contain information for the same biological features and contain the same genes at the same loci but possibly different genetic information at those genes.
- 7 The \_\_\_\_\_ strand is the DNA strand opposite the replication fork from the leading strand.
- 8 Binary \_\_\_\_\_ is the form of asexual reproduction in most prokaryotes by which one cell divides into two cells of the same size.
- 12 The replication \_\_\_\_\_ is a structure that forms during DNA replication having two branching prongs, each one made up of a single strand of DNA.
- 14 \_\_\_\_\_ is the stage of mitosis when chromosomes separate in a eukaryotic cell.
- 15 \_\_\_\_\_ ligase is a particular type of ligase that can link together strands that have double-strand breaks
- 16 A DNA \_\_\_\_\_ is an enzyme that assists in DNA replication, catalyzing the polymerization of deoxyribonucleotides alongside a DNA strand.
- 19 \_\_\_\_\_ replication describes the method by which DNA is replicated which produces two copies each containing one of the original strands and one entirely new strand.
- 21 \_\_\_\_\_ is a stage of mitosis in which chromatin condenses into a highly ordered structure called a chromosome.
- 22 \_\_\_\_\_ is the process whereby the cytoplasm of a single cell is divided to spawn two daughter cells.
- 23 Cell \_\_\_\_\_ is a process by which a cell, called the parent cell, divides into two cells, called daughter cells.
- 26 A \_\_\_\_\_ is the region in the middle of a chromosome where sister chromatids join in the double chromosomal structure during mitosis, prophase and metaphase.
- 27 \_\_\_\_\_ is a phase of the cell cycle, defined only by the absence of cell division.
- 28 The \_\_\_\_\_ is the protein structure in eukaryotes which assembles on the centromere and links the chromosome to microtubule polymers from the mitotic spindle during mitosis and meiosis.
- 29 A \_\_\_\_\_ is a single large macromolecule of DNA, and constitutes a physically organized form of DNA in a cell.
- 30 The S phase, short for \_\_\_\_\_ phase, is a period in the cell cycle during interphase, between G1 phase and the G2 phase.
- 33 A \_\_\_\_\_ is a region of highly repetitive DNA at the end of a linear chromosome that functions as a disposable buffer.
- 34 \_\_\_\_\_s are the chief protein components of chromatin. They act as spools around which DNA winds, and they play a role in gene regulation.
- 35 DNA \_\_\_\_\_ is activated by DNA helicase to synthesize a short RNA primer as a starting point for replication.

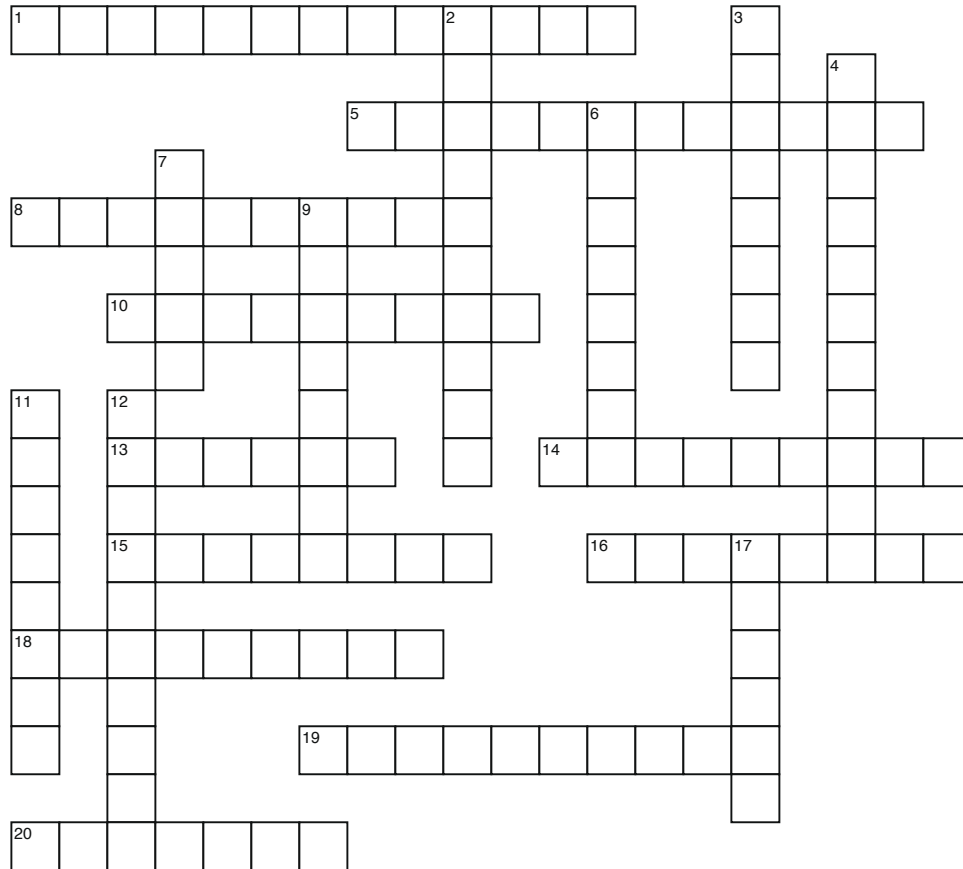


## ACROSS

- 3 \_\_\_\_\_ is the proportion of phenotypic variation in a population that is attributable to genetic variation among individuals.
- 7 The \_\_\_\_\_ sex-determination system is the sex-determination system found in humans, most other mammals, and some insects.
- 8 A \_\_\_\_\_ relationship refers to how the alleles for a locus interact to produce a phenotype.
- 9 The \_\_\_\_\_ describes the outward physical appearance or manifestation of a trait in an organism, as opposed to its genotype.
- 13 F1 \_\_\_\_\_ is a term used in genetics and selective breeding to describe the first filial generation offspring resulting from a cross mating of distinctly different parental types.
- 17 A \_\_\_\_\_ is a non-sex chromosome.
- 18 A \_\_\_\_\_ is a viable DNA coding that occupies a given locus on a chromosome.
- 20 The \_\_\_\_\_ describes the genetic constitution of an individual, that is the specific allelic makeup of an individual, usually with reference to a specific character under consideration.
- 22 A \_\_\_\_\_ breeding organism is an organism having certain biological traits which are passed on to all subsequent generations when bred with another organism of the same type for the same traits.
- 23 \_\_\_\_\_ is a term used in genetics describing the proportion of individuals carrying a particular variation of a gene that also express the particular trait.
- 24 The \_\_\_\_\_ type is the typical form of an organism, strain, gene, or characteristic as it occurs in nature.
- 25 Complete \_\_\_\_\_ is defined as the state in which two loci are so close together that alleles of these loci are virtually never separated by crossing over.

## DOWN

- 1 Gregor \_\_\_\_\_ (1822 - 1884) was an Austrian Augustinian priest and scientist often called the father of modern genetics for his study of the inheritance of traits in pea plants.
- 2 A \_\_\_\_\_ cross is a cross between two individuals identically heterozygous at two loci.
- 4 A \_\_\_\_\_ is a distinct phenotypic character of an organism that may be inherited, environmentally determined or somewhere in between.
- 5 A \_\_\_\_\_ is an individual characteristic or trait which can be possessed by an organism, such as eye colour or height, or any other observable characteristic.
- 6 \_\_\_\_\_ describes the similarity or dissimilarity of DNA between homologous chromosomes at a specific allelic position or gene.
- 10 A \_\_\_\_\_ chart is a chart which shows the known phenotypes for an organism and its ancestors.
- 11 Genetic \_\_\_\_\_ occurs when particular genetic loci or alleles for genes are inherited jointly because the loci are on the same chromosome and thus tend to segregate together during meiosis.
- 12 A \_\_\_\_\_ cross is a cross between individuals who are identically heterozygous at one locus.
- 14 A \_\_\_\_\_ body is the inactive X chromosome in a female cell.
- 15 The \_\_\_\_\_ square is a diagram used by biologists to determine the probability of an offspring having a particular genotype.
- 16 A \_\_\_\_\_ is a fixed position on a chromosome.
- 19 Sex \_\_\_\_\_ is the phenotypic expression of an allele that is related to the gender of the individual and is found on the sex chromosomes.
- 21 A \_\_\_\_\_ cross crosses a homozygous recessive with an individual with an unknown genotype.

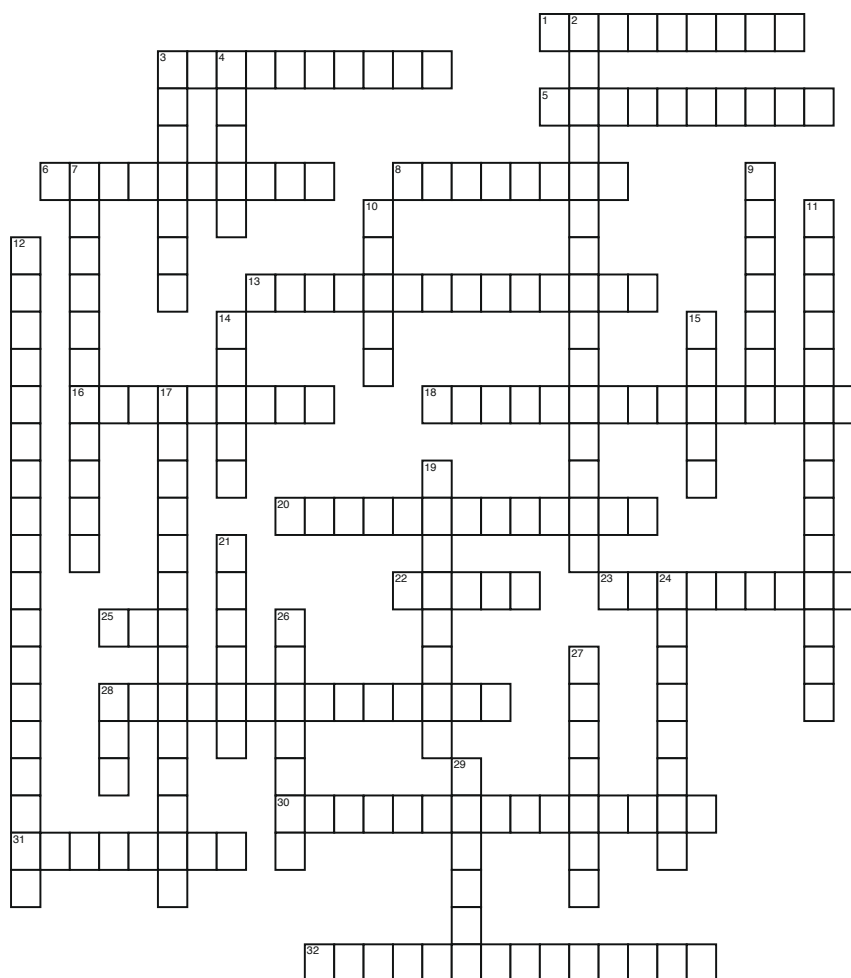


## ACROSS

- 1 Genetic \_\_\_\_\_ is the process by which a strand of DNA is broken and then joined to the end of a different DNA molecule.
- 5 \_\_\_\_\_ is the process by which bacterial DNA is moved from one bacterium to another by a virus.
- 8 \_\_\_\_\_ recombination involves the alignment of similar sequences, a crossover between the aligned DNA strands, and breaking and repair of the DNA to produce an exchange of material between the strands.
- 10 Genetic \_\_\_\_\_ is the addition of one or more nucleotide base pairs into a genetic sequence.
- 13 DNA \_\_\_\_\_ refers to a collection of processes by which a cell identifies and corrects damage to the DNA molecules that encode its genome.
- 14 A \_\_\_\_\_ is a chromosome rearrangement in which a segment of a chromosome is reversed end to end.
- 15 \_\_\_\_\_ mutations or nonsynonymous mutations are types of point mutations where a single nucleotide is changed to cause substitution of a different amino acid.
- 16 A \_\_\_\_\_ mutation is a point mutation in a sequence of DNA that results in a premature stop codon, or a nonsense codon in the transcribed mRNA, and possibly a truncated, and often nonfunctional protein product.
- 18 A \_\_\_\_\_ sequence is a short DNA sequence that acts as a simple transposable element.
- 19 Gene \_\_\_\_\_ may occur during meiotic division through a process by which DNA sequence information is transferred from one DNA helix to another DNA helix, whose sequence is altered.
- 20 A \_\_\_\_\_ is a physical or chemical agent that changes the genetic information of an organism.

## DOWN

- 2 \_\_\_\_\_s are sequences of DNA that can move around to different positions within the genome of a single cell, a process called transposition.
- 3 \_\_\_\_\_s are changes to the base pair sequence of the genetic material of an organism.
- 4 Bacterial \_\_\_\_\_ is the transfer of genetic material between bacteria through direct cell-to-cell contact.
- 6 A \_\_\_\_\_ is a mutation in which a part of a chromosome or a sequence of DNA is missing.
- 7 A \_\_\_\_\_ mutation, or single base substitution, is a type of mutation that causes the replacement of a single base nucleotide with another nucleotide.
- 9 A \_\_\_\_\_ mutation is any detectable, heritable variation in the lineage of germ cells.
- 11 \_\_\_\_\_ over is the process by which two chromosomes, paired up during prophase 1 of meiosis, exchange some portion of their DNA.
- 12 A \_\_\_\_\_ mutation is a genetic mutation caused by inserts or deletes from a DNA sequence of a number of nucleotides not evenly divisible by three.
- 17 \_\_\_\_\_ mutations are DNA mutations that do not result in a change to the amino acid sequence of a protein.



## ACROSS

- 1 The \_\_\_\_\_ factor (also known as F factor or sex factor) is a bacterial DNA sequence that allows a bacterium to produce a sex pilus necessary for conjugation.
- 3 The \_\_\_\_\_ chain reaction is a technique widely used in molecular biology to exponentially amplify a fragment of DNA by in vitro enzymatic replication.
- 5 The term DNA \_\_\_\_\_ encompasses biochemical methods for determining the order of the nucleotide bases in a DNA oligonucleotide.
- 6 \_\_\_\_\_ bacteria refers to bacteria which have been genetically engineered.
- 8 \_\_\_\_\_ chromatography is a chromatographic method of separating biochemical mixtures, based on a highly specific biologic interaction such as that between antigen and antibody or enzyme and substrate.
- 13 \_\_\_\_\_ is the collective term for laboratory techniques which separate

analytes dissolved in a mobile phase by passing them through a stationary phase.

- 16 \_\_\_\_\_ electrophoresis separates biological macromolecules based on their size to charge ratio in the interior of a very narrow tube filled with an electrolyte.
- 18 DNA \_\_\_\_\_ is an analytical technique used to separate DNA fragments by size through the use of an electric field which forces the fragments to migrate through a gel.
- 20 \_\_\_\_\_ is a separation process in which a certain quantity of a mixture is divided up in a large number of smaller quantities in which the composition changes according to a gradient.
- 22 In \_\_\_\_\_ technique an unknown amount of antigen is affixed to a surface, and then a specific labeled antibody is washed over the surface so that it can bind the antigen.
- 23 \_\_\_\_\_ refers to the liquid or clear fluid above a sediment or precipitate.
- 25 \_\_\_\_\_-PAGE, officially

sodium dodecyl sulfate polyacrylamide gel electrophoresis, is a technique used to separate proteins according to their electrophoretic mobility.

- 28 \_\_\_\_\_ is the genetic alteration of a cell resulting from the uptake and expression of foreign genetic material.
- 30 The \_\_\_\_\_ is a centrifuge optimized for spinning a rotor at very high speeds, capable of generating acceleration as high as 1,000,000 g.
- 31 Ion-\_\_\_\_\_ chromatography is a process that allows the separation of ions and polar molecules based on the charge properties of the molecules.
- 32 In peptide mass \_\_\_\_\_ an unknown protein is cleaved into peptides by a protease such as Trypsin to form a collection of peptides serving as a unique identifier of the unknown protein.

## DOWN

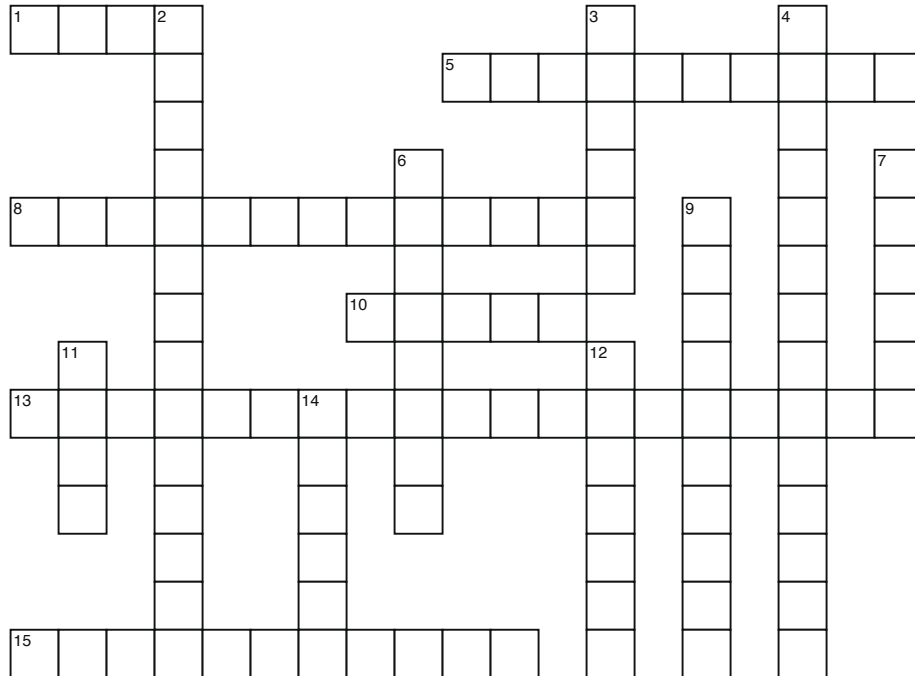
- 2 Gel \_\_\_\_\_ is a technique used for the

separation of biological molecules using an electric field.

- 3 A \_\_\_\_\_ is a DNA molecule separate from chromosomal DNA which is capable of autonomous replication. It is typically circular and double-stranded.
- 4 Thin \_\_\_\_\_ chromatography is a chromatography technique involving a stationary phase consisting of a thin patina of adsorbent material immobilised on a flat, inert carrier sheet.
- 7 A \_\_\_\_\_ enzyme is an enzyme that cuts double-stranded DNA in such a way that the fragments from different chromosomes or genes can be spliced together by ligases.
- 9 \_\_\_\_\_ is a material used to form a common type of electrophoresis gel which is derived from the cell membranes of some species of red algae or seaweed.
- 10 \_\_\_\_\_ degradation is a method of sequencing amino acids in a peptide in which the amino-terminal

residue is labeled and cleaved from the peptide without disrupting the peptide bonds between other amino acid residues.

- 11 \_\_\_\_\_ is a process that involves the use of the centripetal force for the separation of mixtures.
- 12 \_\_\_\_\_ are nucleotides lacking a three prime hydroxyl group on their deoxyribose sugar. After one is added by a DNA polymerase to a growing nucleotide chain, no further nucleotides can be added.
- 14 A \_\_\_\_\_ is a hairlike appendage found on the surface of many bacteria.
- 15 A hybridization \_\_\_\_\_ is a labeled fragment of DNA of variable length which is used to detect in DNA or RNA samples the presence of nucleotide sequences that are complementary to the sequence in the fragment.
- 17 \_\_\_\_\_ is a general term in biochemistry that applies to any use of an antibody-based method to detect a specific protein in a sample.
- 19 \_\_\_\_\_ is the process of separating molecules in solution by the difference in their rates of diffusion through a semipermeable membrane.
- 21 A restriction \_\_\_\_\_ is a procedure which uses a restriction enzyme to selectively cleave DNA strands into shorter segments, which are more suitable for analytical techniques such as chromatography.
- 24 A \_\_\_\_\_ is a phage genome inserted as part of the linear structure of the DNA chromosome of a bacterium.
- 26 In \_\_\_\_\_ sequencing, DNA is broken up randomly into numerous small segments, which are sequenced. The process is repeated until multiple overlapping reads for the target DNA are obtained.
- 27 Molecular \_\_\_\_\_ refers to the procedure of isolating a defined DNA sequence and obtaining multiple copies of it in vivo.
- 28 \_\_\_\_\_ polymerase is a thermostable DNA polymerase named after the thermophilic bacterium *Thermus aquaticus* from which it was isolated. This enzyme is able to withstand the high temperature required during PCR.
- 29 A cloning \_\_\_\_\_ is a small DNA vehicle that carries a foreign DNA fragment.

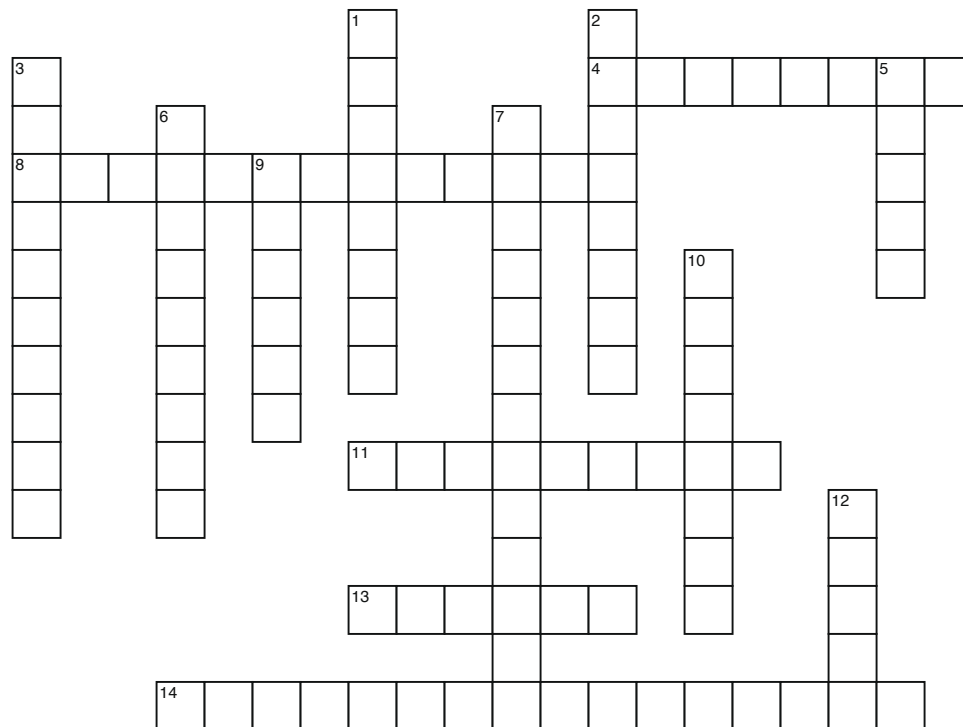


## ACROSS

- 1 \_\_\_\_\_ syndrome or trisomy 21 is a genetic disorder caused by the presence of all or part of an extra 21st chromosome.
- 5 \_\_\_\_\_ is a change in the number of chromosomes that can lead to a chromosomal disorder.
- 8 A \_\_\_\_\_ is a section of DNA that consists of a short series of 10-100 bases. These types of sequences occur at more than 1000 locations in the human genome.
- 10 A \_\_\_\_\_'s peak is a descending V-shaped point in the middle of the hairline. This is a dominant genetic trait.
- 13 \_\_\_\_\_, also known as PTC, or phenylthiourea, is an organic compound which either tastes very bitter, or virtually tasteless, depending on the genetic makeup of the taster.
- 15 \_\_\_\_\_'s syndrome or XXY syndrome is a condition caused by a chromosome aneuploidy in which affected males have an extra X sex chromosome.

## DOWN

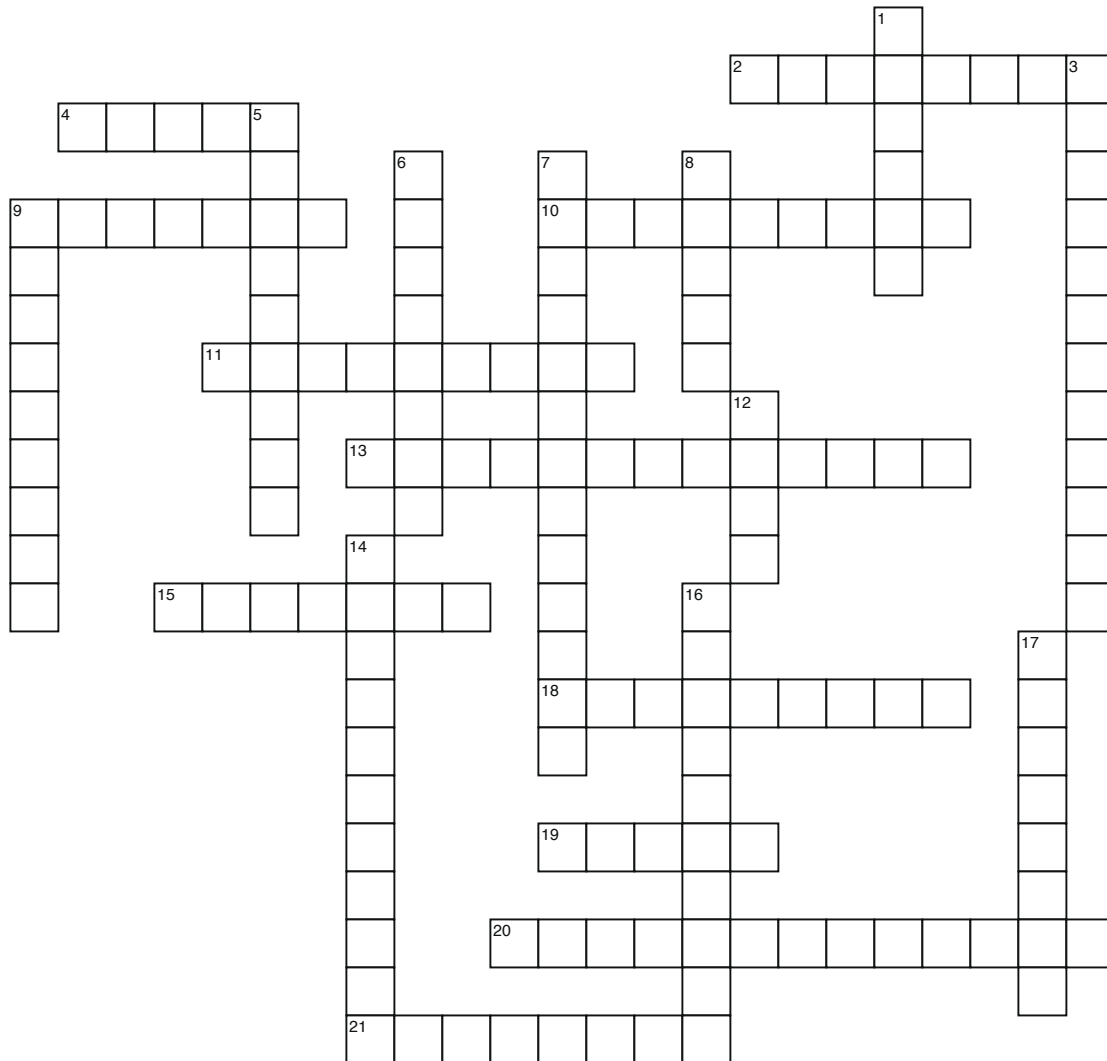
- 2 \_\_\_\_\_ is the failure of chromosome pairs to separate properly during meiosis or mitosis.
- 3 \_\_\_\_\_ syndrome encompasses several chromosomal abnormalities, of which monosomy X is the most common.
- 4 Genetic \_\_\_\_\_ is a technique used to distinguish between individuals of the same species using only samples of their DNA, exploiting highly variable repeating sequences called minisatellites.
- 6 The recessive trait \_\_\_\_\_ is a form of hypopigmentary congenital disorder, characterized by a lack of melanin pigment in the eyes, skin and hair. It is a recessive genetically inherited trait.
- 7 \_\_\_\_\_s are visible indentations of the skin, a dominant genetic trait which shows on some people's cheeks when they smile.
- 9 Sexadactyly or hexadactyly is dominant genetic condition in which a person has six fingers on one or both hands, or six toes on one or both feet.
- 11 Cri du \_\_\_\_\_ syndrome is due to a partial deletion of the short arm of chromosome number 5.
- 12 \_\_\_\_\_s are small colored spots of melanin on the exposed skin. Having them is genetic and is related to the presence of the melanocortin-1 receptor MC1R gene variant, which is a dominant trait.
- 14 \_\_\_\_\_ X syndrome is a form of chromosomal variation characterized by the presence of an extra X chromosome in each cell of a human female.

**ACROSS**

- 4 \_\_\_\_\_-sense viral RNA is complementary to the viral mRNA and thus must be converted to positive-sense RNA by an RNA polymerase prior to translation.
- 8 A reverse \_\_\_\_\_, also known as RNA-dependent DNA polymerase, is a DNA polymerase enzyme that transcribes single-stranded RNA into single-stranded DNA.
- 11 The \_\_\_\_\_ cycle is the mode of viral reproduction characterized by the fusion of the nucleic acid of a bacteriophage with that of a host so that the integrated prophage can then be transmitted to daughter cells in subsequent cell divisions.
- 13 Tobacco \_\_\_\_\_ virus is an RNA virus that infects plants. It was the first virus to be discovered.
- 14 Human \_\_\_\_\_ virus (HIV) is a retrovirus that can lead to AIDS, a condition in humans in which the immune system begins to fail.

**DOWN**

- 1 \_\_\_\_\_-sense viral RNA is viral RNA which may be directly translated into the desired viral proteins.
- 2 Viral \_\_\_\_\_s are present in many viruses, covering the protein capsid, typically derived from portions of the host cell membranes but including some viral glycoproteins.
- 3 A \_\_\_\_\_ is an enveloped viruses possessing a RNA genome, which replicates via a DNA intermediate.
- 5 A \_\_\_\_\_ is a sub-microscopic particle that can infect the cells of a biological organism and which can replicate itself only by infecting a host cell.
- 6 \_\_\_\_\_, commonly known as flu, is an infectious disease of birds and mammals caused by RNA viruses of the family Orthomyxoviridae.
- 7 A \_\_\_\_\_ is any one of a number of viruses that infect bacteria.
- 9 A \_\_\_\_\_ is the protein shell of a virus.
- 10 A \_\_\_\_\_ is a virus genome that has integrated itself into the DNA of a host cell.
- 12 The \_\_\_\_\_ cycle is the one of the two cycles of viral reproduction that is typically considered the main method of viral replication, since it results in the destruction of the infected cell and release of virus particles.



## ACROSS

- 2 Gram-\_\_\_\_\_ bacteria are those that retain a crystal violet dye during the Gram stain process.
- 4 A \_\_\_\_\_ is a hairlike appendage found on the surface of many bacteria.
- 9 A \_\_\_\_\_ is a proteinaceous appendage in many gram-negative bacteria that is thinner and shorter than a flagellum.
- 10 A \_\_\_\_\_ is a dormant, tough, non-reproductive structure produced by a small number of bacteria the purpose of which is to ensure the survival of the bacterium through periods of environmental stress.
- 11 \_\_\_\_\_ is a protein that arranges itself in a hollow cylinder to form the filament in bacterial flagellum
- 13 A \_\_\_\_\_ is an organism that is too small to be seen by the human eye.
- 15 The \_\_\_\_\_, or archaeobacteria, are a major group of prokaryotic microorganisms in which many species are extremophiles.
- 18 A \_\_\_\_\_ is an organism that produces complex organic compounds

from simple inorganic molecules and an external source of energy.

- 19 A \_\_\_\_\_ dish is a shallow glass or plastic cylindrical dish that biologists use to culture cells.
- 20 \_\_\_\_\_ is a phylum of bacteria which obtain their energy through photosynthesis, often referred to as blue-green algae.
- 21 The cell \_\_\_\_\_ of a bacterium is the cell membrane and cell wall plus an outer membrane.

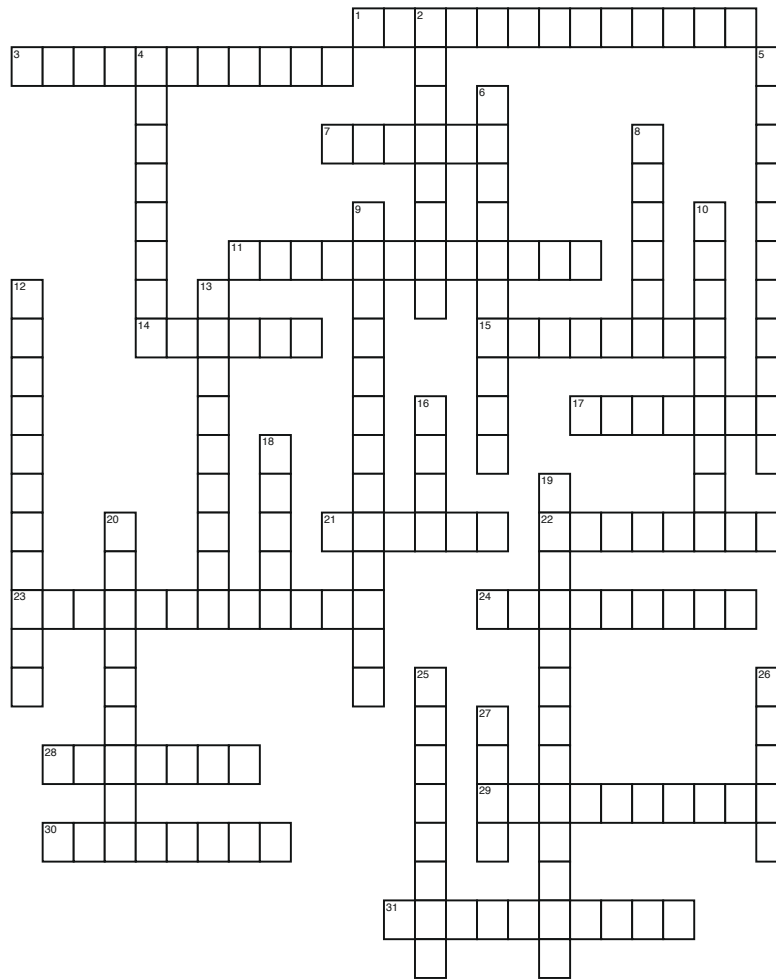
## DOWN

- 1 \_\_\_\_\_ fission is the form of asexual reproduction in prokaryotic single-celled organisms by which one cell divides into two cells of the same size.
- 3 A \_\_\_\_\_ is an organism that thrives in and may even require physically or geochemically extreme conditions that are detrimental to the majority of life on Earth.
- 5 \_\_\_\_\_ in microbiology refers to a bacterium with a cell body that twists like a spiral.
- 6 \_\_\_\_\_ are prokaryotic unicellular

microorganisms ubiquitous in every habitat on Earth.

- 7 \_\_\_\_\_ or murein is a polymer consisting of sugars and amino acids that forms a mesh-like layer outside the plasma membrane of eubacteria.
- 8 \_\_\_\_\_ are microorganisms whose overall shape is spherical or nearly spherical.
- 9 A \_\_\_\_\_ is a long, slender projection from the cell body, composed of microtubules and surrounded by the plasma membrane.
- 12 A cell \_\_\_\_\_ is a fairly rigid layer surrounding a cell, located external to the cell membrane.
- 14 The \_\_\_\_\_ is a bacterial microcompartment made up of a protein shell, that contains enzymes involved in carbon fixation reactions.
- 16 \_\_\_\_\_s are a group of organisms that lack a cell nucleus or any other membrane-bound organelles.
- 17 The \_\_\_\_\_ in prokaryotes is an irregularly shaped region within the cell where the genetic material is localized.

# Embryology



## ACROSS

- 1 \_\_\_\_\_ is the process by which the embryo is formed and develops.
- 3 The \_\_\_\_\_ is known as the primitive gut that forms during gastrulation in the developing blastula.
- 7 The \_\_\_\_\_ nerve cord is one of the embryonic features unique to chordates, along with a notochord, a post-anal tail and pharyngeal slits.
- 11 \_\_\_\_\_ is a phase early in the development of animal embryos, during which the morphology of the embryo is dramatically restructured by cell migration.
- 14 A \_\_\_\_\_ is an embryo at an early stage of embryonic development, consisting of approximately 12-32 cells in a solid ball contained within the zona pellucida.
- 15 \_\_\_\_\_ is a primary germ layer which forms during gastrulation when some of the cells migrating inward to form the endoderm form an additional layer between the

endoderm and the ectoderm.

- 17 The term \_\_\_\_\_ pole refers to the hemisphere of a blastula embryo which contains large yolk cells that divide very slowly.
- 21 The term \_\_\_\_\_ pole refers to the hemisphere of a blastula embryo which consists of small cells that divide rapidly, in contrast with the vegetal pole.
- 22 The \_\_\_\_\_ is the primary germ layer which emerges first during embryogenesis and forms from the outermost of the germ layers.
- 23 \_\_\_\_\_ is a physiological process involving the growth of new blood vessels from pre-existing vessels.
- 24 The \_\_\_\_\_ is a flexible, rod-shaped body found in embryos of all chordates which is composed of cells derived from the mesoderm and defines the primitive axis of the embryo.
- 28 \_\_\_\_\_ is the expansion of one cell sheet over other cells. Takes place during gastrulation.

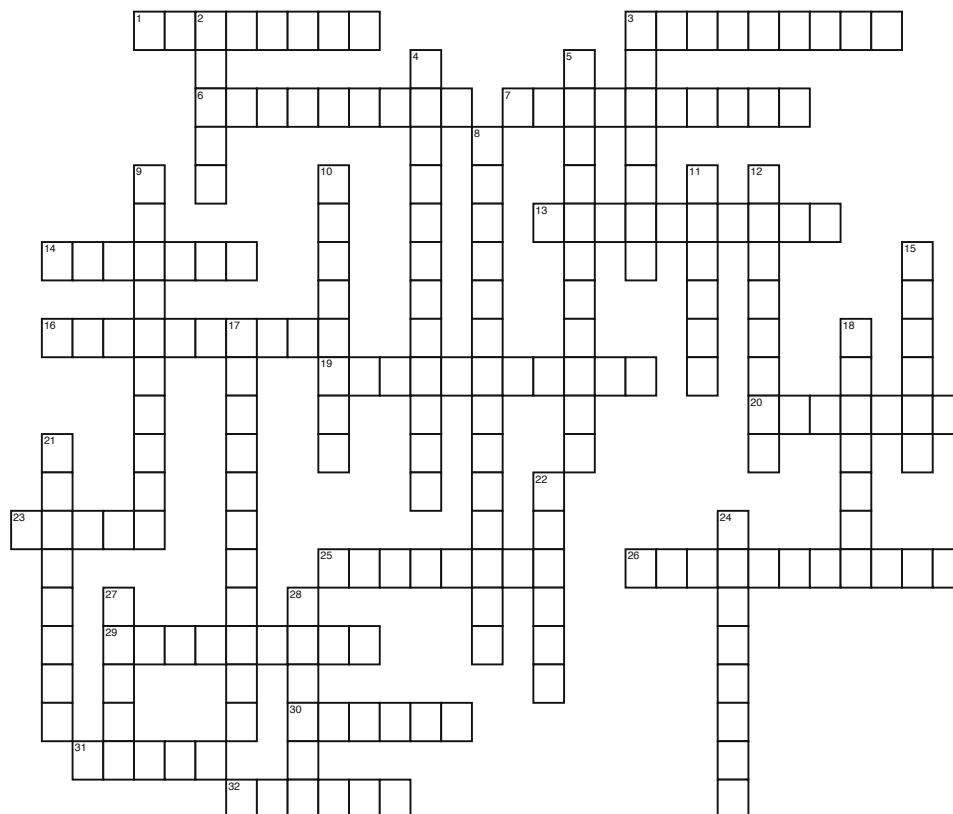
- 29 A \_\_\_\_\_ is an opening into the archenteron during the embryonic stages of an organism.
- 30 \_\_\_\_\_ is the division of cells in the early embryo.
- 31 The \_\_\_\_\_ is the structure formed in early human embryogenesis, after the formation of the blastocoele, but before implantation, possessing an inner cell mass, or embryoblast, and an outer cell mass, or trophoblast.

## DOWN

- 2 The \_\_\_\_\_ stage of embryonic development in animals follows the morula and precedes the gastrula stage in the developmental sequence.
- 4 \_\_\_\_\_ is one of the primary germ layers formed during animal embryogenesis when cells migrating inward along the archenteron form the inner layer of the gastrula.
- 5 A \_\_\_\_\_ is the fluid-filled central region of a blastocyst.

- 6 \_\_\_\_\_ is the term for the cells formed by cleavage of the ovum in very early embryonic development.
- 8 A \_\_\_\_\_ is the cell that results from fertilization.
- 9 \_\_\_\_\_ is the process in animal development by which the ectoderm, endoderm, and mesoderm develop into the internal organs of the organism.
- 10 The \_\_\_\_\_ streak is a structure that forms during the early stages of embryonic development, characterized as a furrow in the midline of the embryonic disk at the future caudal end of the embryo.
- 12 \_\_\_\_\_s are cells forming the outer layer of a blastocyst, which provide nutrients to the embryo and develop into a large part of the placenta.
- 13 During the early stages of embryonic development, a shallow groove, the \_\_\_\_\_ groove, appears on the surface of the primitive streak
- 16 A \_\_\_\_\_ layer is a collection of cells, a primary tissue layer, formed during animal embryogenesis.
- 18 Formation of neural \_\_\_\_\_ is the first step of neurulation in human embryology. It is created by a flat thickening opposite to the primitive streak.
- 19 \_\_\_\_\_ is fusion of gametes to form a new organism of the same species.
- 20 The \_\_\_\_\_ knot is the organizer for gastrulation in vertebrates, starting as a regional knot of cells that forms on the blastodisc immediately anterior to where the outer layer of cells will begin to migrate inwards.
- 25 The \_\_\_\_\_ phase of embryonic development, which follows after the blastula stage, is seen in all animals except the sponges.
- 26 In early embryogenesis, the \_\_\_\_\_ cell mass is the mass of cells inside the primordial embryo that will eventually give rise to the definitive structures of the fetus.
- 27 Following primary and secondary neurulation, the neural \_\_\_\_\_ is the developing vertebrate embryo's precursor to the central nervous system.





## ACROSS

- 1 \_\_\_\_\_ epithelia are cube-shaped epithelial cells.
- 3 \_\_\_\_\_s are the cells that primarily compose adipose tissue, specialized in storing energy as fat.
- 6 The \_\_\_\_\_ epithelium is a specialized epithelial tissue inside the nasal cavity that is involved in smell.
- 7 \_\_\_\_\_ tissue is largely a category of exclusion rather than one with a precise definition, but most tissues in this category are involved in structure and support, derived from mesoderm, and characterized by the traits of non-living tissue.
- 13 \_\_\_\_\_ columnar epithelia have several layers, with columnar cells as the outermost of these.
- 14 \_\_\_\_\_ connective tissue is a type of connective tissue which has relatively high tensile strength, due to a relatively high concentration of collagenous fibers.
- 16 \_\_\_\_\_ is a tissue composed of layers of cells which line the cavities and surfaces of structures throughout the body. It is also the type of tissue of which many glands are formed.
- 19 The \_\_\_\_\_ is the innermost layer of tissue that lines the chambers of the heart.
- 20 The \_\_\_\_\_ microscope, often referred to as a light microscope, is a type of microscope which uses visible light and a system of lenses to magnify images of small samples.

- 23 A \_\_\_\_\_ is an organ in an animal's body that synthesizes a substance for release, often into the bloodstream (endocrine) or onto a surface (exocrine).
- 25 \_\_\_\_\_ epithelium is an epithelium characterised by its most superficial layer consisting of flat, scale-like cells.
- 26 The \_\_\_\_\_ membrane of a polarized cell is the part of the plasma membrane that forms its basal and lateral surfaces, distinct from the luminal or apical surface.
- 29 \_\_\_\_\_ is the study of tissue sectioned as a thin slice, viewed under a microscope.
- 30 The basal \_\_\_\_\_ is a layer on which epithelium sits and which is secreted by the epithelial cells.
- 31 \_\_\_\_\_ connective tissue has collagen fibers as its main matrix element.
- 32 The extracellular \_\_\_\_\_ is the extracellular part of animal tissue that usually provides structural support to the cells in addition to performing other functions. It is the defining feature of connective tissue in animals.

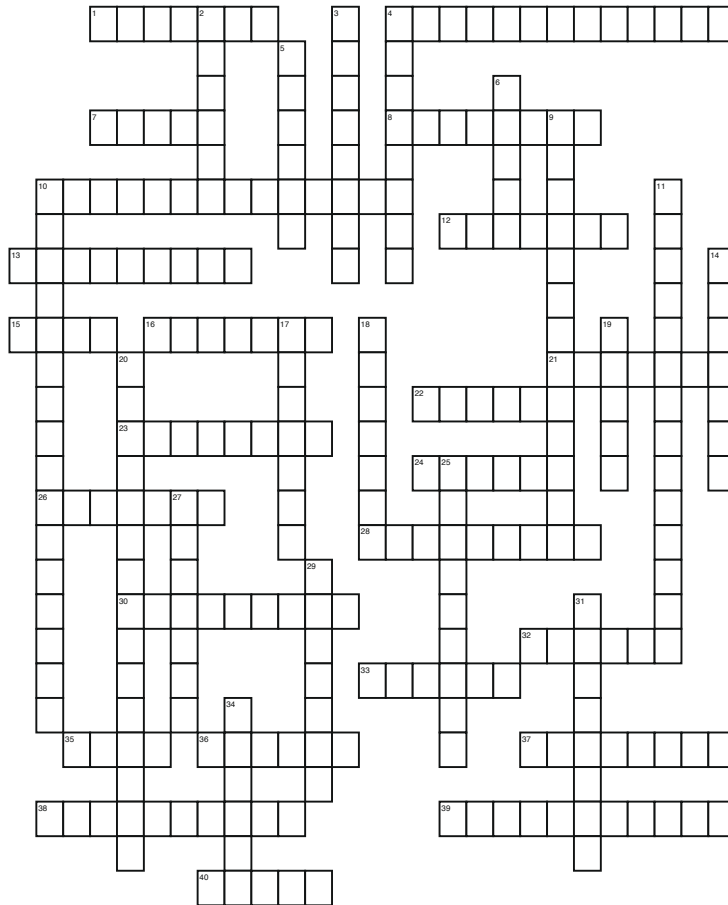
## DOWN

- 2 \_\_\_\_\_ adipose tissue is present in many newborn or hibernating mammals as well as migratory birds. Its primary purpose is to generate body heat.
- 3 \_\_\_\_\_ connective tissue (or loose connective tissue) is the most widely distributed connective tissue type in the body. It can be found in

the skin as well as in places that connect epithelium to other tissues.

- 4 \_\_\_\_\_ epithelia is a type of tissue consisting of multiple layers of epithelial cells which can contract and expand.
- 5 The \_\_\_\_\_ is the thin layer of cells that line the interior surface of blood vessels.
- 8 \_\_\_\_\_ refers to the microscopic examination of tissue in order to study the manifestations of disease.
- 9 \_\_\_\_\_ cuboidal epithelia is epithelial tissue composed of cuboidally shaped cells arranged in multiple layers.
- 10 The \_\_\_\_\_ membrane is a structure that supports overlying epithelial or endothelial cells.
- 11 \_\_\_\_\_ cuboidal epithelia are epithelial cells with a cuboidal shape arranged in a single layer.
- 12 \_\_\_\_\_ is a chemical process used in the fields of histology, pathology, and cell biology by which biological tissues are preserved from decay.
- 15 The \_\_\_\_\_ membrane of a polarized cell is the part of the plasma membrane that forms its luminal surface, distinct from the basolateral membrane.
- 17 Antonie van \_\_\_\_\_ (1632 - 1723) was a Dutch tradesman and scientist who is commonly known as the Father of Microbiology.
- 18 \_\_\_\_\_ tissue or fat is loose connective tissue composed of adipocytes.
- 21 \_\_\_\_\_ epithelia are epithelial cells whose heights are at least twice their width.

- 22 A biological \_\_\_\_\_ is a collection of interconnected cells that perform a similar function within an organism.
- 24 Simple \_\_\_\_\_ epithelium is made up of one layer of cells that are relatively thick and protective of the underlying tissues due to its elongated shape.
- 27 \_\_\_\_\_ adipose tissue is one of the two types of adipose tissue found in mammals, in humans, composing as much as 20% of the body weight in men and 25% of the body weight in women.
- 28 \_\_\_\_\_ cells are glandular simple columnar epithelial cells whose sole function is to secrete mucus.



## ACROSS

- 1 Sodium \_\_\_\_\_s are integral membrane proteins that conduct sodium ions through a cell's plasma membrane.
- 4 The first neurotransmitter identified, the chemical compound \_\_\_\_\_ is a neurotransmitter in both the peripheral nervous system and central nervous system.
- 7 \_\_\_\_\_ neurons begin in the central nervous system projecting their axons outside the CNS and directly or indirectly controlling muscles.
- 8 \_\_\_\_\_ nerves - otherwise known as motor or effector neurons - carry nerve impulses away from the central nervous system to effectors such as muscles or glands.
- 10 Epinephrine and \_\_\_\_\_ are fight or flight hormones released from the adrenal glands, which are also neurotransmitters in the central and sympathetic nervous systems.
- 12 The \_\_\_\_\_ nervous system represents the largest part of the nervous system, including the brain and the spinal cord.
- 13 The \_\_\_\_\_ nervous system is the part of the peripheral nervous system that acts as a control system, maintaining homeostasis in the body.
- 15 The \_\_\_\_\_, or perikaryon, is the bulbous end of a neuron, containing the cell nucleus.
- 16 Chemical \_\_\_\_\_s are specialized junctions through which

the cells of the nervous system employ neurotransmitters to signal to each other and to non-neuronal cells such as those in muscles or glands.

- 21 \_\_\_\_\_ cells are a variety of glial cell that mainly provide myelin insulation to axons in the peripheral nervous system.
- 22 The \_\_\_\_\_ system is the part of the human brain involved in emotion, motivation, and emotional association with memory.
- 23 In a biological membrane, the \_\_\_\_\_ potential (or Nernst potential) of a particular ion is the membrane voltage at which there is no net flow of ions from one side of the membrane to the other.
- 24 The \_\_\_\_\_ cord is a thin, tubular bundle of nerves that is an extension of the central nervous system from the brain, enclosed and protected by the bony vertebral column.
- 26 \_\_\_\_\_ neurons are nerve cells within the nervous system responsible for converting external stimuli from the organism's environment into nerve impulses relayed to the central nervous system.
- 28 \_\_\_\_\_ conduction is the means by which action potentials are transmitted along myelinated nerve fibers.
- 30 Membrane \_\_\_\_\_ is the electrical voltage across a cell's plasma membrane.
- 32 \_\_\_\_\_ is an electrically

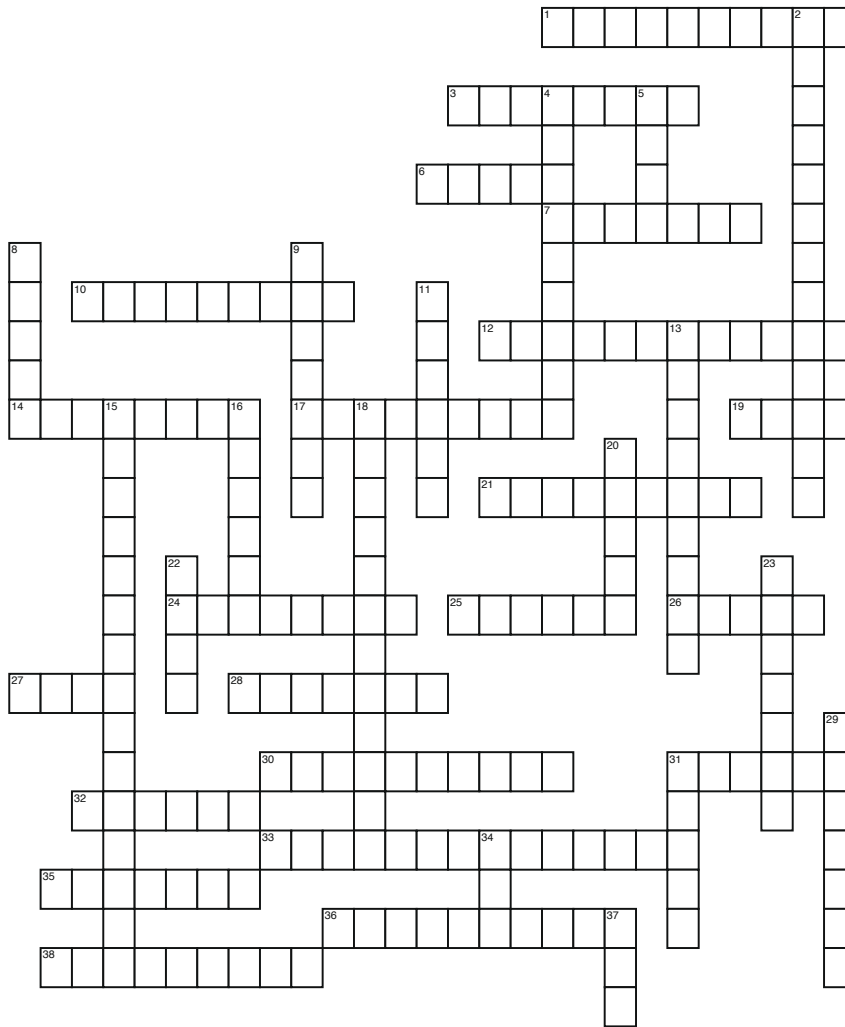
insulating phospholipid layer that surrounds the axons of many neurons.

- 33 A \_\_\_\_\_ potential is a spike of electrical discharge that travels along the membrane of a cell.
- 35 \_\_\_\_\_ matter is a major component of the central nervous system, consisting of nerve cell bodies, glial cells, capillaries, and short axons and dendrites.
- 36 A \_\_\_\_\_ action is an automatic (involuntary) neuromuscular action elicited by a defined stimulus.
- 37 The telencephalon is the name for the forebrain, a large region within the brain to which many functions are attributed, which many people refer to as the \_\_\_\_\_.
- 38 The \_\_\_\_\_ nervous system resides or extends outside the central nervous system serving the limbs and organs.
- 39 The \_\_\_\_\_ nervous system is a branch of the autonomic nervous system, always active at a basal level and becoming more active during times of stress.
- 40 \_\_\_\_\_ cells, commonly called neuroglia, are non-neuronal cells that provide support and nutrition, maintain homeostasis, form myelin, and participate in signal transmission in the nervous system.

## DOWN

- 2 \_\_\_\_\_s are electrically excitable cells in the nervous system that process and transmit information.

- 3 \_\_\_\_\_ feedback is a feedback system in which the system responds to the perturbation with activity in the same direction as the perturbation.
- 4 \_\_\_\_\_ neurons--otherwise known as sensory or receptor neurons--carry nerve impulses from receptors or sense organs toward the central nervous system.
- 5 The fight-or-\_\_\_\_\_ response states that animals react to threats with a general discharge of the sympathetic nervous system.
- 6 The \_\_\_\_\_ or encephalon is the control center of the central nervous system.
- 9 A \_\_\_\_\_ junction is the synapse or junction of the axon terminal of a motoneuron with the motor end plate.
- 10 \_\_\_\_\_s are chemicals that are used to relay, amplify and modulate signals between a neuron and another cell.
- 11 \_\_\_\_\_ is a decrease in the absolute value of a cell's membrane potential.
- 14 \_\_\_\_\_ nerves are nerves that emerge directly from the brain in contrast to spinal nerves which emerge from segments of the spinal cord.
- 17 The \_\_\_\_\_ nervous system is the part of the peripheral nervous system associated with the voluntary control of body movements and with reception of external stimuli.
- 18 \_\_\_\_\_ tissue is composed of neurons, which transmit impulses, and the neuroglia, which assist propagation of the nerve impulse as well as provide nutrients to the neuron.
- 19 \_\_\_\_\_ matter is composed of myelinated nerve cell processes, or axons, which connect various gray matter areas of the brain to each other.
- 20 In a kind of complementary opposition to the sympathetic nervous system, the \_\_\_\_\_ nervous system is the division of the autonomic nervous system that functions with actions that do not correspond to stress.
- 25 \_\_\_\_\_ channels are the most common type of ion channel within the physiology.
- 27 The \_\_\_\_\_ potential of a cell is the membrane potential that would be maintained if there were no action potentials, synaptic potentials, or other active changes in the membrane potential.
- 29 Nodes of \_\_\_\_\_, also known as neurofibril nodes, are regularly spaced gaps in the myelin sheath around an axon or nerve fiber.
- 31 \_\_\_\_\_s are the branched projections of a neuron that act to conduct the electrical stimulation received from other neural cells to the cell body of the neuron.
- 34 A \_\_\_\_\_ network refers to a network or circuitry of biological neurons.



## ACROSS

- 1 The \_\_\_\_\_ system, or balance system, is the sensory system that provides the dominant input about our movement and orientation in space.
- 3 A sensory \_\_\_\_\_ is a structure that recognizes a stimulus in the internal or external environment, and in response, initiates sensory transduction by creating graded potentials or action potentials in the same cell or in an adjacent one.
- 6 The \_\_\_\_\_ window is one of two openings along with the oval window that connect the inner ear to the middle ear.
- 7 \_\_\_\_\_s are small particles, composed of a combination of a gelatinous matrix and calcium carbonate in the viscous fluid of the sacculle and utricle.
- 10 \_\_\_\_\_ refers to the sense of smell.
- 12 The \_\_\_\_\_ canals are

- three half-circular, interconnected tubes located inside each ear that are the equivalent of three gyroscopes located in three orthogonal planes.
- 14 A \_\_\_\_\_ is a detectable change in the internal or external environment.
- 17 The \_\_\_\_\_ is a system of fluid passages in the inner ear, including both the cochlea which is part of the auditory system, and the vestibular system which provides the sense of balance.
- 19 The \_\_\_\_\_ consists of pigmented fibrovascular tissue known as a stroma, which connects a sphincter muscle to contract the pupil, and a set of dilatory muscles to open it.
- 21 The \_\_\_\_\_ system is the sensory system that uses taste buds on the upper surface of the tongue to provide information about the taste of food being eaten.
- 24 The \_\_\_\_\_ are the three smallest bones in the

- human body, contained within the middle ear and serving to transmit sounds to the fluid-filled cochlea.
- 25 The \_\_\_\_\_ ear is the portion of the ear internal to the eardrum, and external to the oval window of the cochlea.
- 26 The \_\_\_\_\_ ear is the bony labyrinth, a system of passages comprising two main functional parts: the cochlea and the vestibular apparatus.
- 27 \_\_\_\_\_ cells are the sensory receptors of both the auditory system and the vestibular system in all vertebrates.
- 28 The \_\_\_\_\_ is a hammer-shaped small bone or ossicle of the middle ear which connects with the incus and is attached to the inner surface of the eardrum.
- 30 The \_\_\_\_\_ tube is a tube that links the pharynx to the middle ear.
- 31 The \_\_\_\_\_ is the transparent front part of the eye that covers the iris,

- pupil, and anterior chamber, providing most of an eye's optical power.
- 32 The \_\_\_\_\_ is a thin layer of neural cells that lines the back of the eyeball.
- 33 A \_\_\_\_\_ is a sensory receptor that responds to temperature, primarily within the innocuous range.
- 35 A light-sensitive derivative of vitamin A, \_\_\_\_\_ is the fundamental chromophore involved in the transduction of light into visual signals.
- 36 A \_\_\_\_\_ is a sensory receptor that sends signals that cause the perception of pain in response to potentially damaging stimulus.
- 38 \_\_\_\_\_ is an extracellular fluid located within the scala tympani and scala vestibuli of the cochlea.

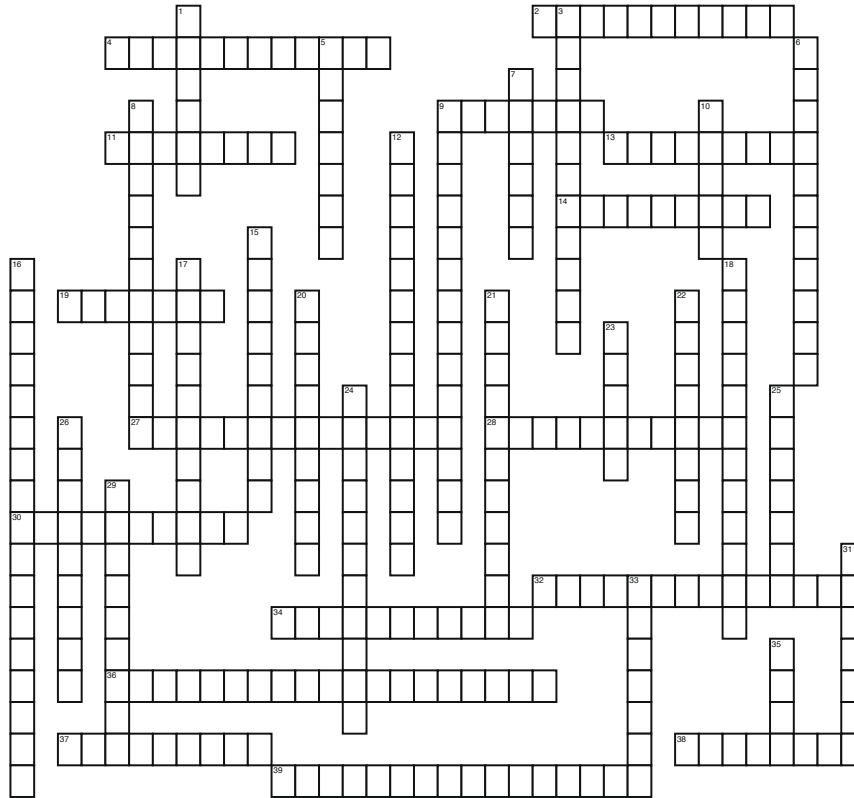
## DOWN

- 2 \_\_\_\_\_ is the process by which the eye increases

optical power to maintain a clear image of an object as it draws near the eye.

- 4 \_\_\_\_\_ is the fluid contained in the membranous labyrinth of the inner ear.
- 5 Also called the vestibular window, the \_\_\_\_\_ window is a membrane-covered opening which leads from the middle ear to the vestibule of the inner ear.
- 8 The \_\_\_\_\_ is the anvil-shaped small bone or ossicle in the middle ear.
- 9 The \_\_\_\_\_ is the auditory portion of the inner ear.
- 11 An olfactory receptor \_\_\_\_\_ is the primary transduction cell in the olfactory system.
- 13 \_\_\_\_\_, or visual purple, is a pigment consisting of an opsin protein and retinal cofactor that is responsible for both the formation of the photoreceptor cells and the perception of light.
- 15 A \_\_\_\_\_ is a sensory receptor that responds to mechanical pressure or distortion.
- 16 The \_\_\_\_\_ is the stirrup-shaped small bone or ossicle in the middle ear which attaches the incus to the fenestra ovalis.
- 18 \_\_\_\_\_s detect the pressure of blood flowing through them, and can send messages to the central nervous system to increase or decrease total peripheral resistance and cardiac output.
- 20 \_\_\_\_\_ or gustation is a form of direct chemoreception producing the ability to detect the flavor of substances such as food and poisons.
- 22 The ciliary \_\_\_\_\_ is the circumferential tissue inside the eye composed of the ciliary muscle and ciliary processes.
- 23 \_\_\_\_\_ (or audition) refers to the ability to detect sound.
- 29 The tympanic membrane, colloquially known as the \_\_\_\_\_, is a thin membrane that separates the external ear from the middle ear.
- 31 The organ of \_\_\_\_\_, or spiral organ, is the organ in the inner ear of mammals that contains auditory sensory cells, or hair cells.
- 34 \_\_\_\_\_s are organs of vision that detect light.
- 37 \_\_\_\_\_ cells are photoreceptor cells in the retina of the eye that can function in less intense light than cone cells can.

## Endocrine System



## ACROSS

- 2 The \_\_\_\_\_ glands are small endocrine glands in the neck, usually located behind the thyroid gland.
- 4 Located just below the thalamus, the \_\_\_\_\_ links the nervous system to the endocrine system via the pituitary gland.
- 9 One of the largest endocrine glands in the body, the \_\_\_\_\_ controls how quickly the body burns energy, makes proteins, and how sensitive the body should be to other hormones.
- 11 Under the influence of the hypothalamus, the \_\_\_\_\_ pituitary produces and secretes several peptide hormones which regulate many physiological processes including stress, growth, and reproduction.
- 13 A secondary \_\_\_\_\_ system is a method of cellular signalling where the signalling molecule does not enter the cell, but rather utilizes a cascade of events that transduces the signal into a cellular change.
- 14 The \_\_\_\_\_ system is an integrated system of small organs which involve the release of extracellular signaling molecules known as hormones.
- 19 The \_\_\_\_\_ glands are triangle-shaped endocrine glands that sit on top of the

kidneys which regulate the stress response through the synthesis of corticosteroids and catecholamines.

- 27 Epinephrine and \_\_\_\_\_ are a fight or flight hormones released from the adrenal glands, and they are also neurotransmitters within the central and sympathetic nervous systems.
- 28 \_\_\_\_\_ hormone is secreted by the parathyroid glands, acting to increase the concentration of calcium in the blood, opposite the effect of the thyroid hormone calcitonin.
- 30 \_\_\_\_\_ is a polypeptide hormone produced by the parafollicular cells of the thyroid which participates in calcium and phosphorus metabolism, lowering blood calcium, countering the effects of parathyroid hormone.
- 32 \_\_\_\_\_, also called hematopoietin, is a glycoprotein hormone that acts as a cytokine for erythrocyte precursors in the bone marrow.
- 34 \_\_\_\_\_ is a steroid hormone produced by the outer-section of the adrenal cortex in the adrenal gland which regulates sodium and potassium balance in the blood.
- 36 \_\_\_\_\_ hormone or corticotropin is a polypeptide hormone produced and secreted by

the pituitary gland. It is an important player in the hypothalamic-pituitary-adrenal axis.

- 37 \_\_\_\_\_, often abbreviated as T4, is the major hormone secreted by the follicular cells of the thyroid gland.
- 38 \_\_\_\_\_ is released by the pancreas when the glucose level in the blood is low, causing the liver to convert stored glycogen into glucose and release it into the bloodstream.
- 39 \_\_\_\_\_ (T3) is a thyroid hormone similar to thyroxine but with one less iodine atom per molecule. T3 exhibits greater activity than thyroxine but is produced in smaller quantity.

## DOWN

- 1 The adrenal \_\_\_\_\_, situated along the perimeter of the adrenal gland, mediates the stress response through the production of mineralocorticoids and glucocorticoids.
- 3 \_\_\_\_\_ is an oligopeptide in the blood that causes vasoconstriction, increased blood pressure, and release of aldosterone from the adrenal cortex.
- 5 The adrenal \_\_\_\_\_ is the part of the adrenal gland located in the center of the gland, being surrounded by

the adrenal cortex.

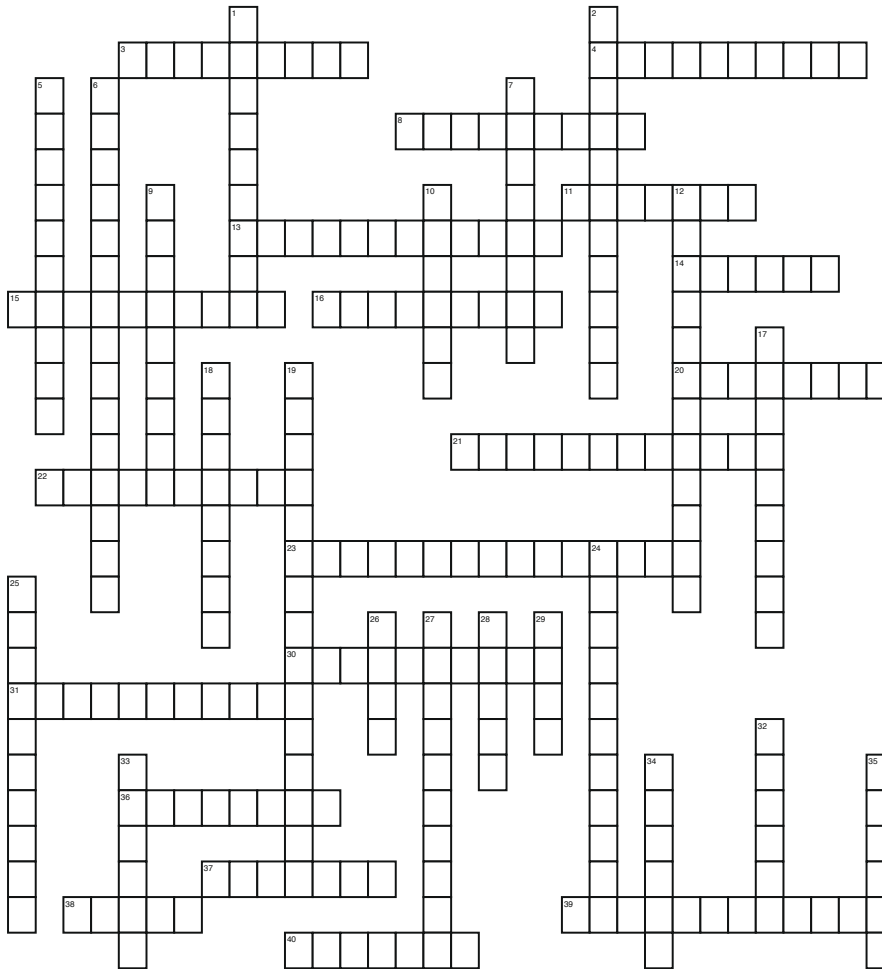
- 6 Atrial \_\_\_\_\_ peptide is a polypeptide hormone involved in the homeostatic control of body water, sodium, and adiposity.
- 7 \_\_\_\_\_ hormone or somatotropin is a protein hormone which stimulates growth and cell reproduction.
- 8 \_\_\_\_\_ is an oligopeptide in the blood that causes vasoconstriction, increased blood pressure, and release of aldosterone from the adrenal cortex.
- 9 \_\_\_\_\_ is a glycoprotein hormone produced mainly by the liver and the kidney that regulates the production of platelets by the bone marrow.
- 10 \_\_\_\_\_ is released by the juxtaglomerular apparatus of the kidneys in response to low blood volume or decreased serum NaCl concentration.
- 12 \_\_\_\_\_s are a class of steroid hormones characterised by an ability to bind with cortisol receptors and trigger events which increase and maintain normal concentrations of glucose in blood.
- 15 \_\_\_\_\_ glands are glands that secrete their product directly into the blood rather than through a duct.
- 16 \_\_\_\_\_s are a class of steroid hormones that

include aldosterone which influence salt and water balance.

- 17 The endocrine cells of the pancreas are grouped in the islets of \_\_\_\_\_.
- 18 Signal \_\_\_\_\_ refers to any process by which a cell converts one kind of signal or stimulus into another.
- 20 The \_\_\_\_\_ pituitary gland and is part of the endocrine system, secreting the hormones oxytocin and vasopressin, which are produced in the hypothalamus.
- 21 Arginine \_\_\_\_\_, also known as antidiuretic hormone, plays a major role in regulating the body's retention of water, being released when the body is dehydrated.
- 22 \_\_\_\_\_ is a hormone that also acts as a neurotransmitter in the brain. In females, it is released in large amounts during labor and it is also released during breastfeeding. It is released in both sexes during orgasm.
- 23 \_\_\_\_\_ cells are endocrine cells in the islets of Langerhans of the pancreas which are responsible for synthesizing and secreting the peptide hormone glucagon.
- 24 \_\_\_\_\_-releasing hormone is a tripeptide hormone that stimulates the release of thyroid-stimulating hormone and prolactin by the anterior pituitary.
- 25 A \_\_\_\_\_ is a chemical messenger that carries a signal from one cell, or group of cells, to another.
- 26 \_\_\_\_\_ is a peptide hormone on the anterior pituitary gland primarily associated with lactation.
- 29 The \_\_\_\_\_ gland, or hypophysis, is an endocrine gland about the size of a pea that sits in a small, bony cavity covered by a dural fold at the base of the brain.
- 31 \_\_\_\_\_ is an animal hormone which causes liver and muscle cells to take in glucose and store it in the form of glycogen and causes fat cells to take in blood lipids and turn them into triglycerides.
- 33 Peptide \_\_\_\_\_s are a class of peptides that are secreted into the blood stream and have endocrine functions in living animals.
- 35 \_\_\_\_\_ cells are a type of cell in the pancreas in areas called the islets of Langerhans which make and release insulin.

# Musculoskeletal System

Answer key - pg 122



## ACROSS

- 3 \_\_\_\_\_s are cylindrical organelles, found within muscle cells, which are bundles of actomyosin filaments that run from one end of the cell to the other, attached to the cell surface membrane at each end.
- 4 A \_\_\_\_\_ is a mononucleate cell that is responsible for bone formation.
- 8 The a star-shaped \_\_\_\_\_ is the most abundant cell found in bone, derived from osteoblasts after they become trapped within the matrix they secrete.
- 11 \_\_\_\_\_ muscle is a type of involuntary striated muscle found within the heart.
- 13 The \_\_\_\_\_ reticulum is a special type of smooth endoplasmic reticulum found in smooth and striated muscle.

- 14 A transverse or T-\_\_\_\_\_ is a deep invagination of the plasma membrane found in skeletal and cardiac muscle cells which allows depolarization of the membrane to quickly penetrate to the interior of the cell.
- 15 A \_\_\_\_\_ is a type of bone cell that removes bone tissue by removing the bone's mineralized matrix.
- 16 \_\_\_\_\_ canals are a series of tubes around narrow channels formed by lamellae in compact bone.
- 20 \_\_\_\_\_ is nitrogenous organic acid which naturally occurs in vertebrates and helps to supply energy to muscle and nerve cells.
- 21 A \_\_\_\_\_ is a cell originating from a mesenchymal stem cell which forms chondrocytes or cartilage cells.
- 22 Also known as

- trabecular, or spongy bone, \_\_\_\_\_ bone fills the inner cavity of long bones. It has low density and strength, but very high surface area.
- 23 The inorganic mineral \_\_\_\_\_ makes up seventy percent of bone.
- 30 Bone \_\_\_\_\_ is the process by which osteoclasts break down bone and release the minerals, resulting in a transfer of calcium from bone fluid to the blood.
- 31 \_\_\_\_\_s are the only cells found in cartilage.
- 36 A \_\_\_\_\_ muscle doesn't need to receive impulses from a nerve to make it contract.
- 37 \_\_\_\_\_ tissue forms the rigid part of the bone organs that make up the skeletal system.
- 38 \_\_\_\_\_ is the monomeric subunit of microfilaments, one of the three major components of the

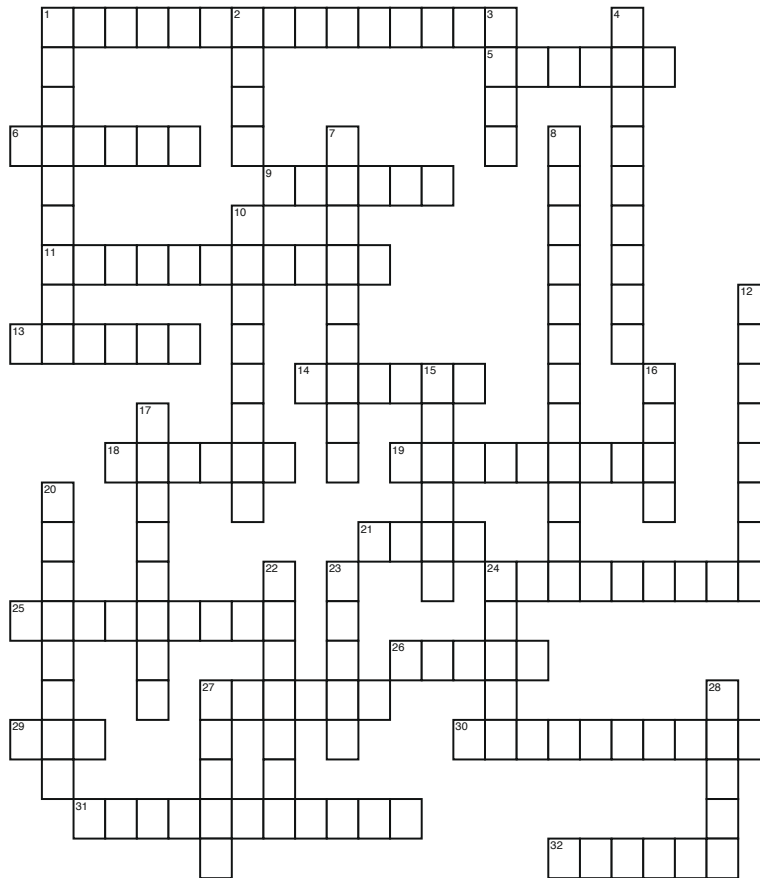
- cytoskeleton, and of thin filaments which are part of the contractile apparatus in muscle cells.
- 39 \_\_\_\_\_ ossification is the type of bone formation responsible for much of the bone growth in vertebrate skeletons, especially in long bones.
- 40 The muscle \_\_\_\_\_'s functions are to send proprioceptive information about the muscle to the central nervous system and to respond to muscle stretching.

## DOWN

- 1 The \_\_\_\_\_ is the main or mid section shaft of a long bone.
- 2 A muscle \_\_\_\_\_ occurs when a muscle fiber generates tension through the action of actin and myosin cross-bridge cycling.
- 5 a \_\_\_\_\_ is a sheath of connective tissue which groups

- individual muscle fibers into bundles or fascicles.
- 6 \_\_\_\_\_ ossification is the type of bone formation responsible for the development of flat bones, especially those found in the skull and clavicles.
- 7 Also known as compact bone, \_\_\_\_\_ bone is dense and forms the surface of bones.
- 9 A \_\_\_\_\_ is the basic unit of a muscle's cross-striated myofibril.
- 10 Bone \_\_\_\_\_ is the soft tissue found in the hollow interior of bones.
- 12 A \_\_\_\_\_ disc is an undulating double membrane separating adjacent cells in cardiac muscle fibers.
- 17 \_\_\_\_\_ is a type of dense connective tissue composed of collagen fibers and/or elastin fibers which can supply smooth surfaces for the movement of

- articulating bones.
- 18 \_\_\_\_\_ muscle is a type of striated muscle, usually attached to the skeleton.
- 19 \_\_\_\_\_ is a phosphorylated creatine molecule that is an important energy store in skeletal muscle.
- 24 As part of the regulation of muscle contraction, in resting muscle fibres, the protein \_\_\_\_\_ is displaced from its normal binding groove by troponin.
- 25 The \_\_\_\_\_ is the cell membrane of a muscle cell.
- 26 \_\_\_\_\_s are rigid organs that form part of the endoskeleton of vertebrates, functioning to move, support, and protect the various organs of the body, produce red and white blood cells and store minerals.
- 27 The \_\_\_\_\_ plate, or growth plate, is the cartilage plate in the long bones of children and adolescents.
- 28 A muscle \_\_\_\_\_ is a single cell of a muscle.
- 29 A motor \_\_\_\_\_ is a single alpha-motor neuron and all of the corresponding muscle fibers it innervates.
- 32 \_\_\_\_\_s are a large family of motor proteins found in eukaryotic tissues which are responsible for actin-based motility.
- 33 \_\_\_\_\_ muscle is a type of non-striated muscle, found within the bladder, abdominal cavity, the uterus, male and female reproductive tracts, the gastrointestinal tract and elsewhere.
- 34 A \_\_\_\_\_ or sinew is a tough band of fibrous connective tissue that connects muscle to bone and is built to withstand tension.
- 35 \_\_\_\_\_ is contractile tissue of the body and is derived from the mesodermal layer of embryonic germ cells.

**ACROSS**

- 1 A \_\_\_\_\_, also vasopressor or simply pressor, is any substance that acts to cause vasoconstriction and usually results in an increase of the blood pressure.
- 5 The right \_\_\_\_\_ is one of four chambers in the human heart, receiving de-oxygenated blood from the superior and inferior vena cavae and the coronary sinus and pumping it into the right ventricle through the tricuspid valve.
- 6 The left \_\_\_\_\_ is one of the four chambers in the human heart, receiving oxygenated blood from the pulmonary veins and pumping it into the left ventricle.
- 9 The hepatic \_\_\_\_\_ vein drains blood from the digestive system and its associated glands.
- 11 \_\_\_\_\_ are the smallest of a body's blood vessels, connecting arterioles to venules
- 13 Blood \_\_\_\_\_s are part of the cardiovascular system and function to transport blood throughout the body, the most important types

being arteries and veins.

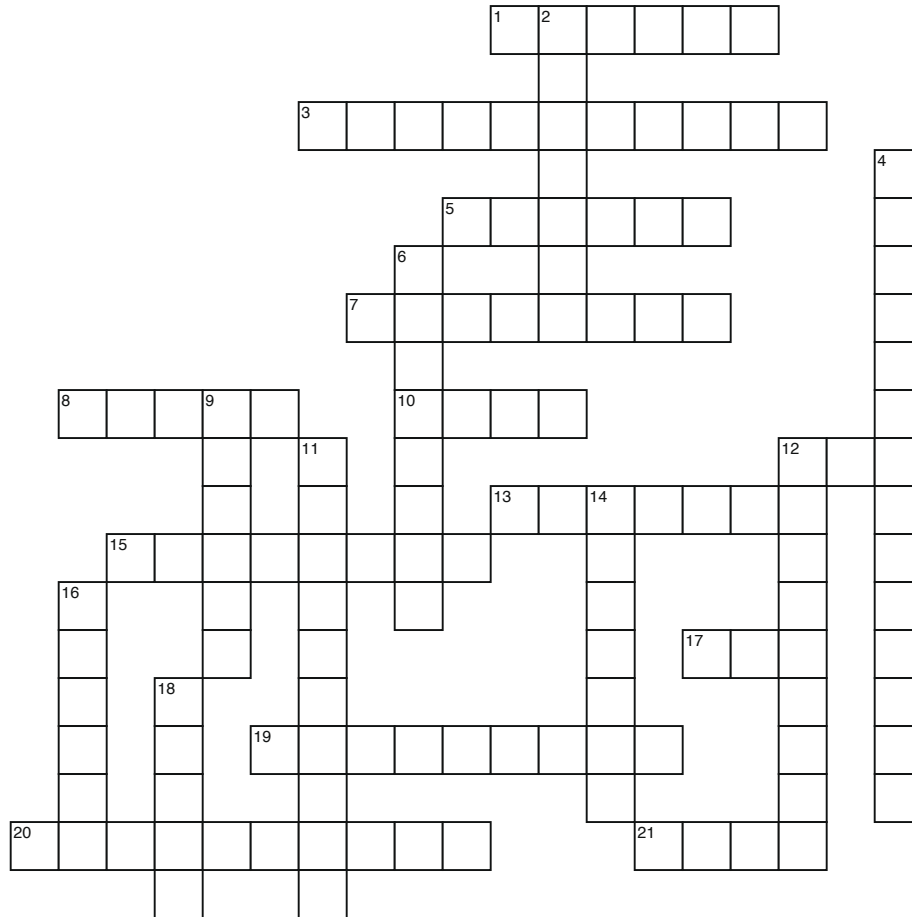
- 14 A \_\_\_\_\_ venous system occurs when a capillary bed drains into another capillary bed through veins.
- 18 The \_\_\_\_\_ valve, also known as the bicuspid valve, is a dual flap valve in the heart that lies between the left atrium and the left ventricle.
- 19 The \_\_\_\_\_ valve is on the right side of the heart, between the right atrium and the right ventricle.
- 21 A \_\_\_\_\_ is a blood vessel that carries blood toward the heart.
- 24 The left \_\_\_\_\_ is one of four chambers in the human heart, receiving oxygenated blood from the left atrium via the mitral valve and pumping it into the aorta via the aortic valve.
- 25 The \_\_\_\_\_ veins carry oxygen-rich blood from the lungs to the left atrium of the heart.
- 26 Cardiac \_\_\_\_\_ is the term referring to all or any of the events related to the flow of blood that occur from the beginning of one heartbeat to the beginning of the next.
- 27 A \_\_\_\_\_ is a muscular blood vessel that carries blood away from the heart.
- 29 The bundle of \_\_\_\_\_ is a collection of heart muscle cells specialized for electrical conduction that transmits the electrical impulses from the AV node to the point of the apex of the fascicular branches.
- 30 \_\_\_\_\_ arteries are the arteries which are furthest from the heart.
- 31 The \_\_\_\_\_ is the thin layer of cells that line the interior surface of blood vessels.
- 32 A \_\_\_\_\_ is a small blood vessel that allows deoxygenated blood to return from the capillary beds to the larger blood vessels called veins.

**DOWN**

- 1 The right \_\_\_\_\_ is one of four chambers in the human heart, receiving de-oxygenated blood from the right atrium via the tricuspid valve and pumping it into the pulmonary artery via the pulmonary valve.
- 2 The sinoatrial \_\_\_\_\_ is the impulse generating pacemaker tissue located in the right atrium of the heart,

and thus the generator of sinus rhythm.

- 3 Heart \_\_\_\_\_ is a term used to describe the frequency of the cardiac cycle.
- 4 The \_\_\_\_\_ arteries carry blood from the heart to the lungs.
- 7 A \_\_\_\_\_ is a small diameter blood vessel that extends and branches out from an artery and leads to capillaries.
- 8 \_\_\_\_\_ is a medical condition in which the blood pressure is chronically elevated.
- 10 \_\_\_\_\_ resistance is a term used to define the resistance to flow that must be overcome to push blood through the circulatory system.
- 12 \_\_\_\_\_ fibers are specialized myocardial fibers located in the inner ventricular walls of the heart that conduct an electrical stimulus or impulse that enables the heart to contract in a coordinated fashion.
- 15 The \_\_\_\_\_ valve is one of the valves of the heart. It lies between the left ventricle and the aorta.
- 16 The atrioventricular \_\_\_\_\_ is an area of specialized tissue between the atria and the ventricles of the heart, which conducts the normal electrical impulse from the atria to the ventricles.
- 17 \_\_\_\_\_ is the period of time when the heart relaxes after contraction.
- 20 A \_\_\_\_\_ is a small blood vessel similar to a capillary but with a discontinuous endothelium.
- 22 \_\_\_\_\_ is the contraction of heart chambers, driving blood out of the chambers.
- 23 The \_\_\_\_\_ is a muscular organ responsible for pumping blood through the blood vessels by repeated, rhythmic contractions.
- 24 The heart \_\_\_\_\_s maintain the unidirectional flow of blood by opening and closing depending on the difference in pressure on each side.
- 27 The \_\_\_\_\_ is the largest artery in the human body.
- 28 The superior and inferior vena \_\_\_\_\_ are the veins that return de-oxygenated blood from the body into the heart, emptying into the right atrium.



## ACROSS

- 1 The \_\_\_\_\_ blood group system refers to the five main Rh antigens (C, c, D, E and e) as well as the many other less frequent Rh antigens.
- 3 \_\_\_\_\_ is a complex process by which blood forms solid clots.
- 5 Blood \_\_\_\_\_ is the liquid component of blood, in which the blood cells are suspended.
- 7 \_\_\_\_\_s or thrombocytes are the cell fragments circulating in the blood involved in the cellular mechanisms of primary hemostasis leading to the formation of blood clots.
- 8 Chloride \_\_\_\_\_ is a process which occurs in a cardiovascular system and refers to the exchange of bicarbonate and chloride across the membrane of red blood cells.
- 10 The \_\_\_\_\_ effect states that in the presence of carbon dioxide, the oxygen affinity of respiratory pigments such as hemoglobin decreases.
- 12 The \_\_\_\_\_ blood group system is the most important blood type system (or blood group system) in human blood transfusion.
- 13 \_\_\_\_\_ is an important enzyme present in blood that degrades many blood plasma proteins, most notably

fibrin clots.

- 15 \_\_\_\_\_ is a serine protease that converts soluble fibrinogen into insoluble strands of fibrin, as well as catalyzing many other coagulation-related reactions.
- 17 \_\_\_\_\_ blood cells are the most common type of blood cell and the body's principal means of delivering oxygen from the lungs to body tissues via the blood.
- 19 A \_\_\_\_\_ is a heterocyclic macrocycle derived from four pyrrole-like subunits interconnected via their alpha carbon atoms.
- 20 \_\_\_\_\_ is the name of a family of hereditary genetic illnesses that impair the body's ability to control coagulation.
- 21 A \_\_\_\_\_ is a prosthetic group that consists of an iron atom contained in the center of a large heterocyclic organic ring called a porphyrin.

## DOWN

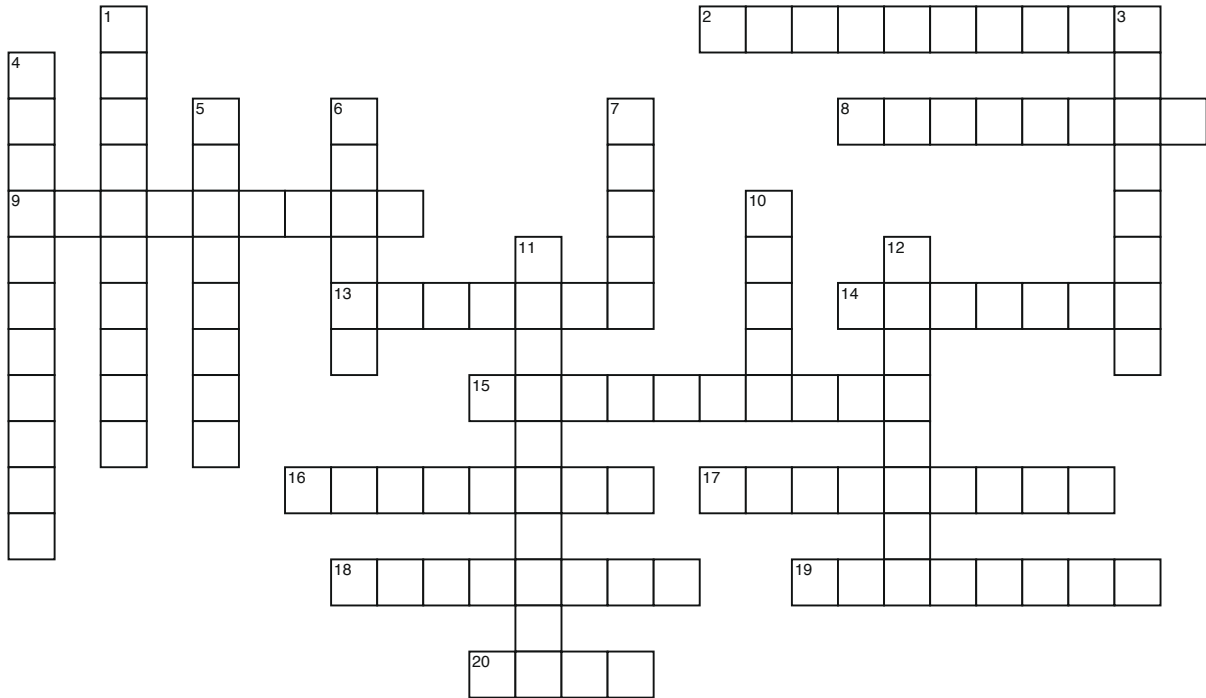
- 2 The \_\_\_\_\_ effect is a property of hemoglobin that leads to deoxygenated blood's increased ability to carry carbon dioxide.
- 4 \_\_\_\_\_ is the process by which red blood cells are produced.
- 6 \_\_\_\_\_ is one of the two types of

serum proteins, the other being albumin. This term encompasses a heterogeneous series of families of proteins.

- 9 \_\_\_\_\_ is a protein involved in the clotting of blood which is polymerised to form a mesh that forms a hemostatic plug or clot over a wound site.
- 11 \_\_\_\_\_ is the iron-containing oxygen-transport metalloprotein in red blood cells.
- 12 Carbonic \_\_\_\_\_ is a family of metalloenzymes that catalyze the rapid conversion of carbon dioxide to bicarbonate and protons.
- 14 Human serum \_\_\_\_\_ is the most abundant protein in human blood plasma.
- 16 \_\_\_\_\_-cell disease is a group of genetic disorders caused by an abnormal form of hemoglobin.
- 18 \_\_\_\_\_ is a specialized biological fluid consisting of erythrocytes, leukocytes, and thrombocytes suspended in a complex fluid medium known as plasma.



## Respiratory System

**ACROSS**

- 2 Pulmonary \_\_\_\_\_ is a surface-active lipoprotein complex formed by type II alveolar cells which reduces surface tension in the air water interface within alveoli.
- 8 The \_\_\_\_\_ bronchi arise from the secondary bronchi.
- 9 \_\_\_\_\_ circulation is the portion of the cardiovascular system which carries oxygen-depleted blood away from the heart, to the lungs, and returns oxygenated blood back to the heart.
- 13 A \_\_\_\_\_ is one of the two channels of the nose, from the point where they bifurcate to the external opening.
- 14 The \_\_\_\_\_, or windpipe, is a tube that extends from the larynx to the primary bronchi.
- 15 \_\_\_\_\_, also known as inspiration, is the movement of air from the external environment, through the airways, into the alveoli during breathing.
- 16 The left main \_\_\_\_\_ is smaller in caliber but longer than the right, entering the root

of the left lung opposite the sixth thoracic vertebra.

- 17 The \_\_\_\_\_ is a sheet of muscle extending across the bottom of the ribcage which separates the thoracic cavity from the abdominal cavity and performs an important function in respiration.
- 18 \_\_\_\_\_ ducts are the tiny end tubules of the branching airways that fill the lungs.
- 19 Functional \_\_\_\_\_ capacity is the volume of air present in the lungs at the end of passive expiration.
- 20 \_\_\_\_\_ space is air that is inhaled by the body in breathing, but does not partake in gas exchange.

**DOWN**

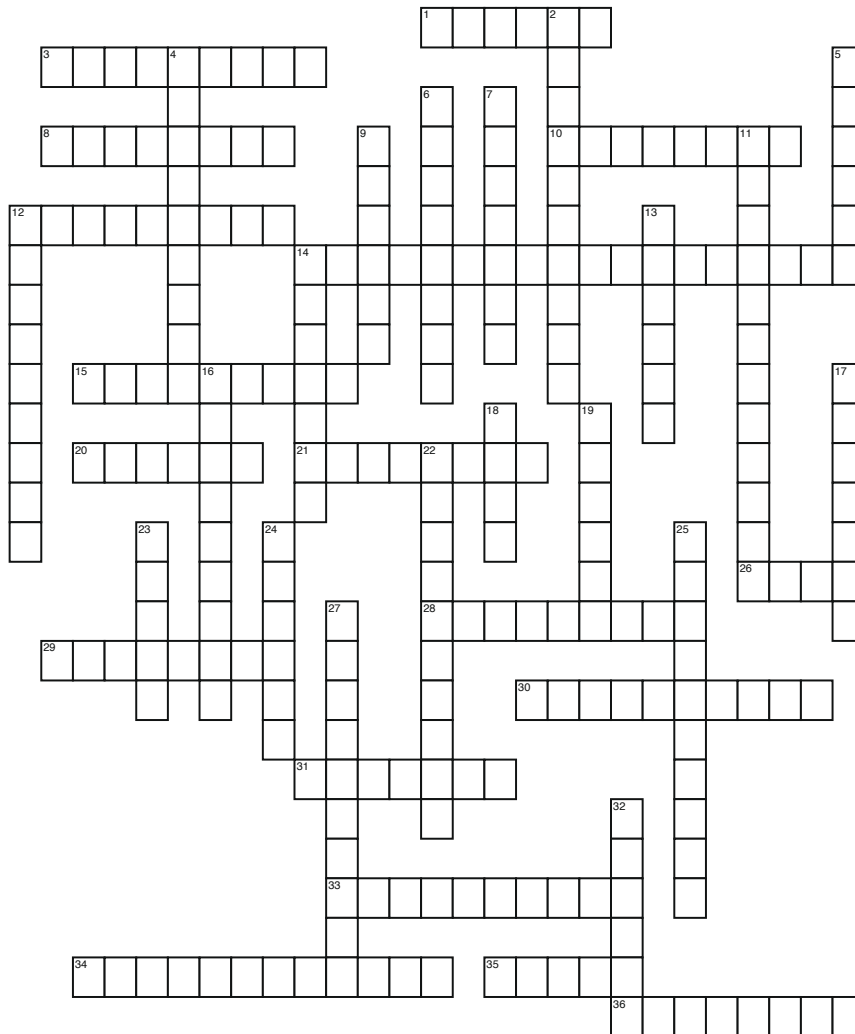
- 1 \_\_\_\_\_, or expiration, is the movement of air out of the bronchial tubes, through the airways, to the external environment during breathing.
- 3 A \_\_\_\_\_ bronchiole is a bronchiole at the end of the conducting zone.
- 4 The \_\_\_\_\_ system consists of the airways, the lungs, and

the muscles that mediate the movement of air into and out of the body.

- 5 A \_\_\_\_\_ is a caliber of airway in the respiratory tract that conducts air into the lungs.
- 6 The \_\_\_\_\_, colloquially known as the voicebox, is an organ in the neck of mammals involved in protection of the trachea and sound production.
- 7 \_\_\_\_\_ capacity is the maximum volume of air that a person can exhale after maximum inhalation.
- 10 In humans the respiratory \_\_\_\_\_ is the part of the anatomy that has to do with the process of respiration.
- 11 The primary \_\_\_\_\_s arise from the tertiary bronchi.
- 12 The right main \_\_\_\_\_ is wider, shorter, and more vertical in direction than the left, entering the right lung nearly opposite the fifth thoracic vertebra.



# Immunity



## ACROSS

- 1 The \_\_\_\_\_ system is a collection of mechanisms within the body that protects against disease by identifying and killing pathogens and tumor cells.
- 3 \_\_\_\_\_ is a biogenic amine involved in local immune responses as well as regulating physiological function in the gut and acting as a neurotransmitter.
- 8 The \_\_\_\_\_ immune response provides the vertebrate immune system with the ability to recognize and remember specific pathogens.
- 10 The \_\_\_\_\_ duct is the largest lymphatic vessel in the body, collecting most of the lymph in the body and draining into the systemic circulation at the left subclavian vein
- 12 A \_\_\_\_\_ is a cell that ingests and destroys foreign matter such as microorganisms or debris.
- 14 The major \_\_\_\_\_ complex (MHC) is a large gene family found in most vertebrates, the most gene-dense region of the mammalian genome, which plays an important role in the immune system, autoimmunity, and reproductive success.
- 15 A \_\_\_\_\_ is the detrimental

colonization of a host organism by a foreign species.

- 20 The \_\_\_\_\_ immune system comprises the cells and mechanisms that defend the host from infection by other organisms, in a non-specific manner.
- 21 A \_\_\_\_\_ is a nonparasitic antigen capable of stimulating a type I hypersensitivity reaction in atopic individuals.
- 26 Lymph \_\_\_\_\_s are components of the lymphatic system that contain white blood cells and act as filters or traps for foreign particles.
- 28 The \_\_\_\_\_ system is a complex network of lymphoid organs, lymph nodes, lymph ducts, tissues, lymph capillaries and lymph vessels that produce and transport lymph fluid from tissues to the circulatory system.
- 29 \_\_\_\_\_s are a family of small, signaling proteins and glycoproteins particularly important in both innate and adaptive immune responses.
- 30 \_\_\_\_\_ or immunoglobulins are proteins used by the immune system to identify and neutralize foreign objects, such as bacteria and viruses.
- 31 \_\_\_\_\_ is an abnormal reaction to a substance foreign to the body that is acquired, predictable and

rapid.

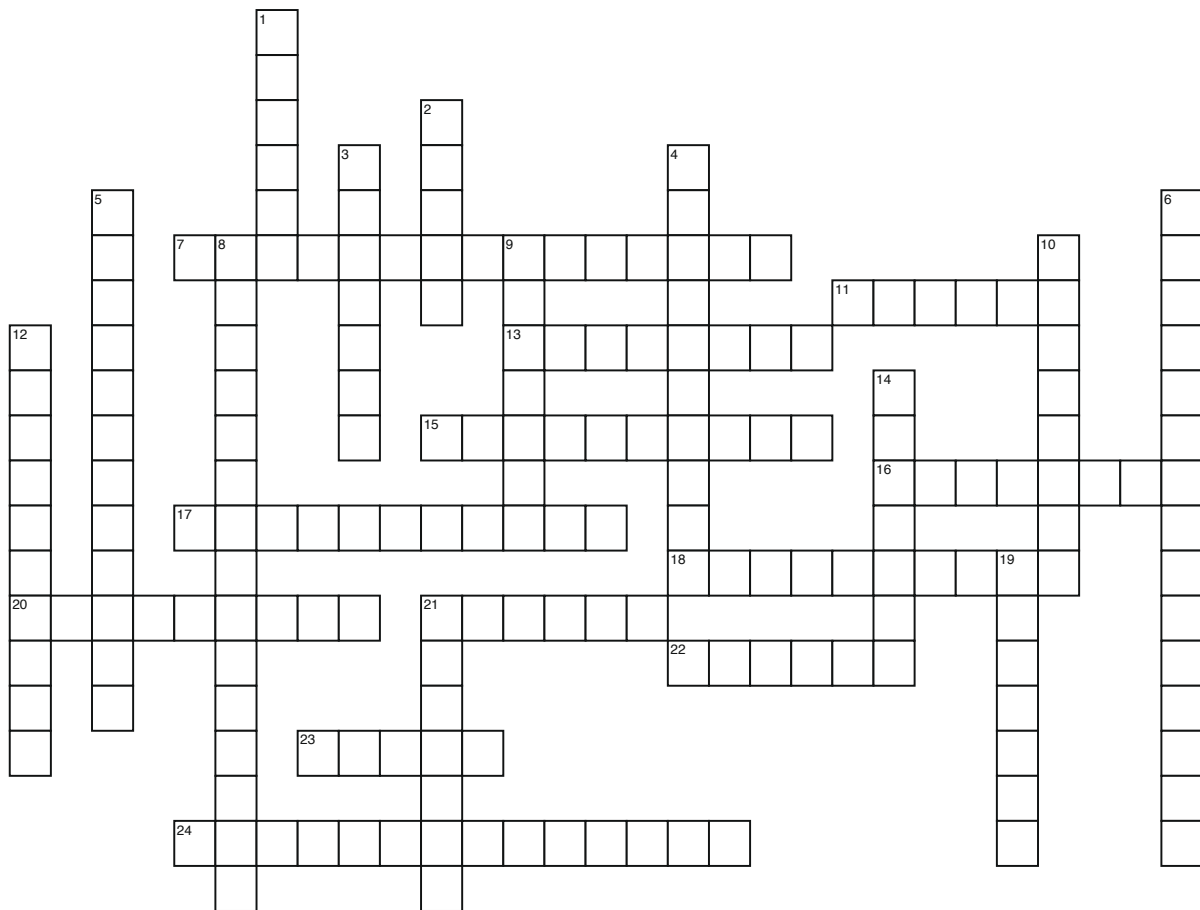
- 33 \_\_\_\_\_ granulocytes are white blood cells of the immune system that are responsible for combating infection by parasites in vertebrates
- 34 Antigen \_\_\_\_\_ is a process in the body's immune system by which macrophages, dendritic cells and other cell types capture antigens and then show them for recognition by T-cells.
- 35 \_\_\_\_\_ blood cells or leukocytes are cells of the immune system which defend the body against both infectious disease and foreign materials.
- 36 The T cell \_\_\_\_\_ is a molecule found on the surface of T lymphocytes that is generally responsible for recognizing antigens bound to major histocompatibility complex molecules.

## DOWN

- 2 \_\_\_\_\_s are the most abundant type of white blood cells, phagocytes that quickly congregate at a focus of infection, attracted by cytokines expressed by activated endothelium, mast cells and macrophages.
- 4 \_\_\_\_\_ signalling is a form of hormonal signalling in which a cell

## Answer key - pg 125

- secretes a hormone, or chemical messenger, that binds to receptors on the same cell.
- 5 \_\_\_\_\_ B cells are a B cell subtype that are formed following primary infection. They remember the same pathogen for faster antibody production in future infections
- 6 A \_\_\_\_\_ or infectious agent is a biological agent that causes disease or illness to its host.
- 7 A \_\_\_\_\_ is the part of a macromolecule that is recognized by the immune system, specifically by antibodies, B cells, or T cells.
- 9 Lymph \_\_\_\_\_s are thin walled, valved structures that carry lymph.
- 11 \_\_\_\_\_ is the complex biological response of vascular tissues to harmful stimuli, such as pathogens, damaged cells, or irritants.
- 12 \_\_\_\_\_ signaling is a form of cell signaling in which the target cell is close to the signal releasing cell.
- 13 Natural \_\_\_\_\_ cells are a form of cytotoxic lymphocyte which constitute a major component of the innate immune system.
- 14 The \_\_\_\_\_ immune response is the aspect of immunity that is mediated by antibodies, produced by the cells of the B lymphocyte lineage.
- 16 A \_\_\_\_\_ T cell belongs to a subgroup of T lymphocytes which are capable of inducing the death of infected somatic or tumor cells.
- 17 A \_\_\_\_\_ or immunogen is a molecule that stimulates an immune response.
- 18 Not involving antibodies, \_\_\_\_\_ mediated immunity is an immune response involving the activation of macrophages, natural killer cells, cytotoxic T-lymphocytes, and the release of various cytokines in response to an antigen.
- 19 \_\_\_\_\_ cells are cells of the immune system that secrete large amounts of antibodies.
- 22 \_\_\_\_\_ T cells, sometimes known as suppressor T cells, act to suppress activation of the immune system and thereby maintain immune system homeostasis and tolerance to self-antigens.
- 23 A \_\_\_\_\_ is an abnormal growth or mass of tissue.
- 24 The \_\_\_\_\_ is an organ located in the abdomen of the human body, where it carries out immune functions as well as functions concerned with the destruction of old red blood cells.
- 25 Monocytes and \_\_\_\_\_s are phagocytes, acting in both innate immunity as well as cell-mediated immunity of vertebrate animals.
- 27 The \_\_\_\_\_ system is a biochemical cascade which helps clear pathogens from an organism consisting of a number of small proteins found in the blood, normally circulating as inactive zymogens.
- 32 With no cytotoxic or phagocytic activity, T \_\_\_\_\_ cells are a sub-group of lymphocytes playing an important role in establishing and maximizing the capabilities of the immune system.

**ACROSS**

- 7 The \_\_\_\_\_ apparatus is a microscopic structure in the kidney which regulates the function of each nephron.
- 11 The \_\_\_\_\_s are organs that filter wastes, such as urea, from the blood and excrete them, along with water, as urine.
- 13 \_\_\_\_\_ is increased production of urine by the kidney.
- 15 The glomerular \_\_\_\_\_ rate is the volume of fluid filtered from the renal glomerular capillaries into the Bowman's capsule per unit time.
- 16 The \_\_\_\_\_ tubule is the portion of the duct system of the nephron leading from Bowman's capsule to the loop of Henle.
- 17 The \_\_\_\_\_ buffering system is the most important buffer solution for maintaining a relatively constant pH in the plasma.
- 18 A \_\_\_\_\_ is a capillary tuft surrounded by Bowman's capsule in nephrons of the vertebrate kidney which

receives its blood supply from an afferent arteriole of the renal circulation.

- 20 \_\_\_\_\_, known by physiologists as micturition or voiding, is the process of disposing urine from the urinary bladder through the urethra.
- 21 The \_\_\_\_\_s are the ducts that carry urine from the kidneys to the urinary bladder.
- 22 \_\_\_\_\_'s capsule is a cup like sac at the beginning of the tubular component of a nephron in the kidney. A glomerulus is enclosed in the sac.
- 23 \_\_\_\_\_ is a liquid produced through the kidney, and is collected in the bladder and excreted through the urethra.
- 24 \_\_\_\_\_ exchange is a mechanism used to transfer some property of a fluid to another across a semipermeable membrane.

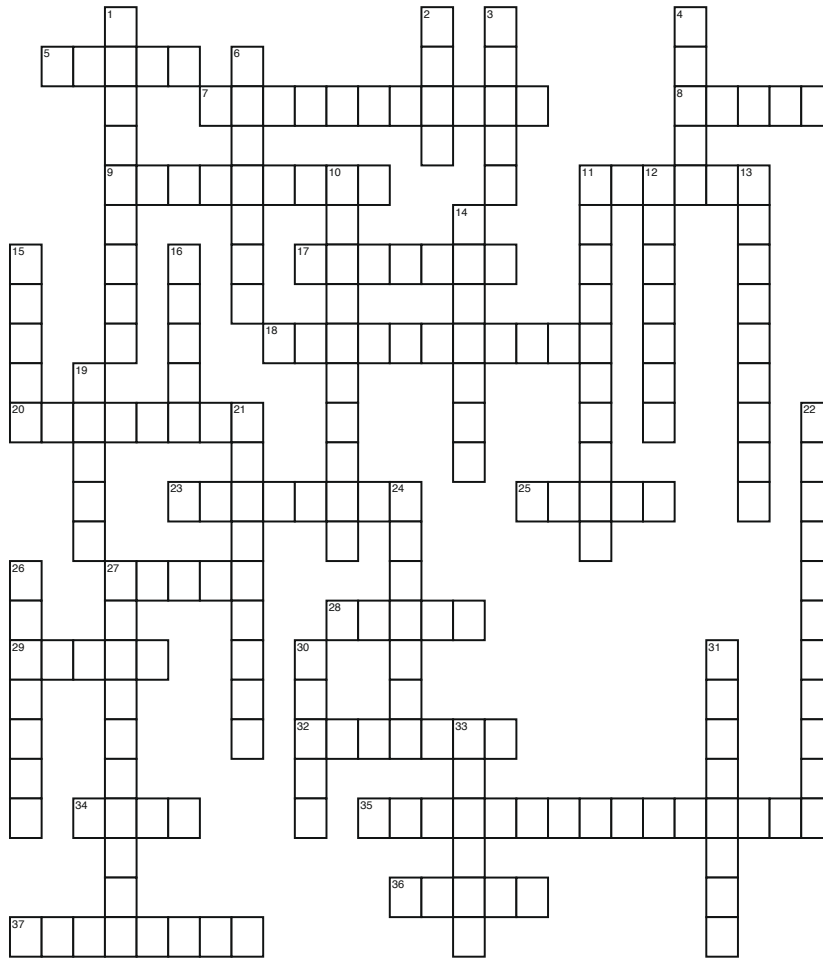
**DOWN**

- 1 The renal \_\_\_\_\_ is the outer portion of the kidney

between the renal capsule and the renal medulla.

- 2 In the kidney, the loop of \_\_\_\_\_ is the portion of the nephron that leads from the proximal convoluted tubule to the distal convoluted tubule. The main function of this structure is to reabsorb water and ions from the urine.
- 3 The urinary \_\_\_\_\_ is a hollow, muscular, and distensible organ that collects urine excreted by the kidneys prior to disposal by urination.
- 4 The \_\_\_\_\_ duct system of the kidney consists of a series of tubules and ducts that connect the nephrons to the ureter.
- 5 Renal \_\_\_\_\_ is a mechanism by which the kidneys can regulate the plasma pH.
- 6 The \_\_\_\_\_ cells are cells that synthesize, store, and secrete the enzyme renin.
- 8 \_\_\_\_\_ occurs at the barrier between the blood and the filtrate in the renal corpuscle or Bowman's capsule in the kidneys.
- 9 The renal \_\_\_\_\_ is the innermost part of the kidney.
- 10 Renal \_\_\_\_\_ are cone-shaped tissues of the kidney within the renal medulla, which is made up of 8 to 18 of these conical subdivisions.
- 12 The distal \_\_\_\_\_ tubule is a portion of kidney nephron between the loop of Henle and the collecting duct system.
- 14 A \_\_\_\_\_ is the basic structural and functional unit of the kidney.
- 19 The \_\_\_\_\_ is a tube which connects the urinary bladder to the outside of the body.
- 21 The \_\_\_\_\_ system is the organ system that produces, stores, and eliminates urine. In humans it includes two kidneys, two ureters, the bladder, and the urethra.

# Digestive System



## ACROSS

- 5 Gastric \_\_\_\_\_ is a strong acidic liquid, pH 1 to 3 in humans, released by gastric glands in the lining of the stomach. Its main components are digestive enzymes pepsin and rennin, hydrochloric acid, and mucus.
- 7 \_\_\_\_\_ is the rhythmic contraction of smooth muscles to propel contents through the digestive tract.
- 8 The \_\_\_\_\_ intestine, commonly referred to by its Greek name, the colon, is the last part of the digestive system: the final stage of the alimentary canal in vertebrate animals.
- 9 In the gastrointestinal tract, the \_\_\_\_\_ is the layer of loose connective tissue that supports the mucosa, as well as joins the mucosa to the bulk of underlying smooth muscle.
- 11 \_\_\_\_\_ is a digestive protease released by the chief cells in the stomach that functions to degrade food proteins into peptides.
- 17 \_\_\_\_\_ acid is one of the main secretions of the stomach, an acid solution consisting mainly of hydrochloric acid, and small quantities of potassium chloride and sodium chloride.
- 18 The \_\_\_\_\_, or cholecyst, is a pear-shaped organ that stores

about 50 ml of bile until the body needs it for digestion.

- 20 \_\_\_\_\_ glands are glands that secrete their products into ducts.
- 23 The \_\_\_\_\_ is a hollow jointed tube about 25-30 cm long connecting the stomach to the jejunum.
- 25 Pancreatic \_\_\_\_\_ is produced by the pancreas, containing a variety of enzymes including trypsinogen, chymotrypsinogen, elastase, carboxypeptidase, pancreatic lipase, and amylase.
- 27 The \_\_\_\_\_, also known as the buccal cavity or the oral cavity, is the orifice through which an organism takes in food and water.
- 28 The \_\_\_\_\_ is the final section of the small intestine.
- 29 The gastrointestinal \_\_\_\_\_ is the system of organs within multicellular animals that takes in food, digests it to extract energy and nutrients, and expels the remaining waste.
- 32 \_\_\_\_\_ is the name given to glycoside hydrolase enzymes that break down starch into glucose molecules.
- 34 Released from the gall bladder, \_\_\_\_\_ acids serve multiple functions including elimination of cholesterol from the body, elimination of catabolites from the liver, and emulsifying lipids and fat soluble vitamins in the intestine.

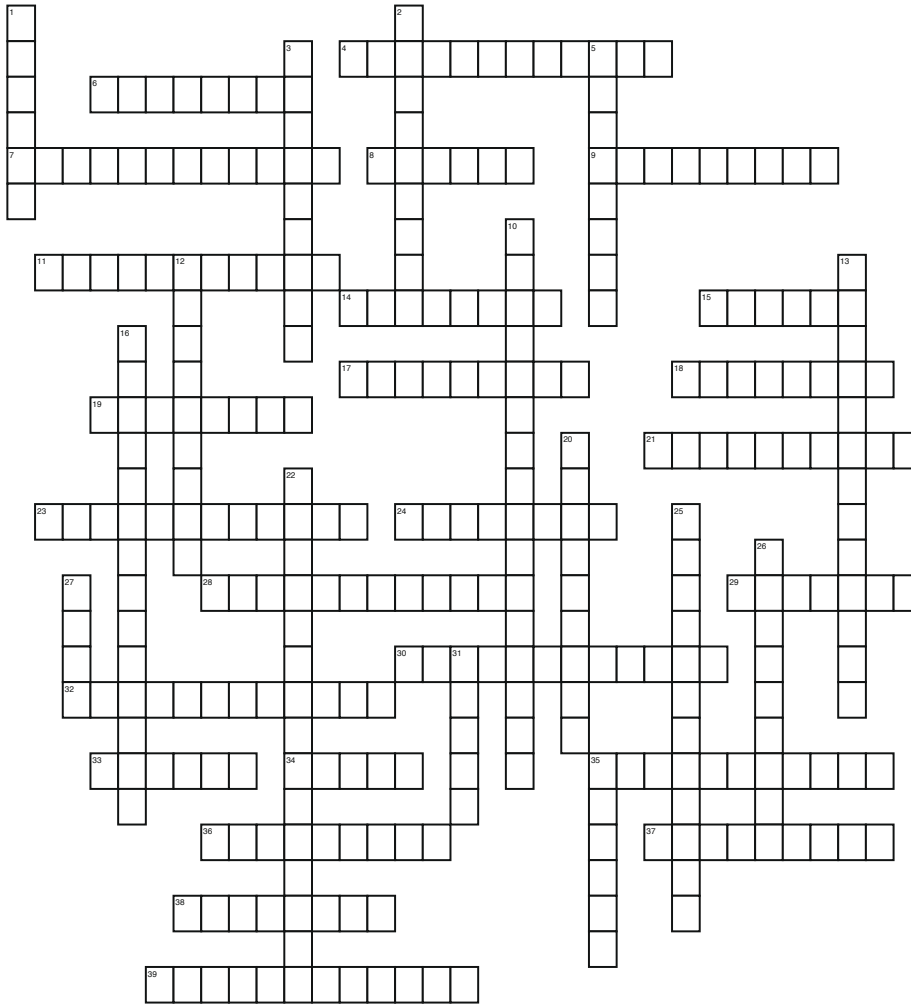
- 35 \_\_\_\_\_ is a peptide hormone of the gastrointestinal system responsible for stimulating the digestion of fat and protein.
- 36 In addition to being the largest gland in the human body, producing bile for example, the \_\_\_\_\_ plays a major role in metabolism.
- 37 \_\_\_\_\_ cells are the stomach epithelium cells which secrete gastric acid and intrinsic factor.

## DOWN

- 1 \_\_\_\_\_ is the process of metabolism whereby a biological entity processes a substance in order to chemically and mechanically convert the substance for the body to use.
- 2 \_\_\_\_\_ is a bitter, yellow or green alkaline fluid secreted by hepatocytes from the liver with components including cholesterol, lecithin, bilirubin, biliverdin, sodium glycocholate and sodium taurocholate.
- 3 A gastric \_\_\_\_\_ cell is a cell in the stomach that releases pepsinogen and rennin.
- 4 A \_\_\_\_\_ is a round mass of organic matter moving through the digestive tract.
- 6 The \_\_\_\_\_ is the central of the three divisions of the small intestine and lies between the duodenum and the ileum.

## Answer key - pg 127

- 10 \_\_\_\_\_, known scientifically as deglutition, is the reflex in the human body that makes something pass from the mouth, to the pharynx, into the esophagus, with the shutting of the epiglottis.
- 11 The \_\_\_\_\_ duct is a duct joining the pancreas to the common bile duct.
- 12 The \_\_\_\_\_ is the part of the neck and throat situated immediately posterior to the mouth and nasal cavity, and cranial, or superior, to the esophagus, larynx, and trachea.
- 13 \_\_\_\_\_ is a science that examines the relationship between diet and health.
- 14 A \_\_\_\_\_ is a nutrient that is an organic compound required in tiny amounts for essential metabolic reactions in a living organism.
- 15 \_\_\_\_\_ is the liquid substance found in the stomach before passing through the pyloric valve and entering the duodenum.
- 16 Intestinal \_\_\_\_\_ are tiny, finger-like structures that protrude from the wall of the intestine.
- 19 The \_\_\_\_\_ is another name for the large intestine.
- 21 The \_\_\_\_\_ or gullet is an organ in vertebrates which consists of a muscular tube through which food passes from the pharynx to the stomach.
- 22 \_\_\_\_\_ or chewing is the process by which food is mashed and crushed by teeth.
- 24 Dietary \_\_\_\_\_s are the chemical elements required by living organisms, other than the four elements carbon, hydrogen, nitrogen, and oxygen which are present in common organic molecules.
- 26 A \_\_\_\_\_ is an essential human nutrient. In foods of animal origin, the major form of this vitamin is retinol, but all forms have a beta-ionone ring to which an isoprenoid chain is attached.
- 27 The \_\_\_\_\_ are structures that increase the surface area of cells by approximately 600 fold, thus facilitating absorption and secretion.
- 30 The \_\_\_\_\_ intestine is where the majority of digestion takes place, the part of the gastrointestinal tract (gut) between the stomach and the large intestine which includes the duodenum, jejunum, and ileum.
- 31 A \_\_\_\_\_ is a substance used in an organism's metabolism or physiology which must be taken in from the environment.
- 33 \_\_\_\_\_ is the watery and usually frothy substance produced in the mouths of humans and some animals.



## ACROSS

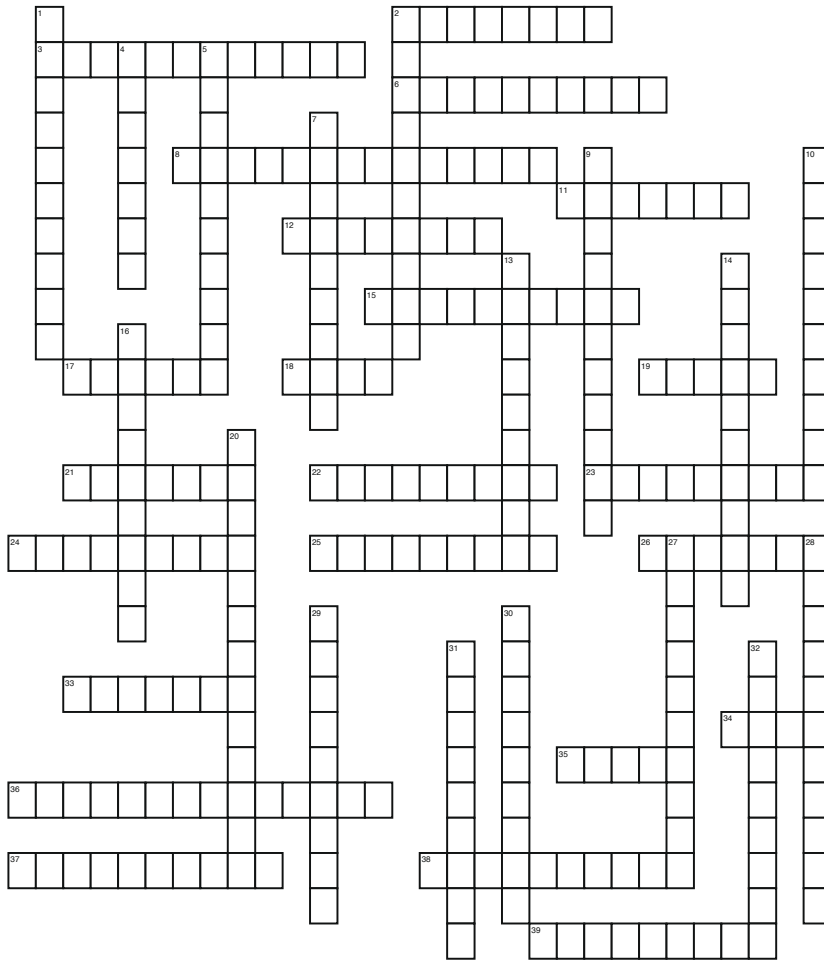
- 4 A \_\_\_\_\_ is the haploid cell that is the male gamete. It joins an ovum to form a zygote.
- 6 Ovarian \_\_\_\_\_s are the basic unit of female reproductive biology, roughly spherical aggregations of cells found in the ovary.
- 7 \_\_\_\_\_ is an event that occurs early in pregnancy in which the embryo adheres to the wall of uterus.
- 8 The \_\_\_\_\_ or womb is the major female reproductive organ. One end, the cervix, opens into the vagina; the other is connected on both sides to the fallopian tubes.
- 9 \_\_\_\_\_ is the process by which a mature ovarian follicle ruptures and discharges an ovum.
- 11 The \_\_\_\_\_ is the inner membrane of the uterus.
- 14 \_\_\_\_\_ stimulating hormone is secreted by the anterior pituitary gland to stimulate the growth of Graafian follicles in women and enhance the production of androgen-binding protein by Sertoli cells in men.
- 15 A \_\_\_\_\_ is a female gametocyte or germ cell involved in reproduction, in other words, an immature ovum.
- 17 The zona \_\_\_\_\_ is a glycoprotein membrane surrounding the plasma membrane of an oocyte.
- 18 The \_\_\_\_\_ is an ephemeral organ present during pregnancy, which develops from the same sperm and egg cells that form the fetus, and functions as a fetomaternal organ for filtration and transfer.
- 19 \_\_\_\_\_ refers to the first menstrual period, or first menstrual bleeding.
- 21 The \_\_\_\_\_ phase, or proliferative phase, is the phase of the menstrual cycle during which follicles in the ovary mature to climax with ovulation.
- 23 Human chorionic \_\_\_\_\_ is a peptide hormone made by the embryo soon after conception and later by the placenta, preventing the disintegration of the corpus

luteum and thereby maintaining progesterone levels for pregnancy.

- 24 \_\_\_\_\_ is the generic term for any natural or synthetic compound, usually a steroid hormone, that stimulates or controls the development and maintenance of masculine characteristics in vertebrates.
- 28 A \_\_\_\_\_ is a male gametocyte which is derived from a spermatogonium.
- 29 A \_\_\_\_\_ is a kind of germ cell that results from the meiosis of a gametocyte.
- 30 \_\_\_\_\_ is a steroid hormone involved in the female menstrual cycle, pregnancy and embryogenesis.
- 32 \_\_\_\_\_ is a phase of the menstrual cycle in which the endometrium is shed.
- 33 The corpus \_\_\_\_\_ is a temporary endocrine structure in mammals, involved in the production of the progestogens which are needed for the maintenance of a pregnancy.
- 34 A \_\_\_\_\_ is an organ that makes gametes.
- 35 \_\_\_\_\_ hormone is synthesized and secreted by the anterior lobe of the pituitary gland. In the female, an acute rise of LH triggers ovulation. In the male, LH stimulates Leydig cell production of testosterone.
- 36 A \_\_\_\_\_ cell is a somatic cell found closely associated with the developing oocyte within the ovary.
- 37 \_\_\_\_\_ is the creation of an ovum, the female process of gametogenesis.
- 38 The \_\_\_\_\_ is an organelle that develops over the anterior half of the spermatozoon's head which contains digestive enzymes including hyaluronidase and acrosin.
- 39 \_\_\_\_\_ is the principal male sex hormone and an anabolic steroid. It is primarily secreted in the testes of males and the ovaries of females, although small amounts are also secreted by the adrenal glands.

## DOWN

- 1 Found adjacent to the seminiferous tubules in the testicle, \_\_\_\_\_ cells can secrete testosterone and are often closely related to nerves.
- 2 The \_\_\_\_\_ cycle is a recurring cycle of physiologic changes under endocrine control necessary for reproduction that occurs in females.
- 3 The word \_\_\_\_\_ literally means the permanent physiological, or natural, cessation of menstrual cycles.
- 5 A \_\_\_\_\_ is an immature ovum. It is a female gametogonium.
- 10 \_\_\_\_\_ is the maturation of the ovarian follicle, a densely-packed shell of somatic cells that contains an immature oocyte.
- 12 Labelled the female hormone but also present in males, \_\_\_\_\_ is the major estrogen in humans, not only of critical importance for reproductive and sexual functioning, but also affects other organs.
- 13 Fertilization is fusion of gametes to form a new organism of the same species.
- 16 A \_\_\_\_\_ is an intermediary male gametogonium in the production of spermatozoa.
- 20 The term \_\_\_\_\_ refers to the haploid male gametid that results from division of secondary spermatocytes.
- 22 \_\_\_\_\_ is the process by which male spermatogonia develop into mature spermatozoa.
- 25 \_\_\_\_\_ tubules are located in the testicles, and are the specific location of meiosis, and the subsequent creation of gametes, namely spermatozoa.
- 26 \_\_\_\_\_ describes the secretion of milk from the mammary glands, the process of providing that milk to the young, and the period of time that a mother lactates to feed her young.
- 27 A \_\_\_\_\_ is a haploid female reproductive cell or gamete.
- 31 A \_\_\_\_\_ is the egg-producing reproductive organ found in female organisms
- 35 The \_\_\_\_\_ phase, or secretory phase, is the latter phase of the menstrual cycle, which begins with the formation of the corpus luteum and ends in either pregnancy or luteolysis.



## ACROSS

- 2 \_\_\_\_\_ evolution is the independent evolution of similar traits, starting from a similar ancestral condition due to similar environments or other evolutionary pressures.
- 3 A \_\_\_\_\_ tree, also called an evolutionary tree, is a tree showing the evolutionary relationships among various biological species or other entities that are believed to have a common ancestor.
- 6 \_\_\_\_\_ speciation is a form of speciation in which new species are formed in isolated peripheral populations.
- 8 \_\_\_\_\_ is the occurrence of small-scale changes in allele frequencies in a population, over a few generations, also known as change at or below the species level.
- 11 \_\_\_\_\_, also known as mimetism, describes a situation where one organism, the mimic, has evolved to share common outward characteristics with another organism, the model, through the selective action of a signal-receiver or dupe.
- 12 \_\_\_\_\_ selection is the selective removal of alleles that are deleterious.
- 15 A population \_\_\_\_\_ is an evolutionary event in which a significant percentage of a population or species is killed or

otherwise prevented from reproducing, and the population is reduced by 50% or more.

- 17 Charles Robert \_\_\_\_\_ (1809 - 1882) was an English naturalist who proposed and provided scientific evidence that all species of life have evolved over time from one or a few common ancestors through the process of natural selection.
- 18 \_\_\_\_\_ is the genus that includes modern humans and their close relatives.
- 19 A \_\_\_\_\_ is a taxonomic group of organisms comprising a single common ancestor and all the descendants of that ancestor.
- 21 The \_\_\_\_\_ effect is defined as the effect of establishing a new population by a small number of individuals, carrying only a small fraction of the original population's genetic variation.
- 22 \_\_\_\_\_ Speciation is the genetic divergence of multiple populations inhabiting the same geographic region from a single parent species, such that those populations become different species.
- 23 Heterozygote \_\_\_\_\_ describes the case in which the heterozygote genotype has a higher relative fitness than either the homozygote dominant or homozygote recessive genotype.
- 24 \_\_\_\_\_ selection refers to forms of natural selection which work to maintain genetic polymorphisms within a population.
- 25 \_\_\_\_\_ evolution occurs when two or more biological characteristics have a common evolutionary origin but have diverged over evolutionary time.
- 26 A \_\_\_\_\_ is one of the basic units of biological classification, often defined as a group of organisms capable of interbreeding and producing fertile offspring.
- 33 A group of organisms is said to have common \_\_\_\_\_ if they have a common ancestor.
- 34 A gene \_\_\_\_\_ is the complete set of unique alleles in a species or population.
- 35 Genetic \_\_\_\_\_ is the statistical effect that results from the influence that chance has on the survival of alleles, which may cause an allele, and the biological traits that it confers, to become more common or rare over successive generations.
- 36 The \_\_\_\_\_ principle states that the occurrence of a genotype, perhaps one associated with a disease, stays constant unless matings are non-random or inappropriate, or mutations accumulate.
- 37 \_\_\_\_\_ evolution is the process whereby organisms not closely related, not monophyletic, independently evolve similar traits as a result of having to adapt to similar environments or ecological niches.
- 38 \_\_\_\_\_ speciation, also known as

geographic speciation, is the phenomenon where large biological populations are physically isolated by an extrinsic barrier and evolve intrinsic reproductive isolation.

- 39 Adaptive \_\_\_\_\_ describes the rapid speciation of a single or a few species to fill many ecological niches.

## DOWN

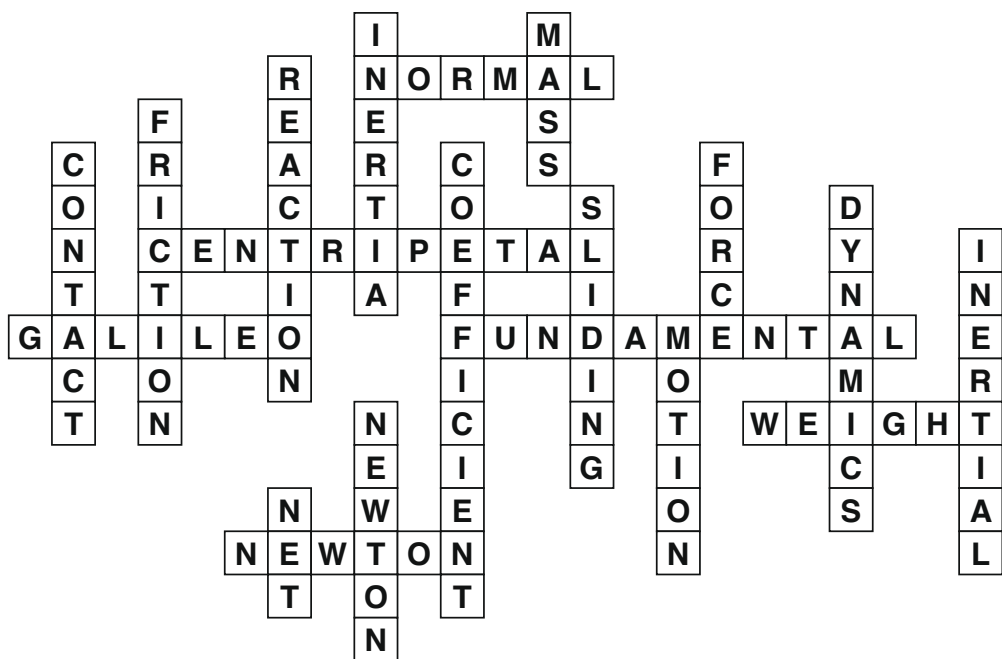
- 1 \_\_\_\_\_ is the evolutionary process by which new biological species arise.
- 2 \_\_\_\_\_ genetics is the study of allele frequency distribution and change under the influence of the four evolutionary forces: natural selection, genetic drift, mutation and gene flow.
- 4 Jean-Baptiste \_\_\_\_\_ (1744 - 1829) was a French soldier, naturalist, academic and an early proponent of the idea that evolution occurred and proceeded in accordance with natural laws.
- 5 \_\_\_\_\_ is the cessation of existence of a species or group of taxa, reducing biodiversity.
- 7 Under \_\_\_\_\_, individuals with advantageous or adaptive traits tend to be more successful than their peers reproductively.
- 9 \_\_\_\_\_ selection occurs when natural selection favors a single allele and therefore allele frequency continuously shifts in one direction.
- 10 \_\_\_\_\_ selection is a descriptive term used to describe changes in population genetics that simultaneously favor individuals at both extremes of the distribution.
- 13 Natural \_\_\_\_\_ is the process by which favorable traits that are heritable become more common in successive generations of a population of reproducing organisms, and unfavorable traits less common.
- 14 \_\_\_\_\_ is a philosophy of classification that arranges organisms only by their order of branching in an evolutionary tree and not by their morphological similarity.
- 16 Allele \_\_\_\_\_ is a measure of the relative proportion of an allele on a genetic locus.
- 20 Habitat \_\_\_\_\_ describes the emergence of discontinuities in an organism's preferred environment.
- 27 \_\_\_\_\_ speciation is a form of speciation that occurs due to variations in mating frequency of a population within a continuous geographical area.
- 28 \_\_\_\_\_ selection, also referred to as purifying selection, is a type of natural selection in which genetic diversity decreases as the population stabilizes on a particular trait value.
- 29 The genotype \_\_\_\_\_ is the proportion of genotypes in a population.
- 30 \_\_\_\_\_ is the change in the inherited traits of a population from generation to generation.
- 31 \_\_\_\_\_ evolution is the process of evolution at the scale of DNA, RNA, and proteins.
- 32 Reproductive \_\_\_\_\_ is a category of mechanisms that prevent two or more populations from exchanging genes.

Puzzle Keys  
Beyond  
This Page

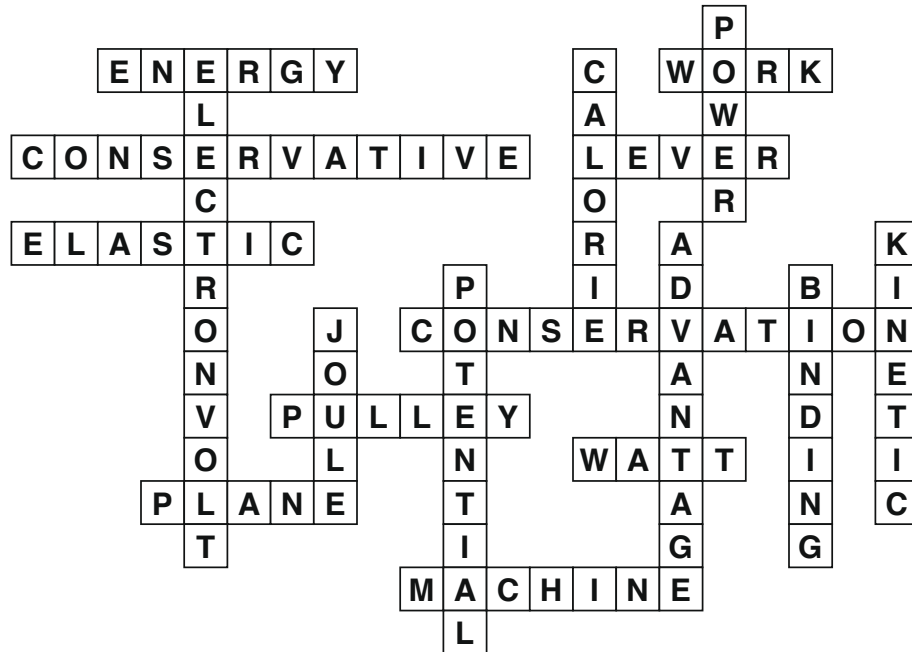
## Kinematics



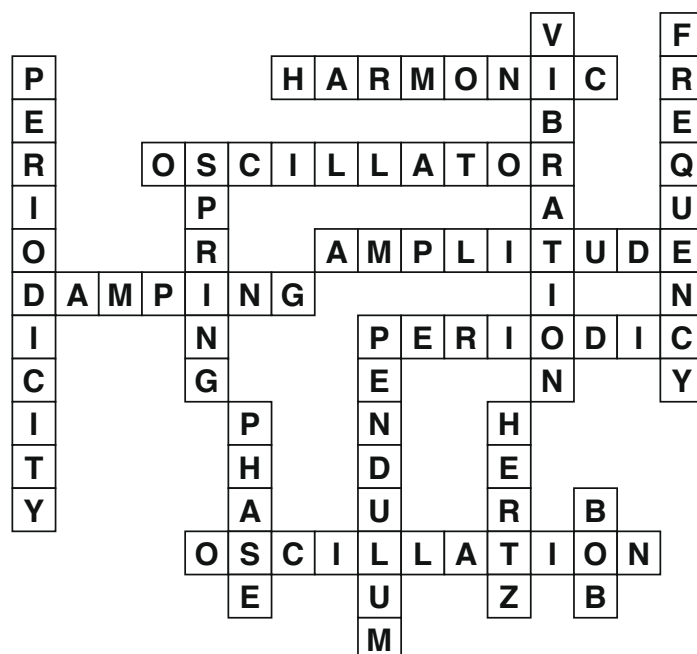
## Newton's Laws



# Work & Energy

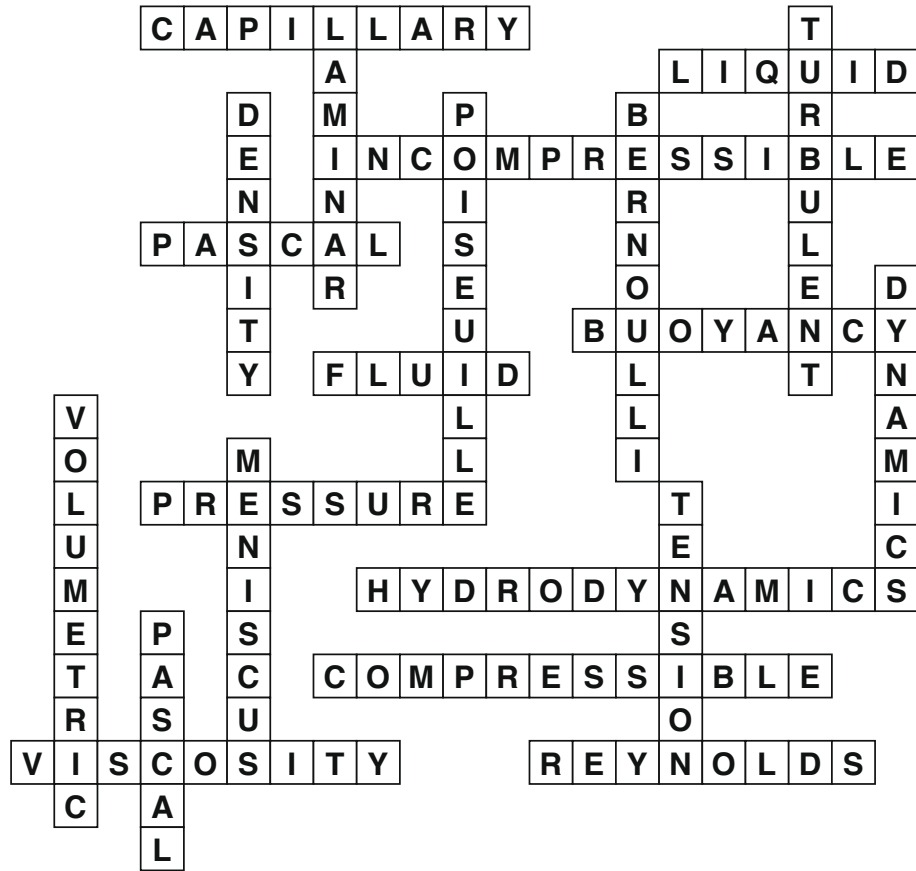


# Harmonic Motion

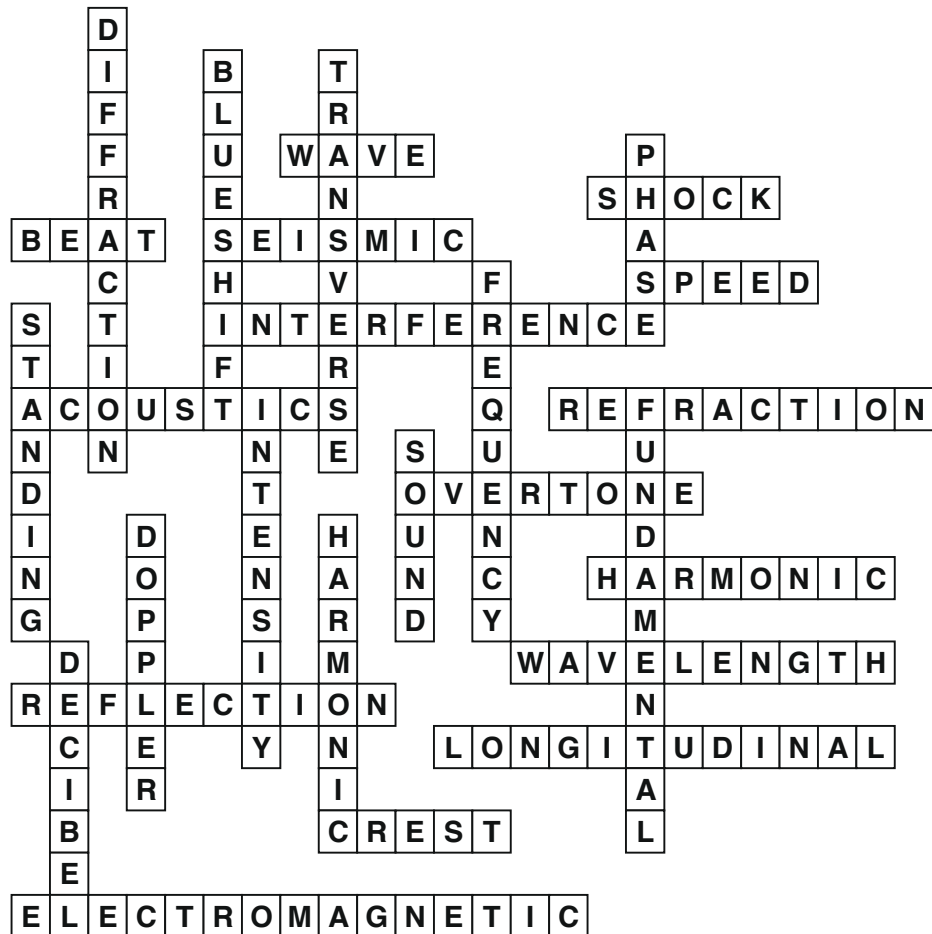




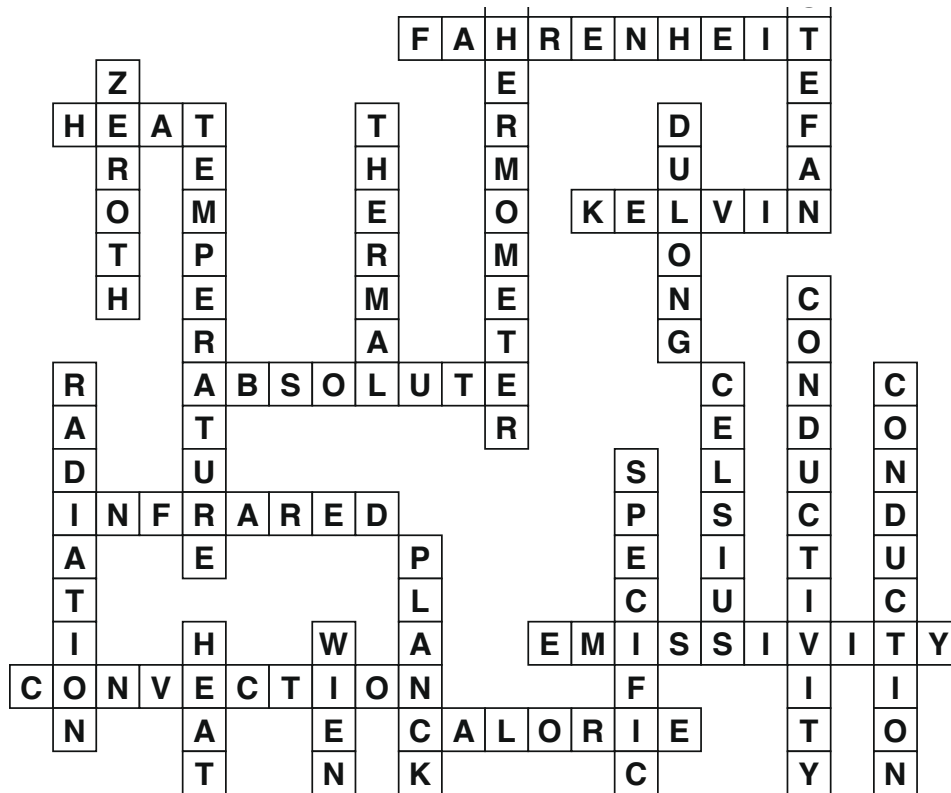
# Fluid Mechanics



# Waves



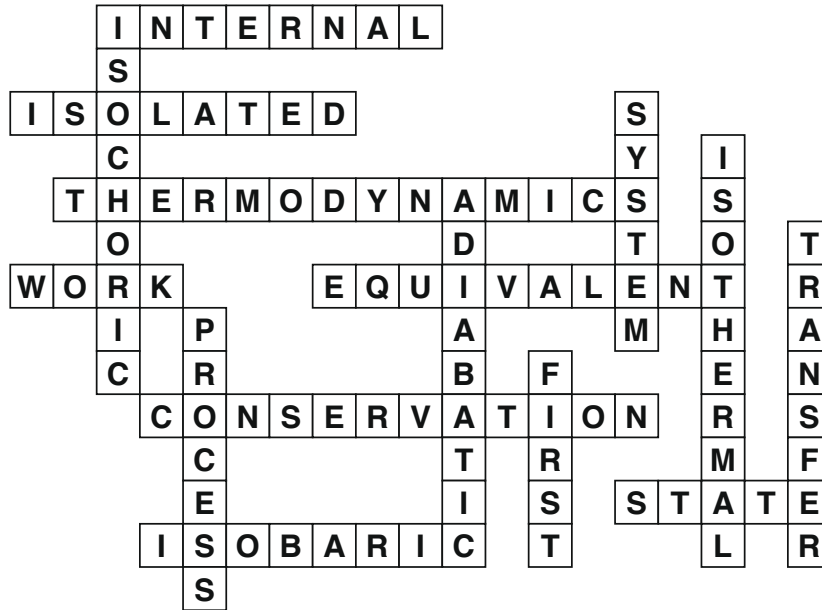
## Temperature and Heat Flow



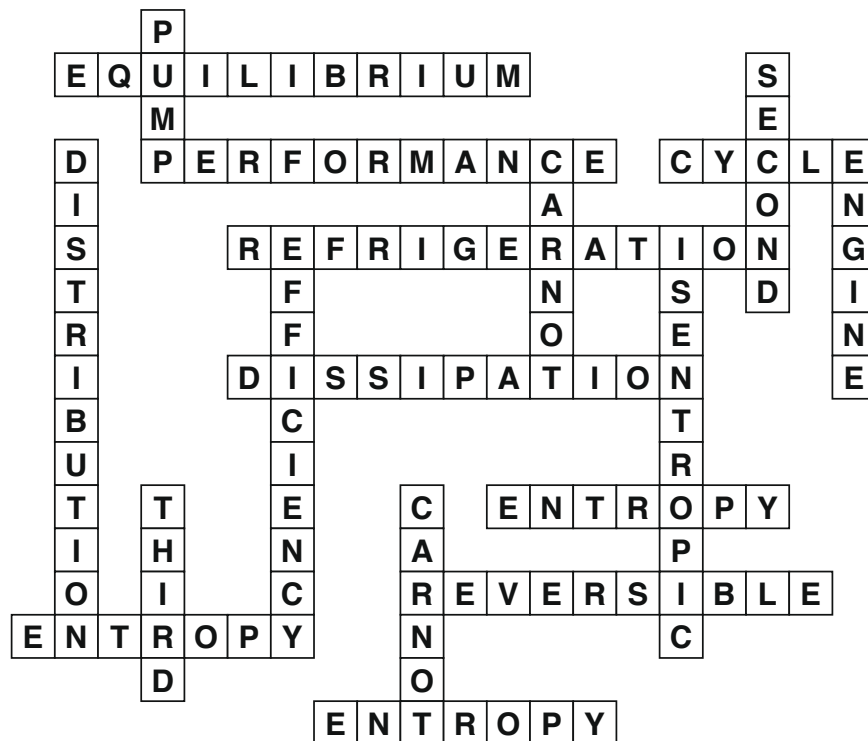
## Ideal Gas



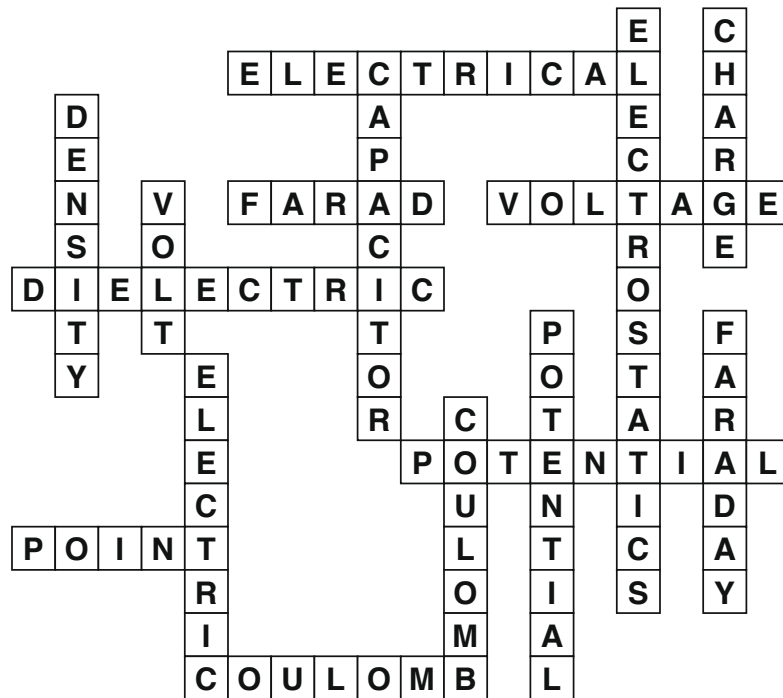
# 1st Law of Thermodynamics



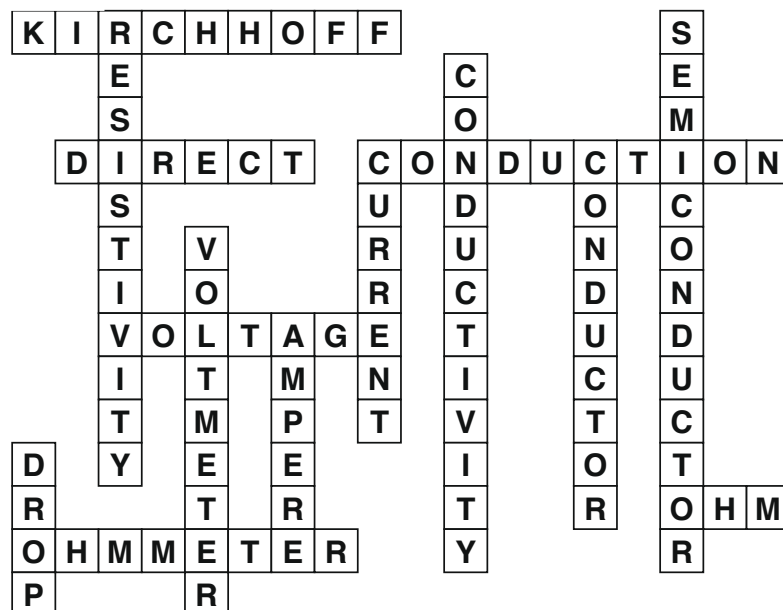
# 2nd Law of Thermodynamics



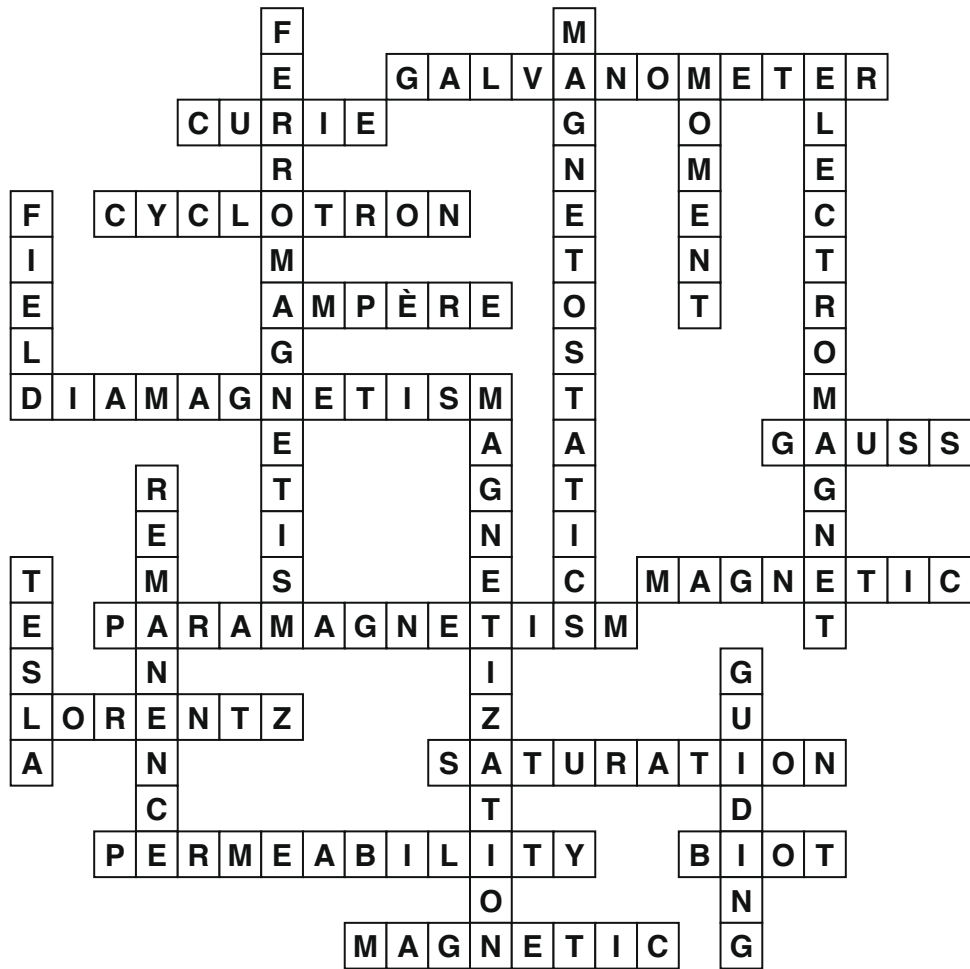
# Electricity



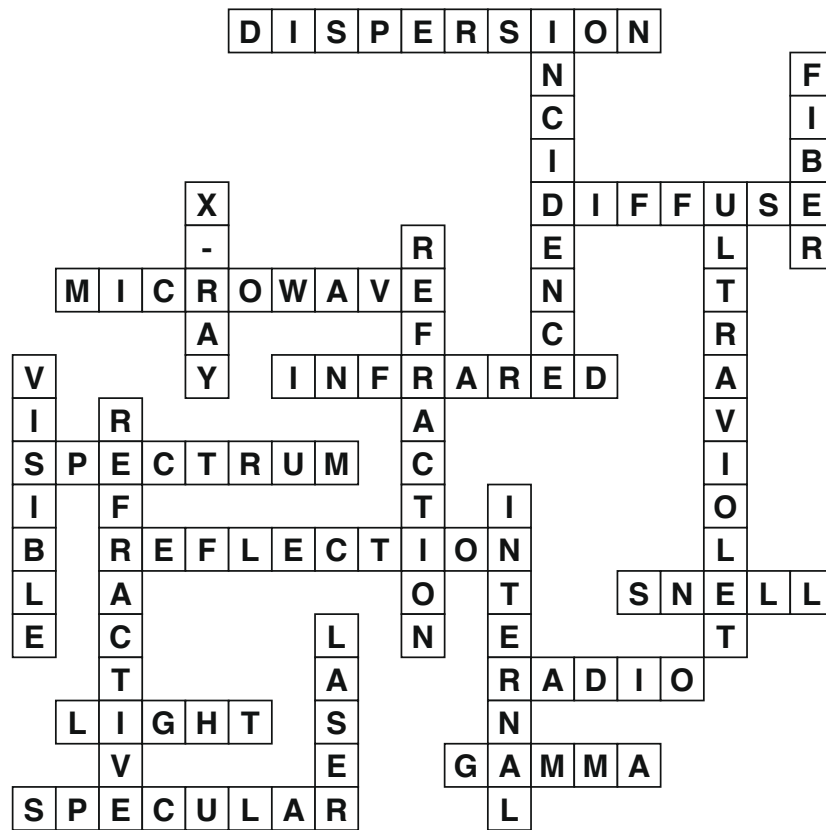
## DC Current



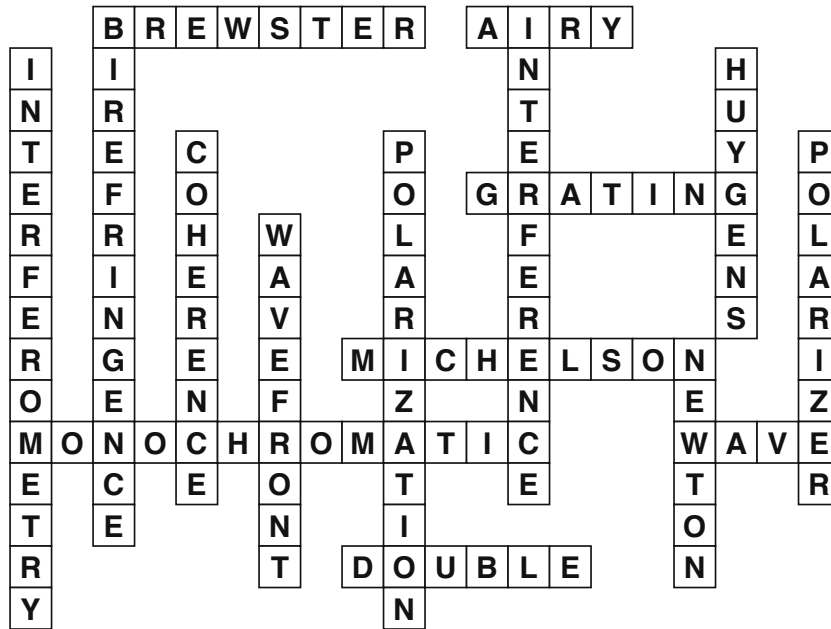
# Magnetism



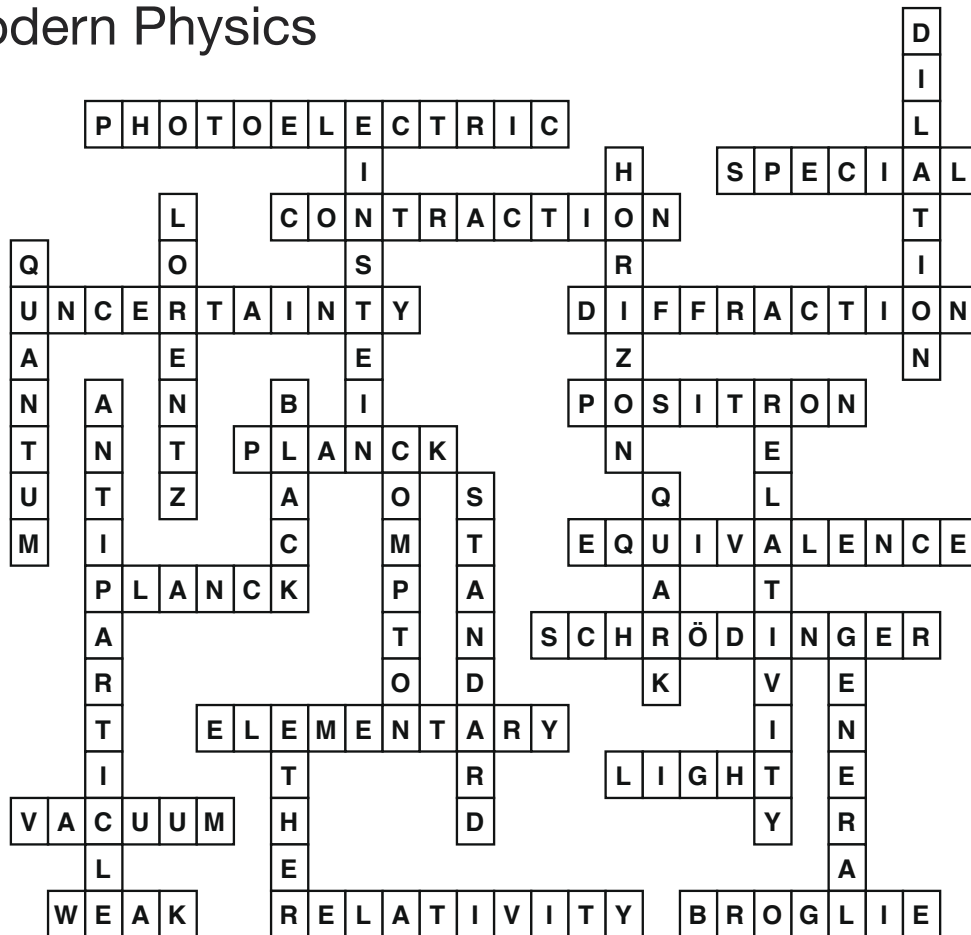
# Properties of Light



# Wave Optics

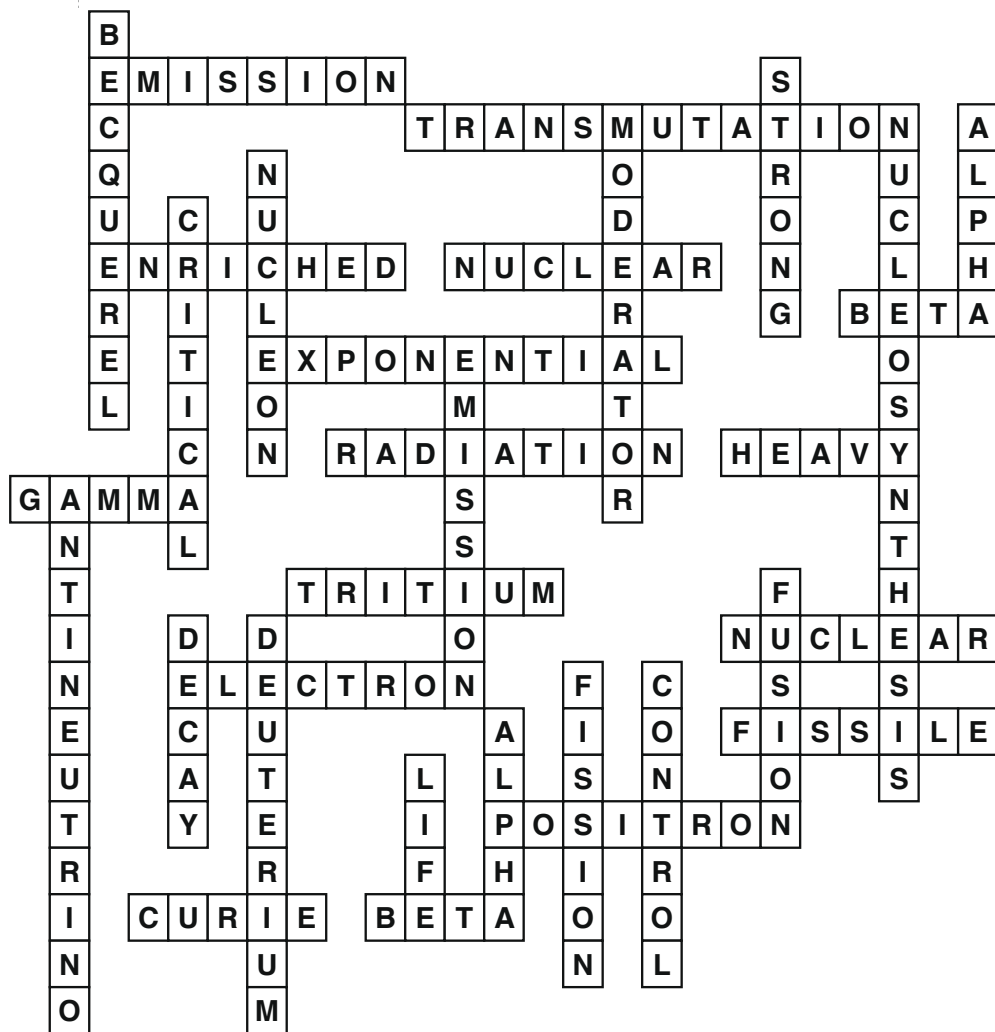


# Modern Physics

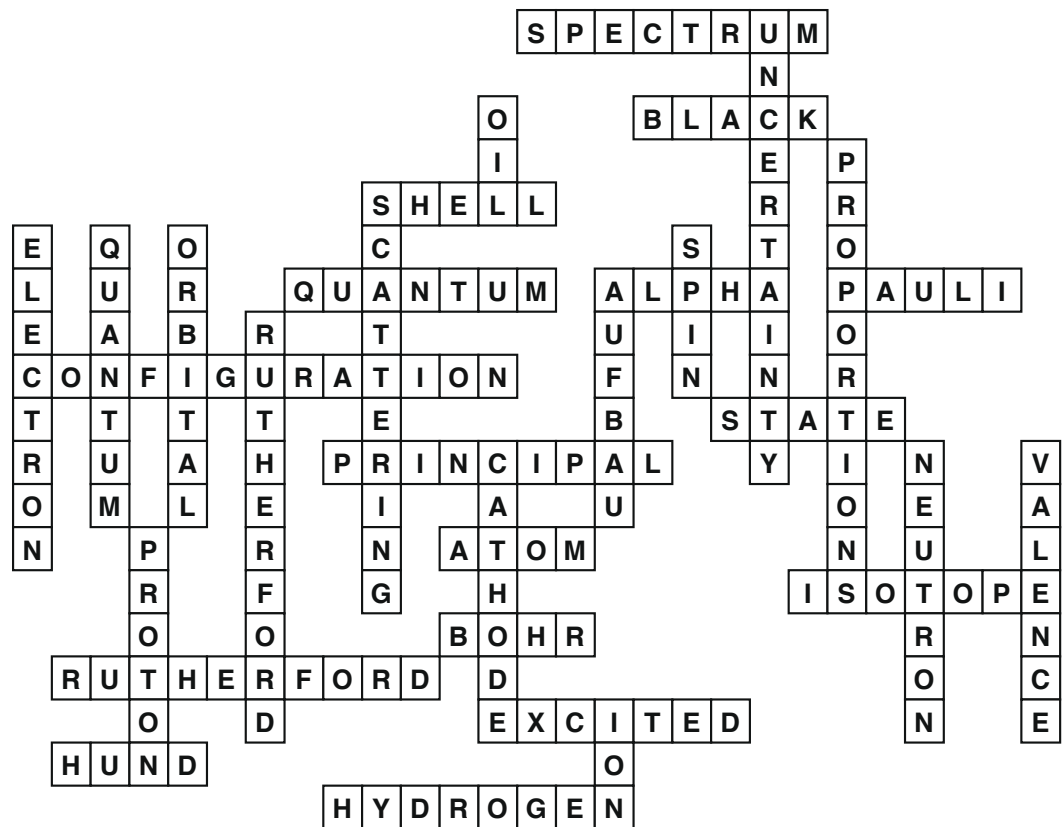




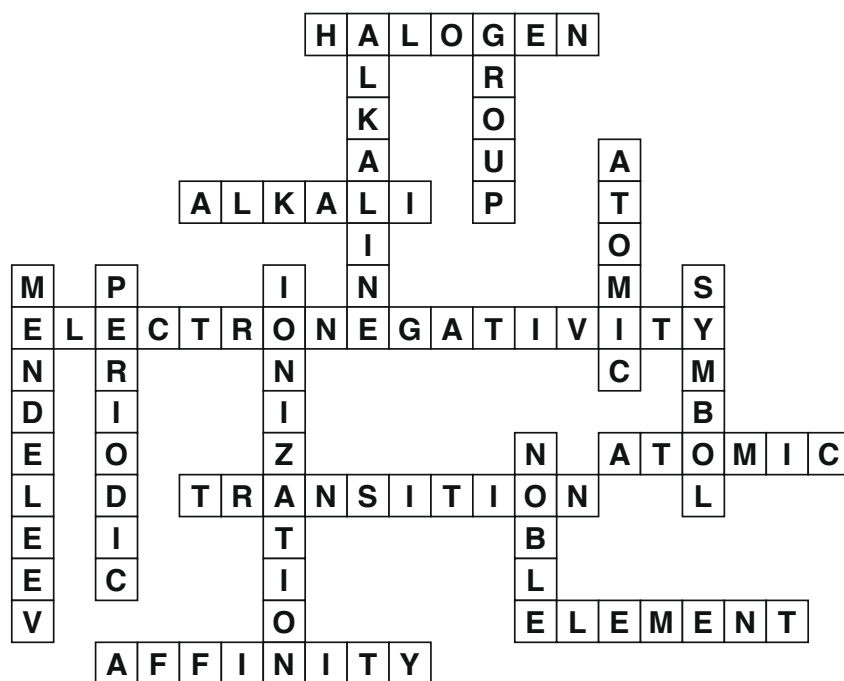
# Nuclear Physics



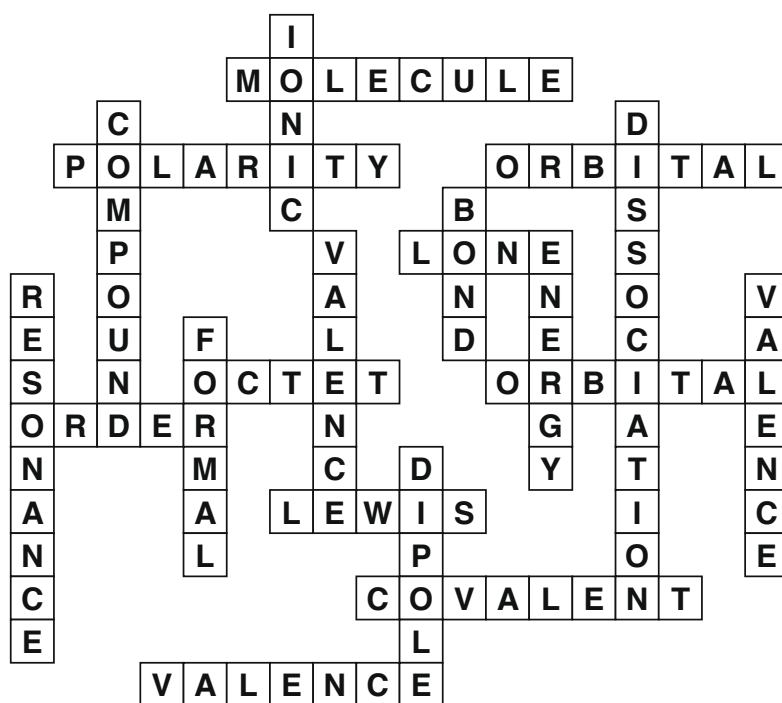
# Atomic Theory



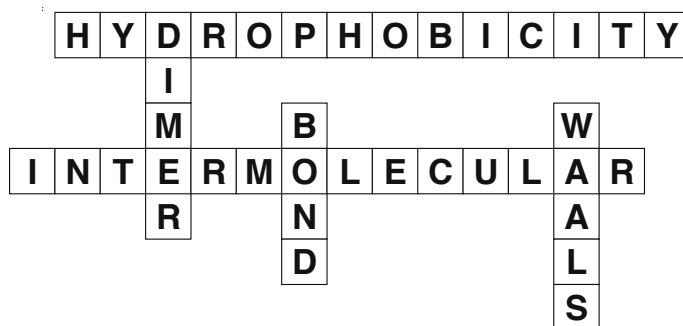
# Periodic Trends



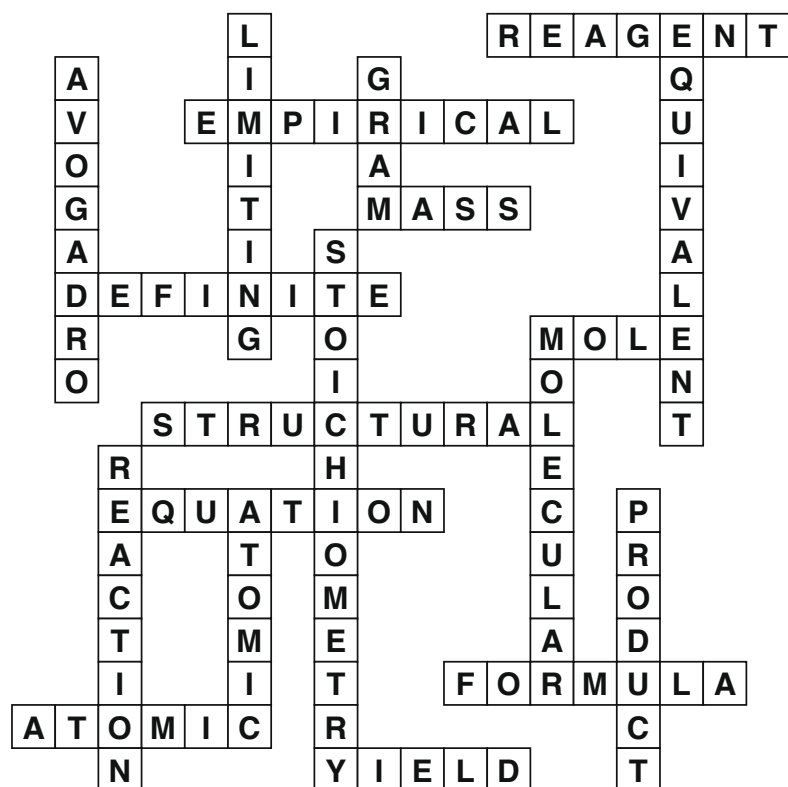
## Chemical Bonding



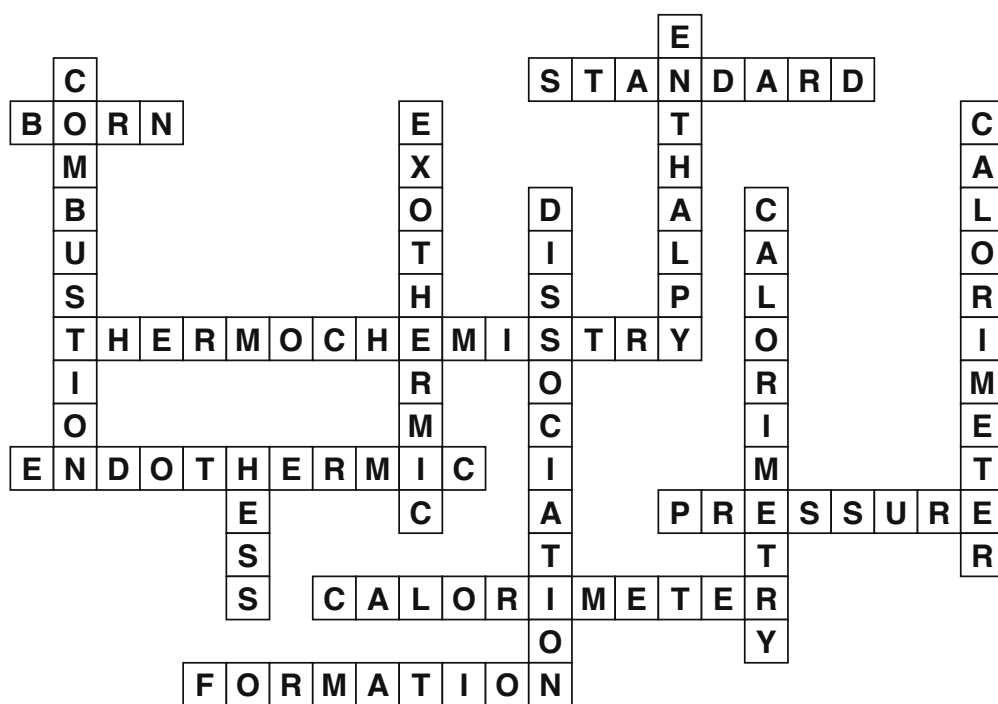
## Intermolecular Force



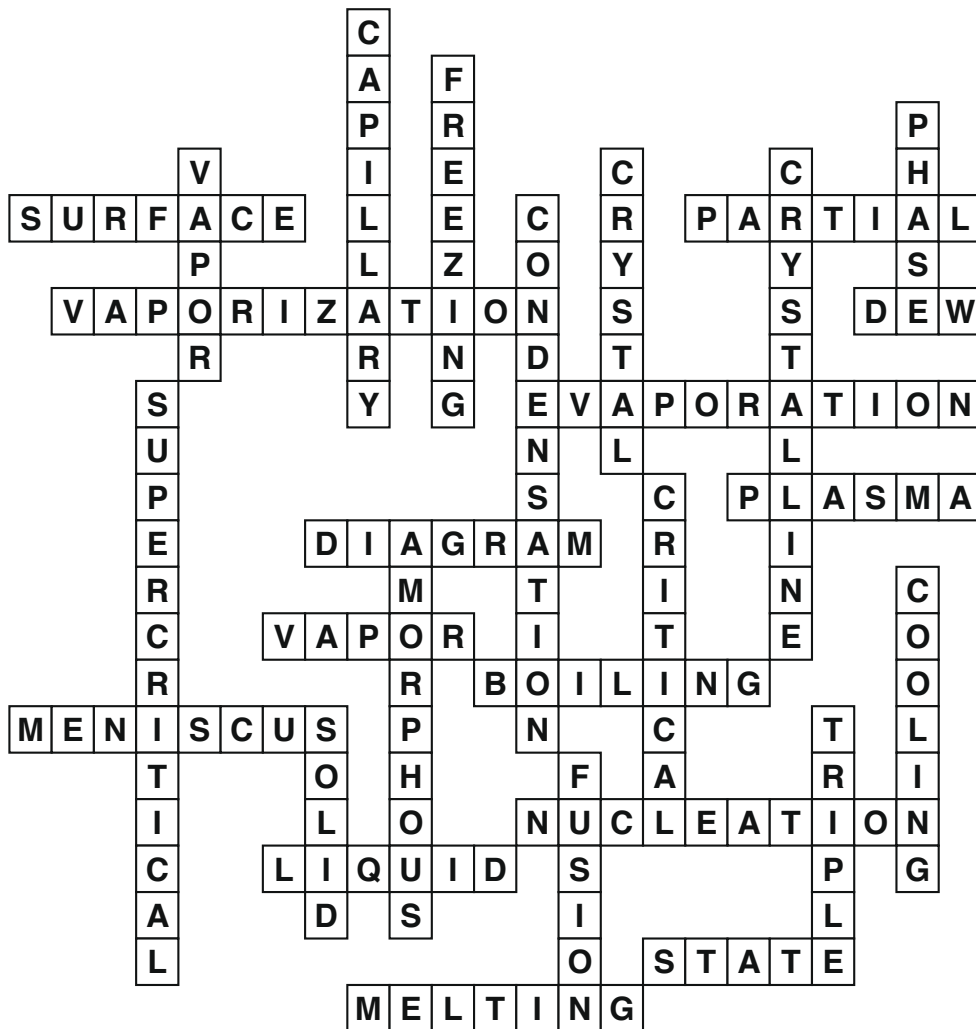
# Stoichiometry



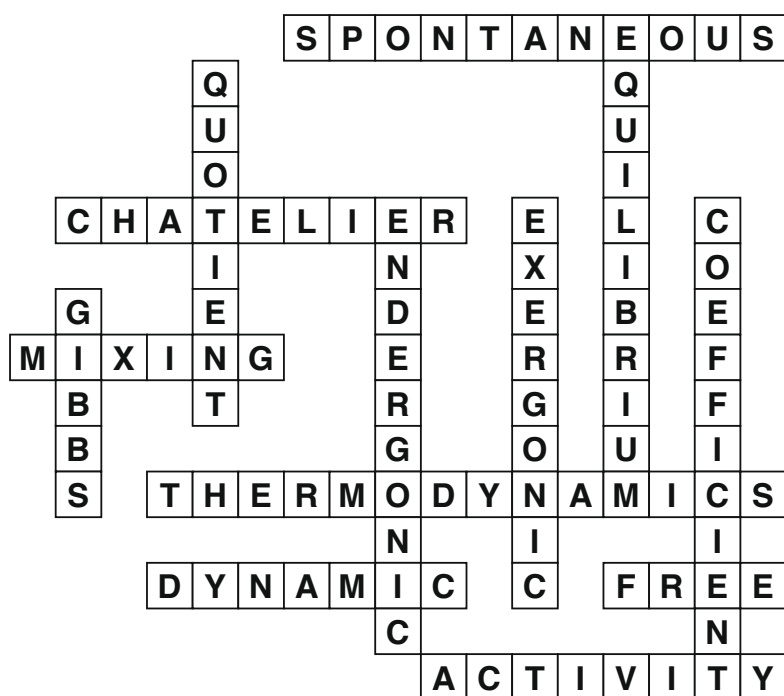
# Thermochemistry



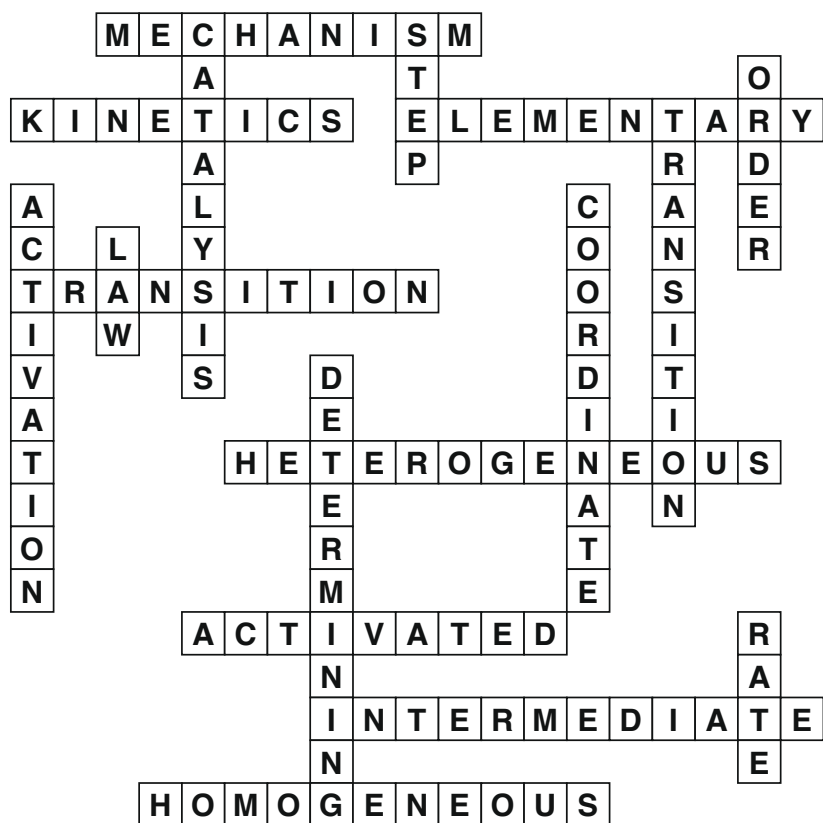
# States of Matter



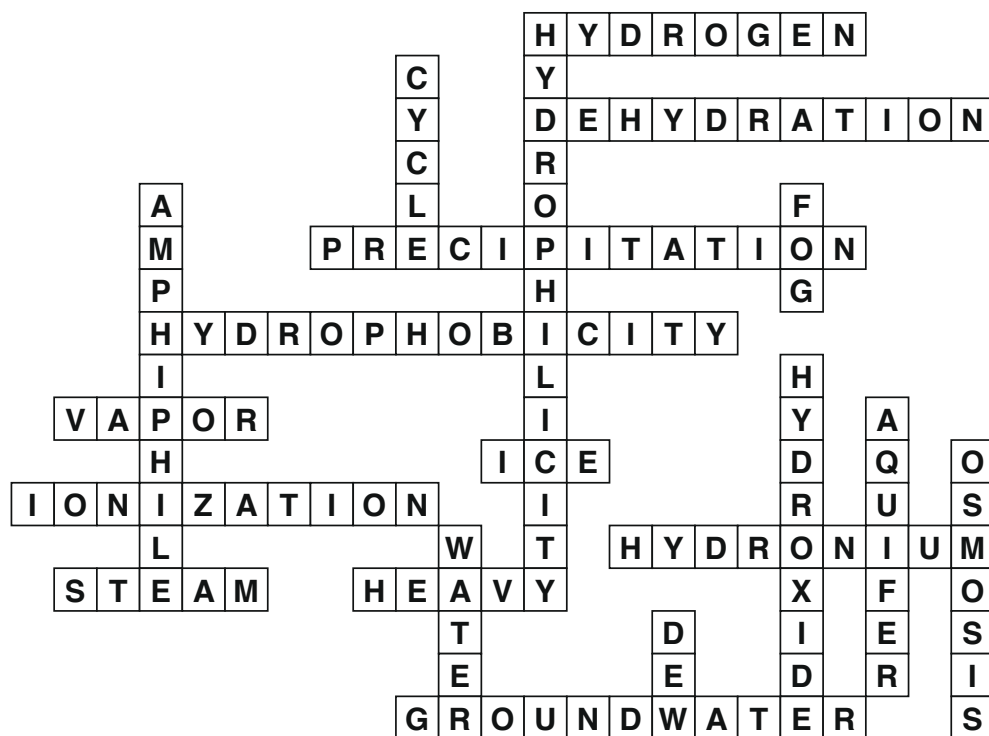
# Chemical Thermodynamics



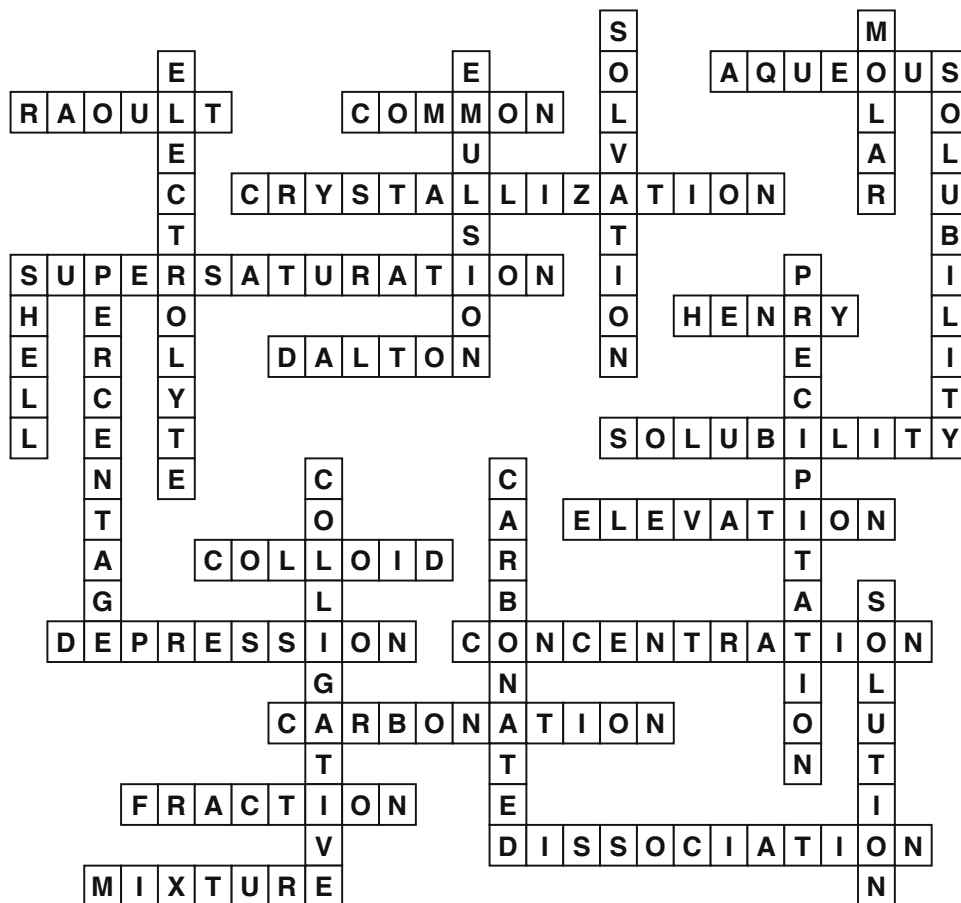
# Chemical Kinetics



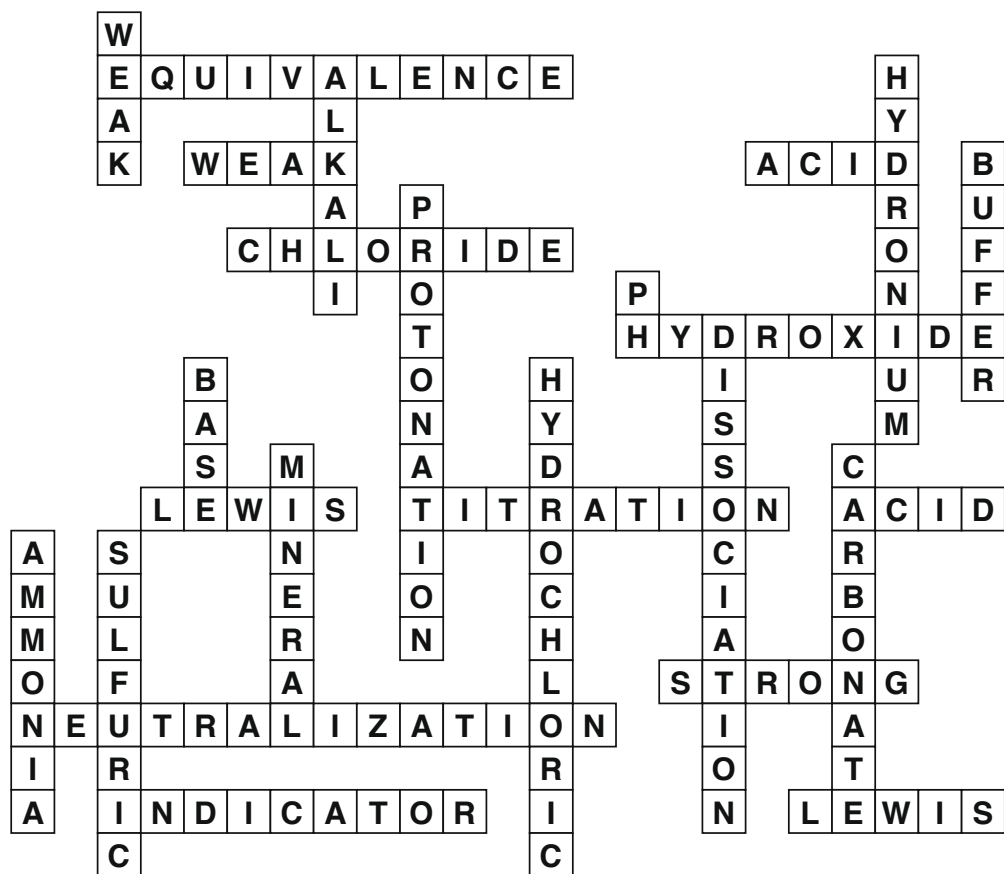
## Water



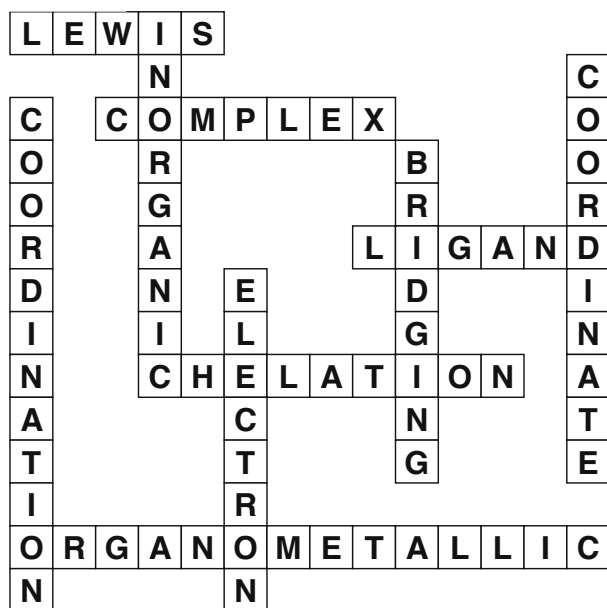
## Solutions



## Acids and Bases

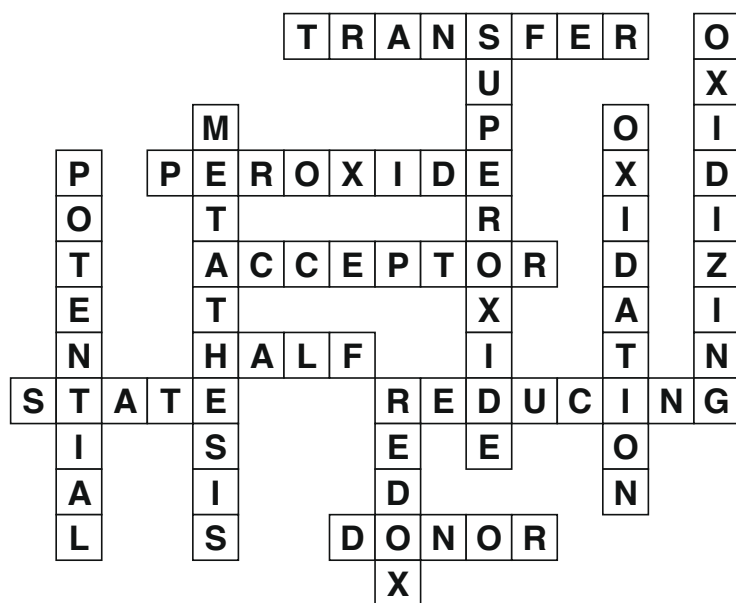


## Coordination Chemistry

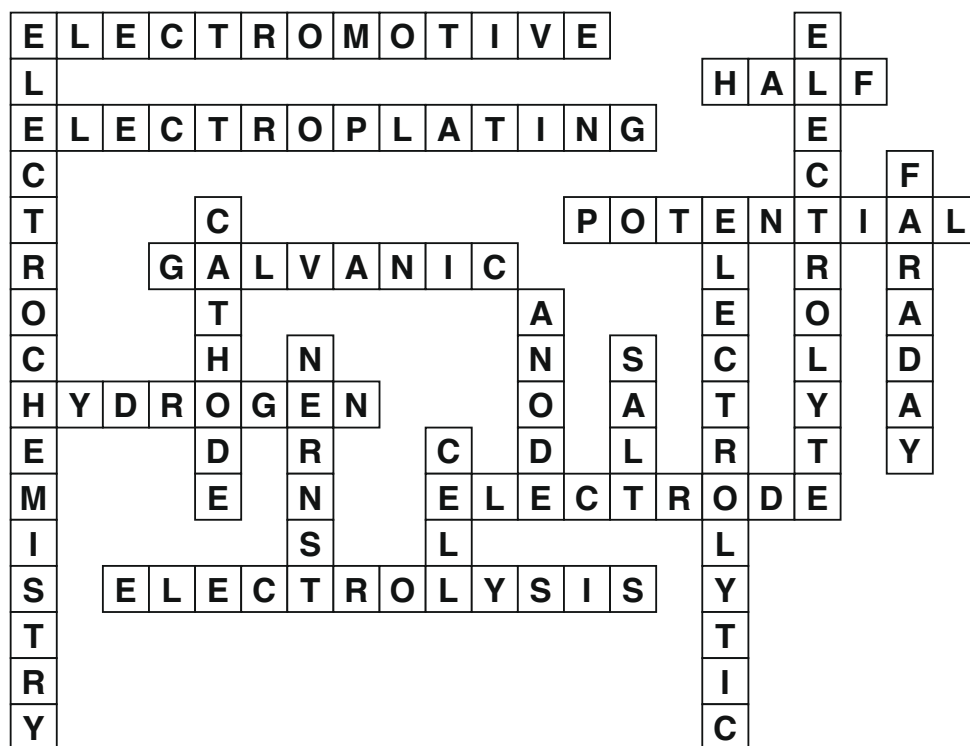




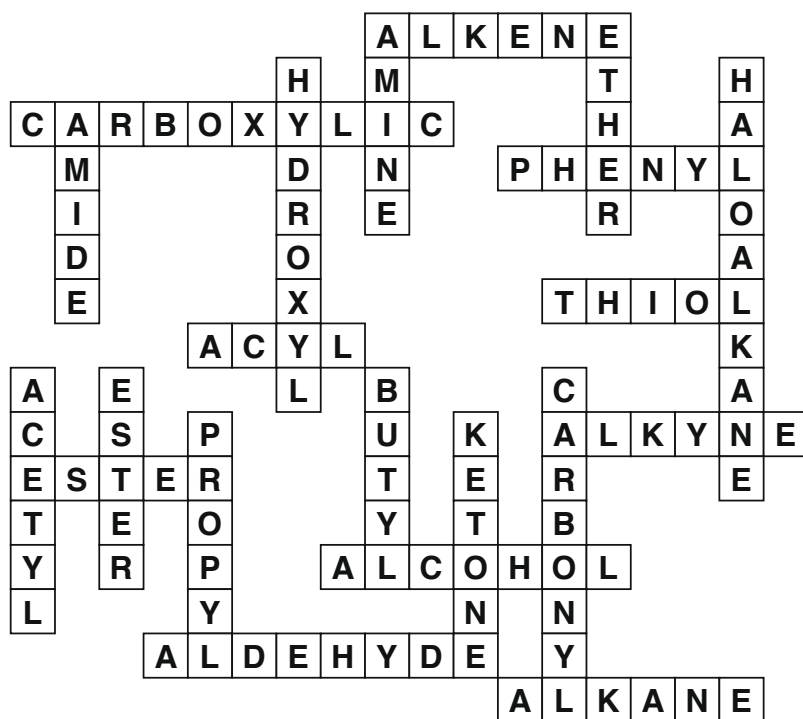
## Oxidation-Reduction



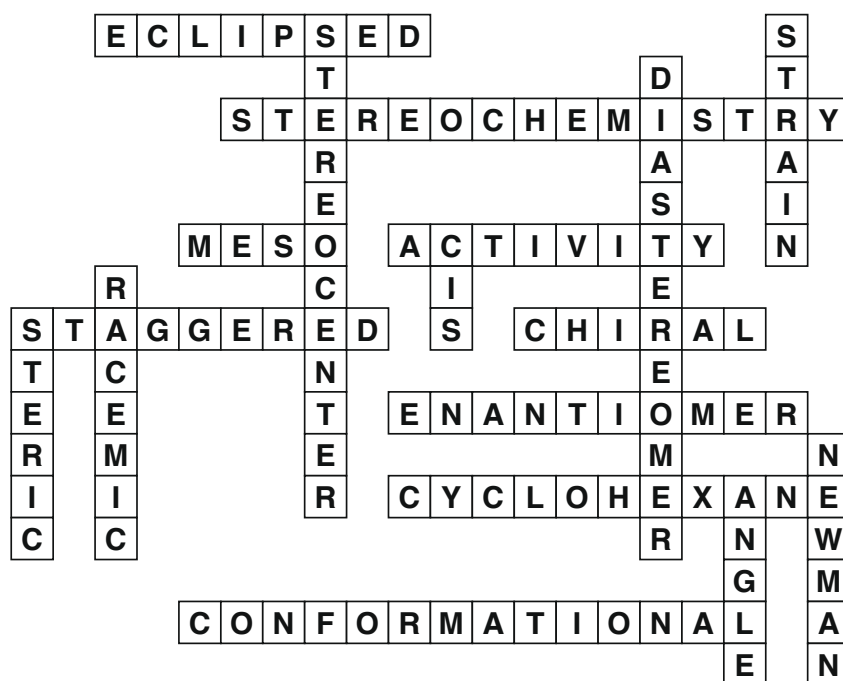
## Electrochemistry



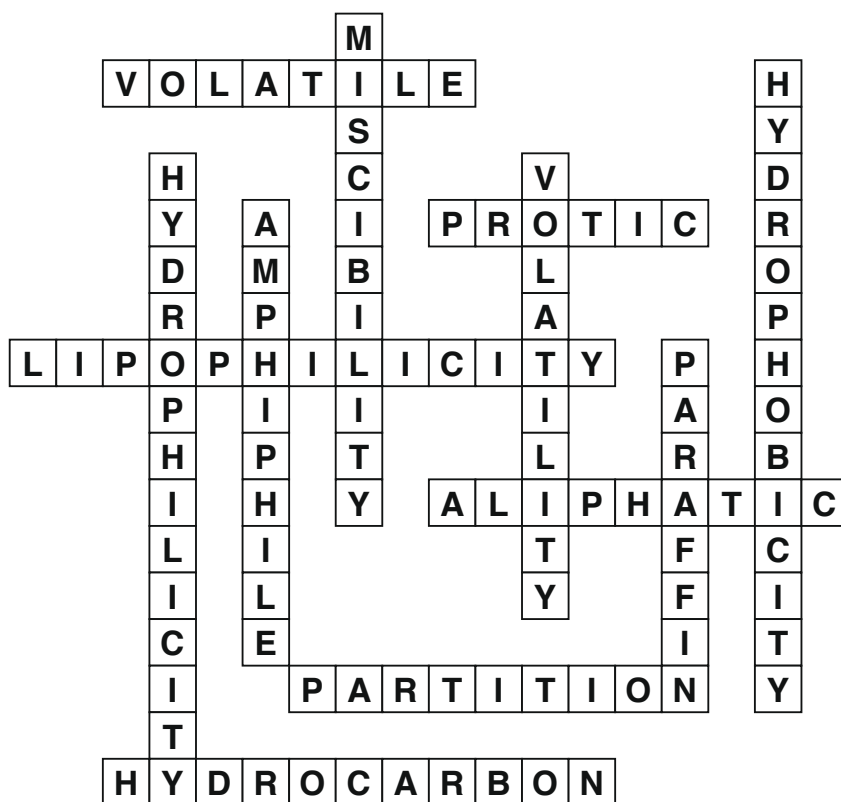
# Organic Functional Groups



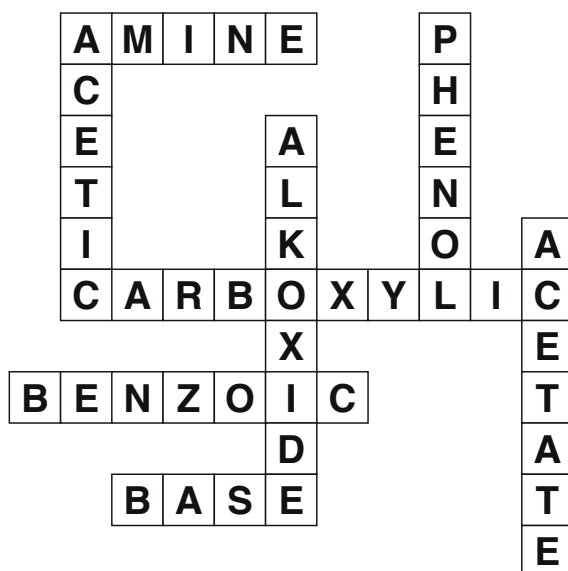
# Stereochemistry



## Physical Properties



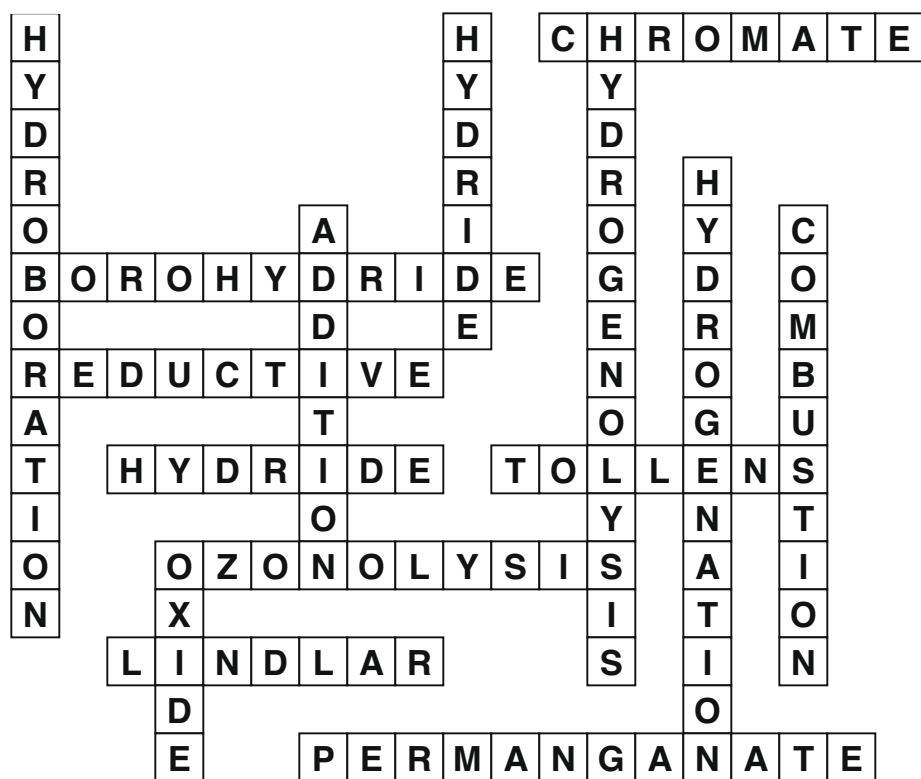
## Organic Acids & Bases



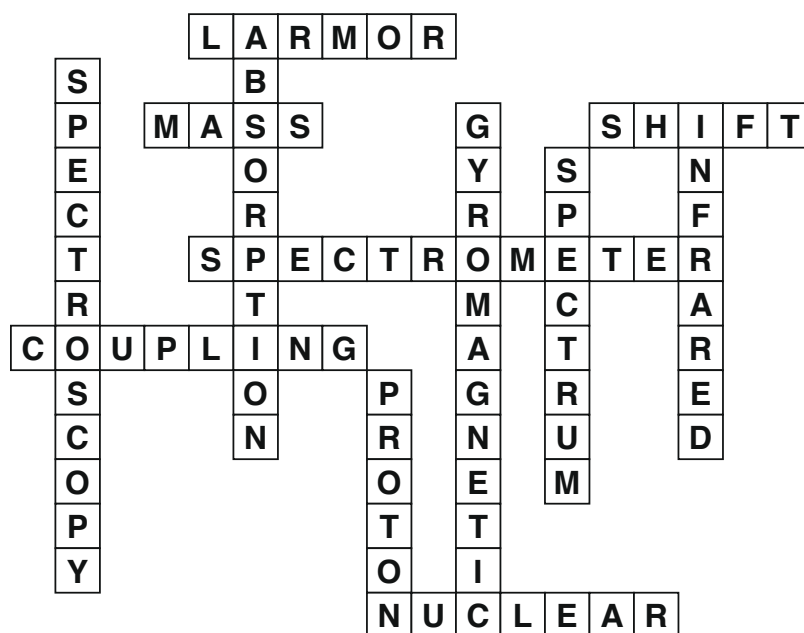
## Aromatic Compounds



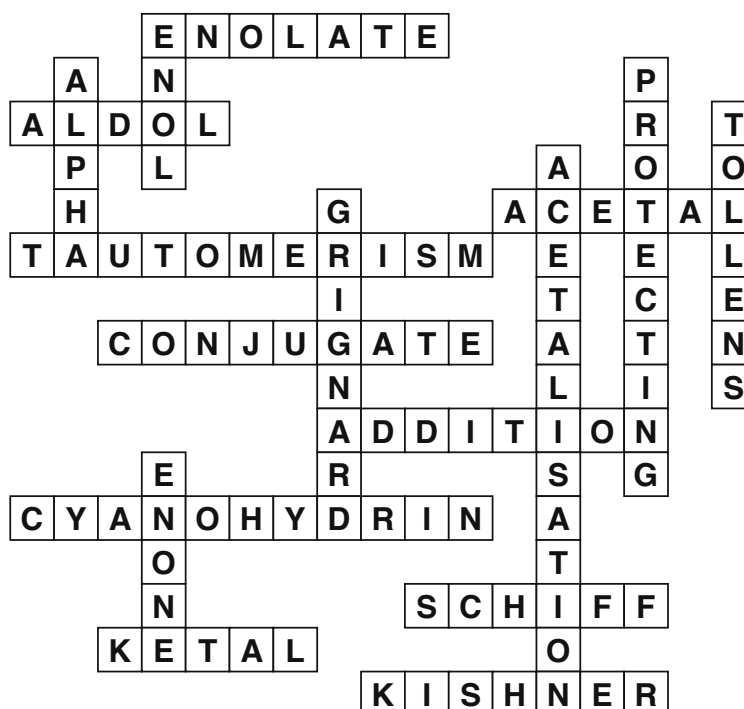
## Organic Redox



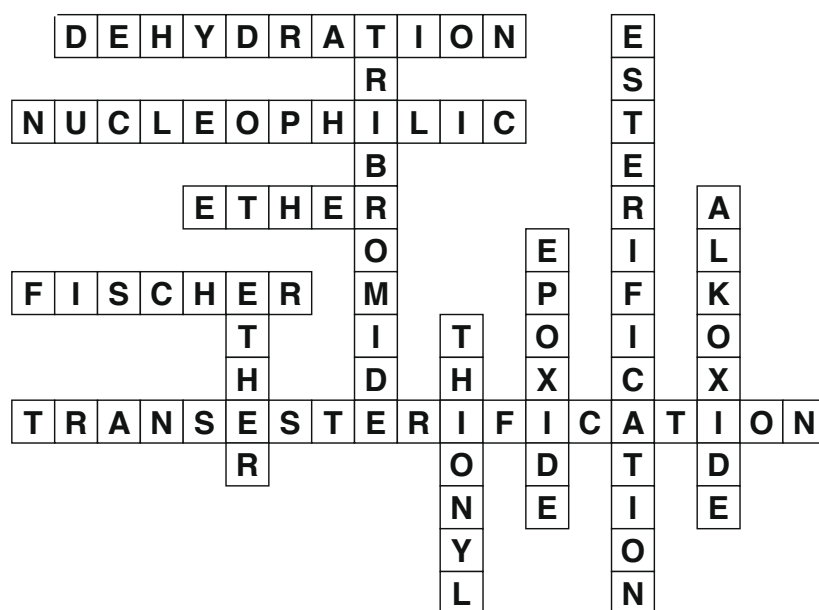
# Molecular Spectroscopy



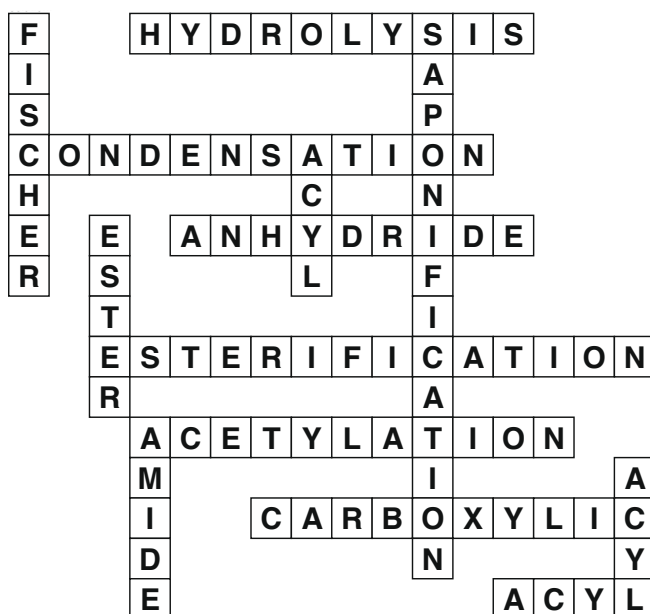
# Aldehydes & Ketones



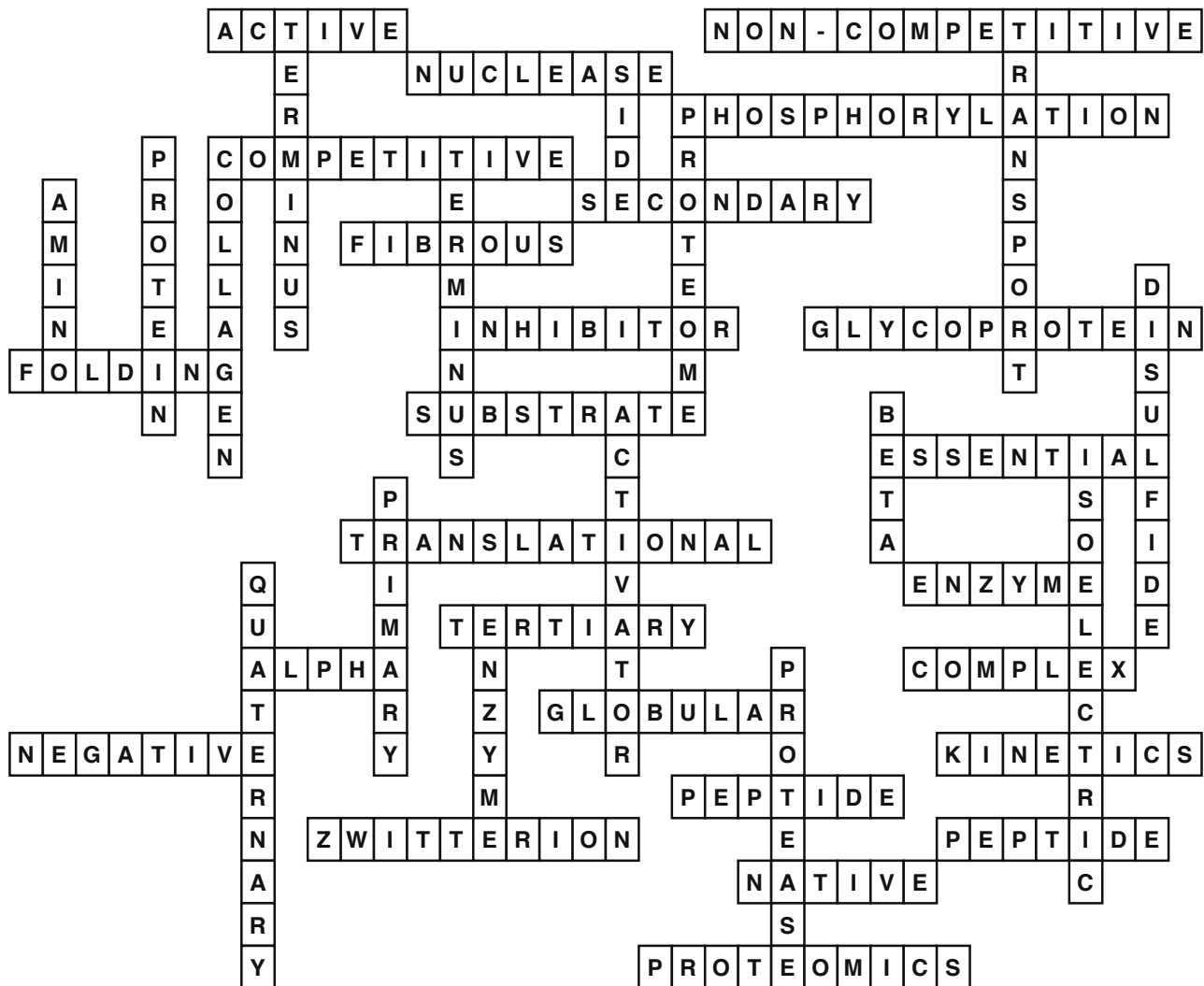
# Alcohols



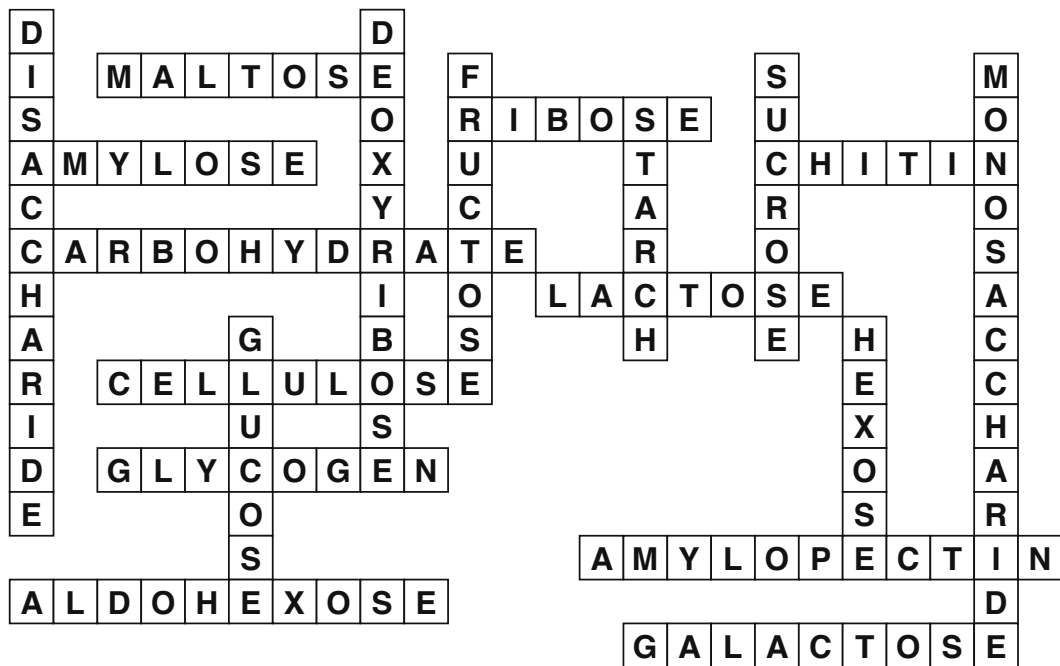
# Carboxylic Acid Derivatives



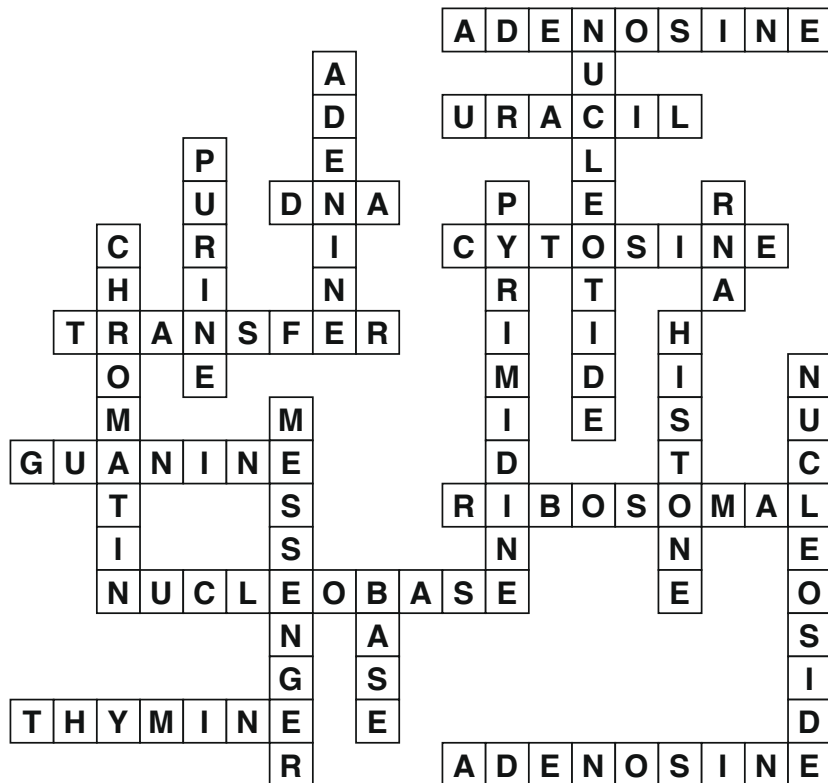
# Proteins



# Carbohydrates

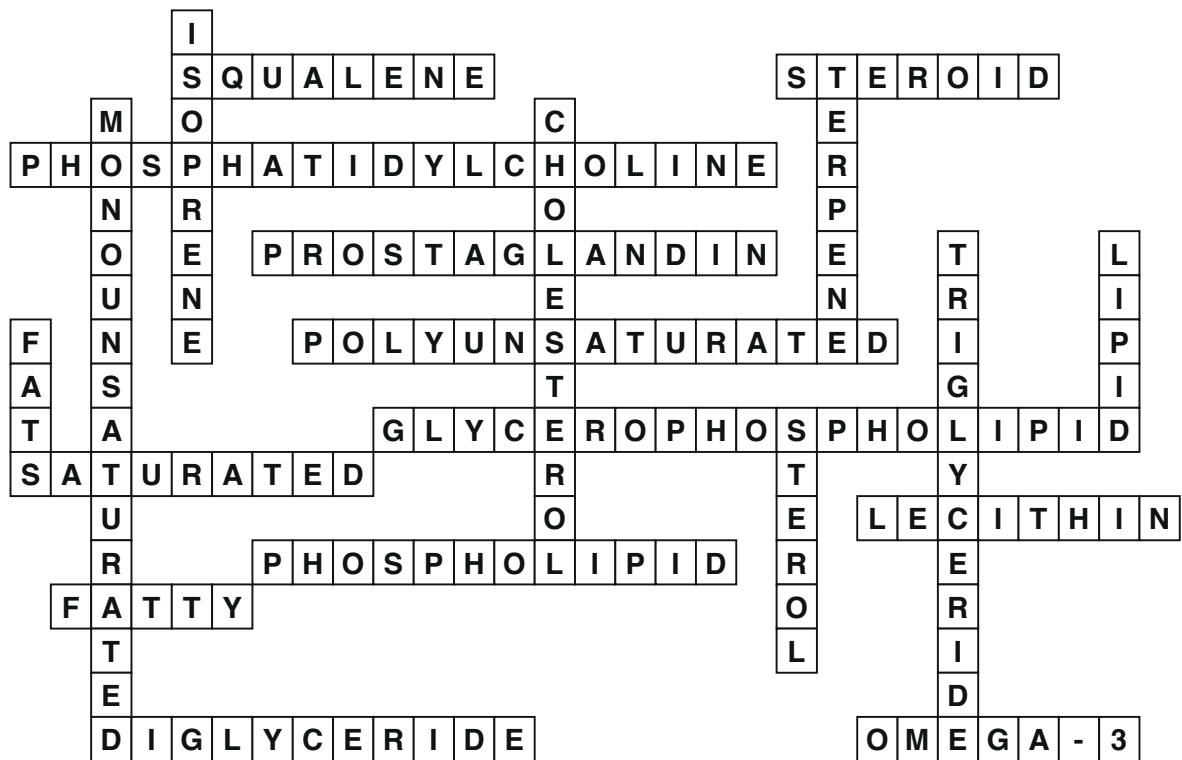


# Nucleic Acids

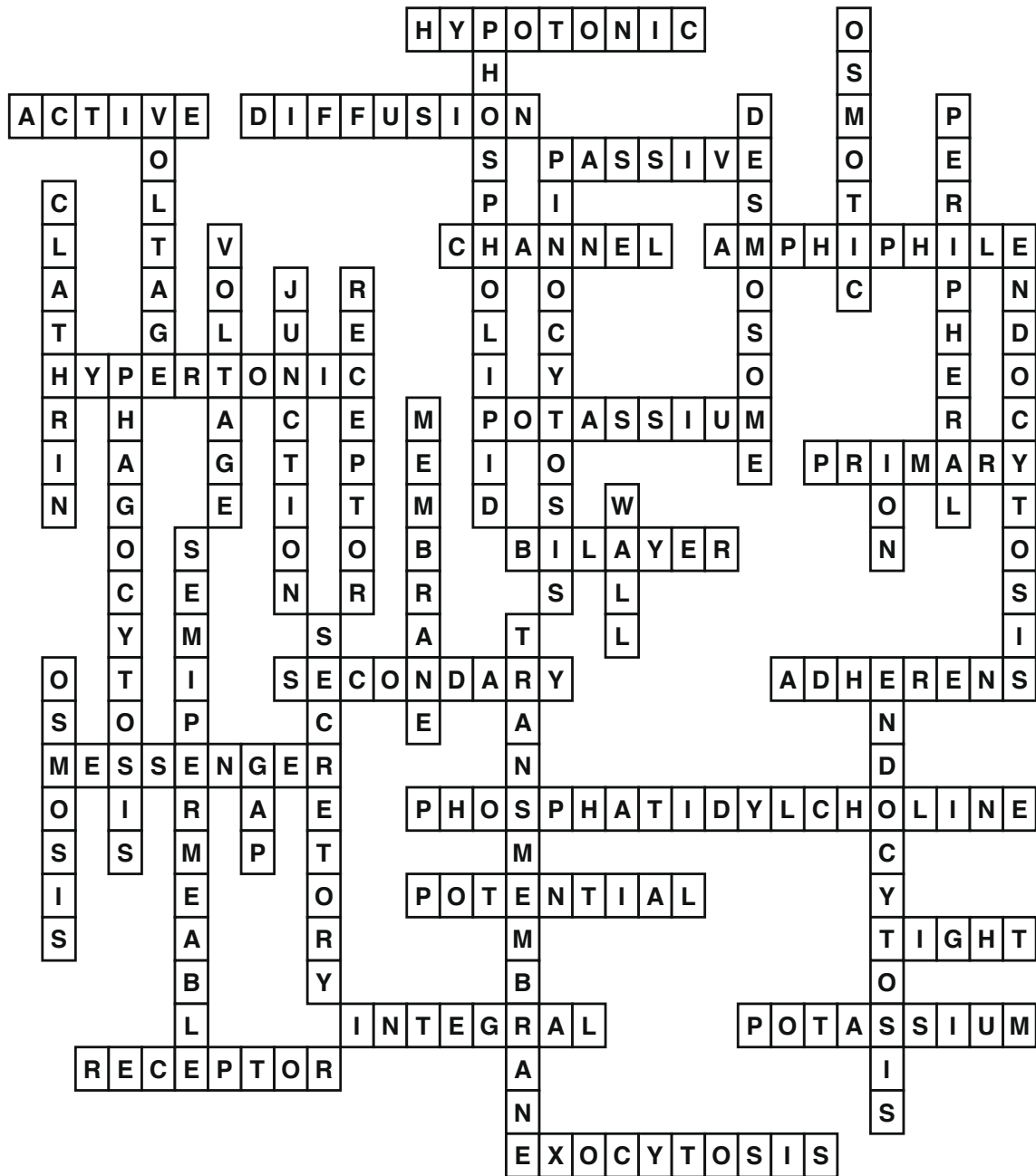




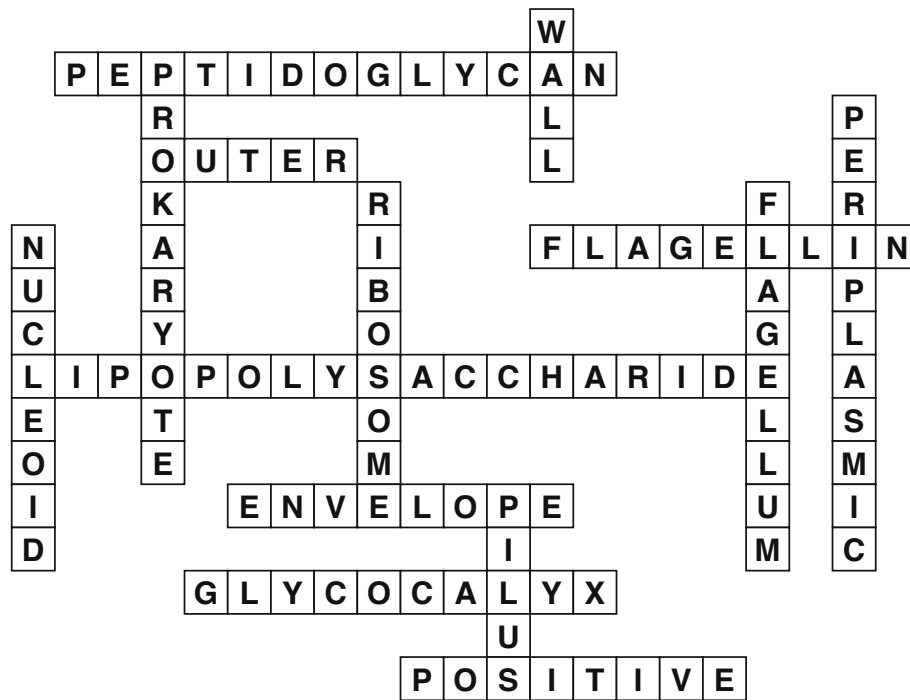
# Lipids



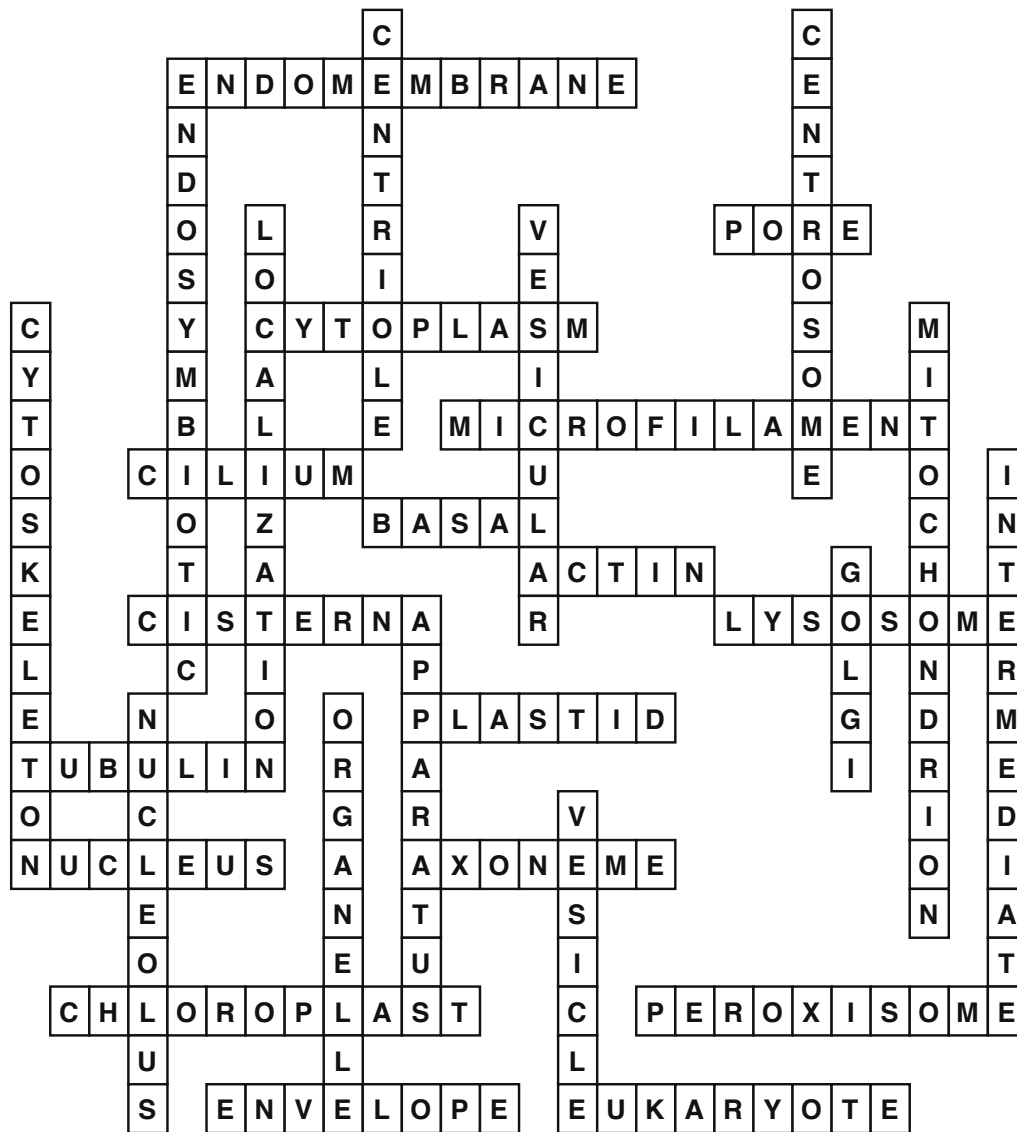
# Biological Membranes



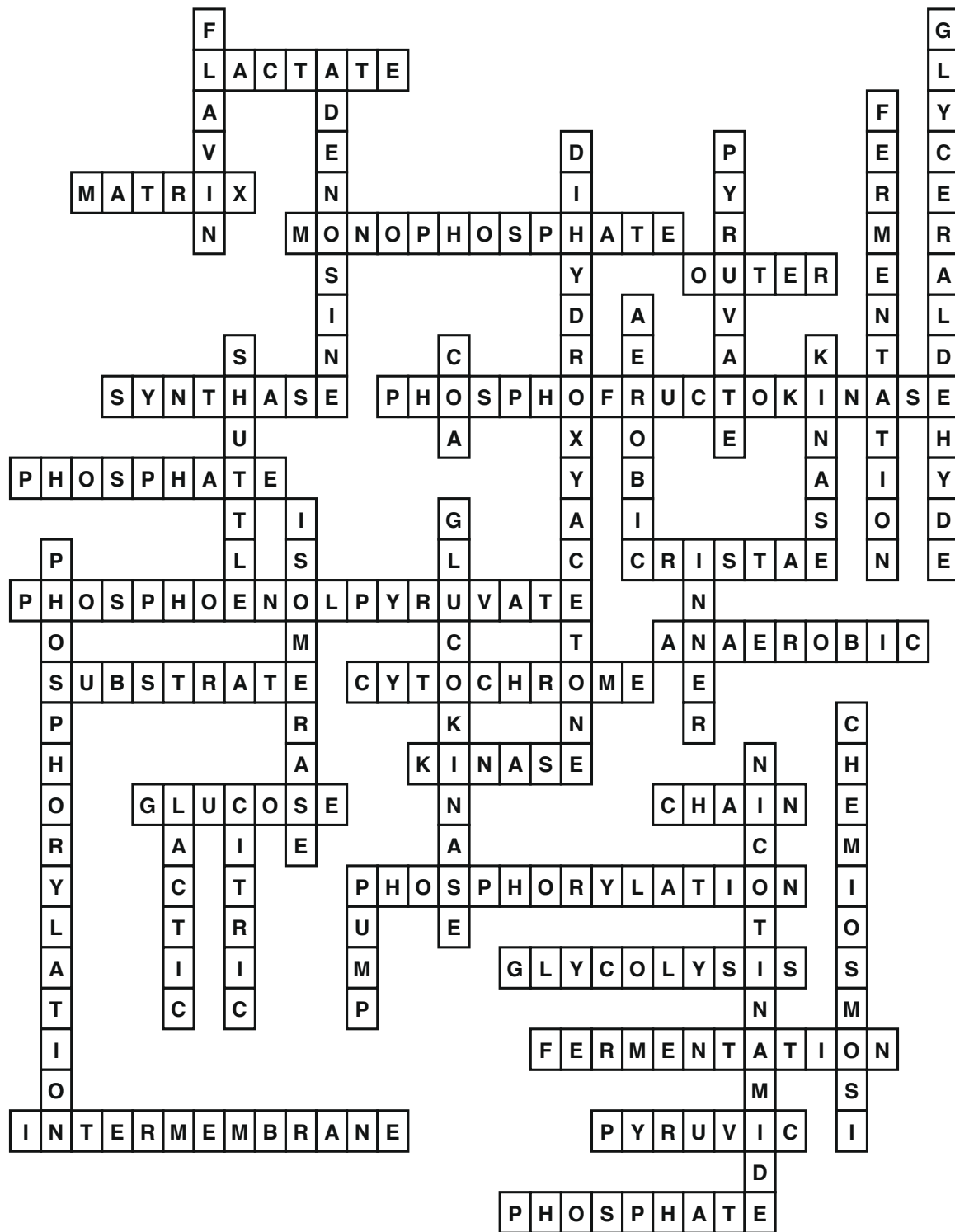
# Prokaryotes



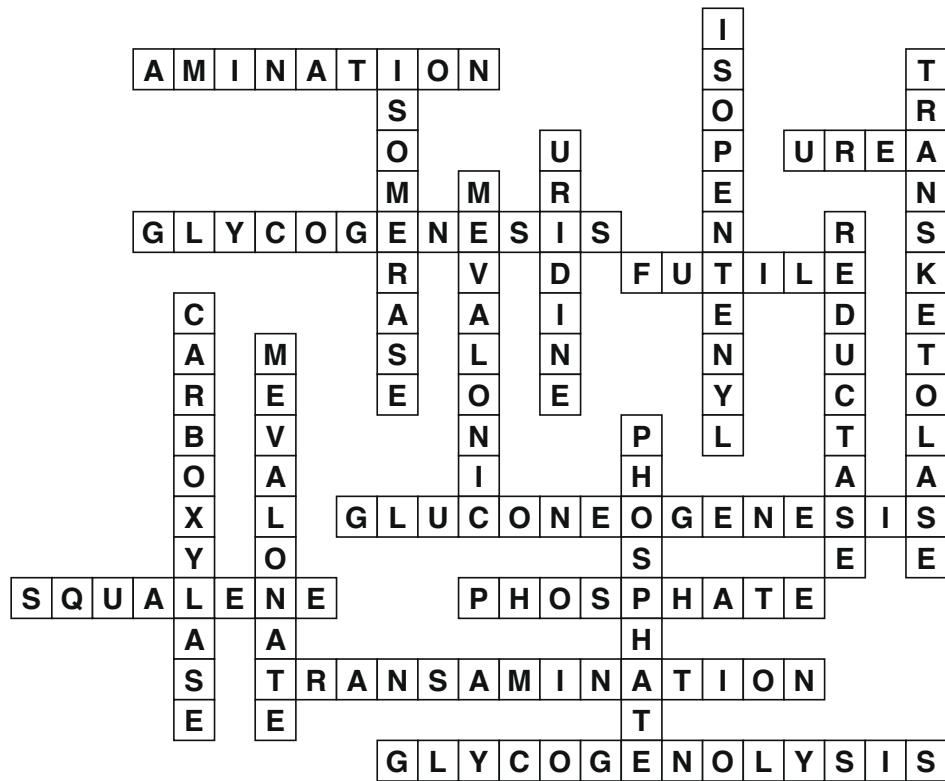
# Eukaryotes



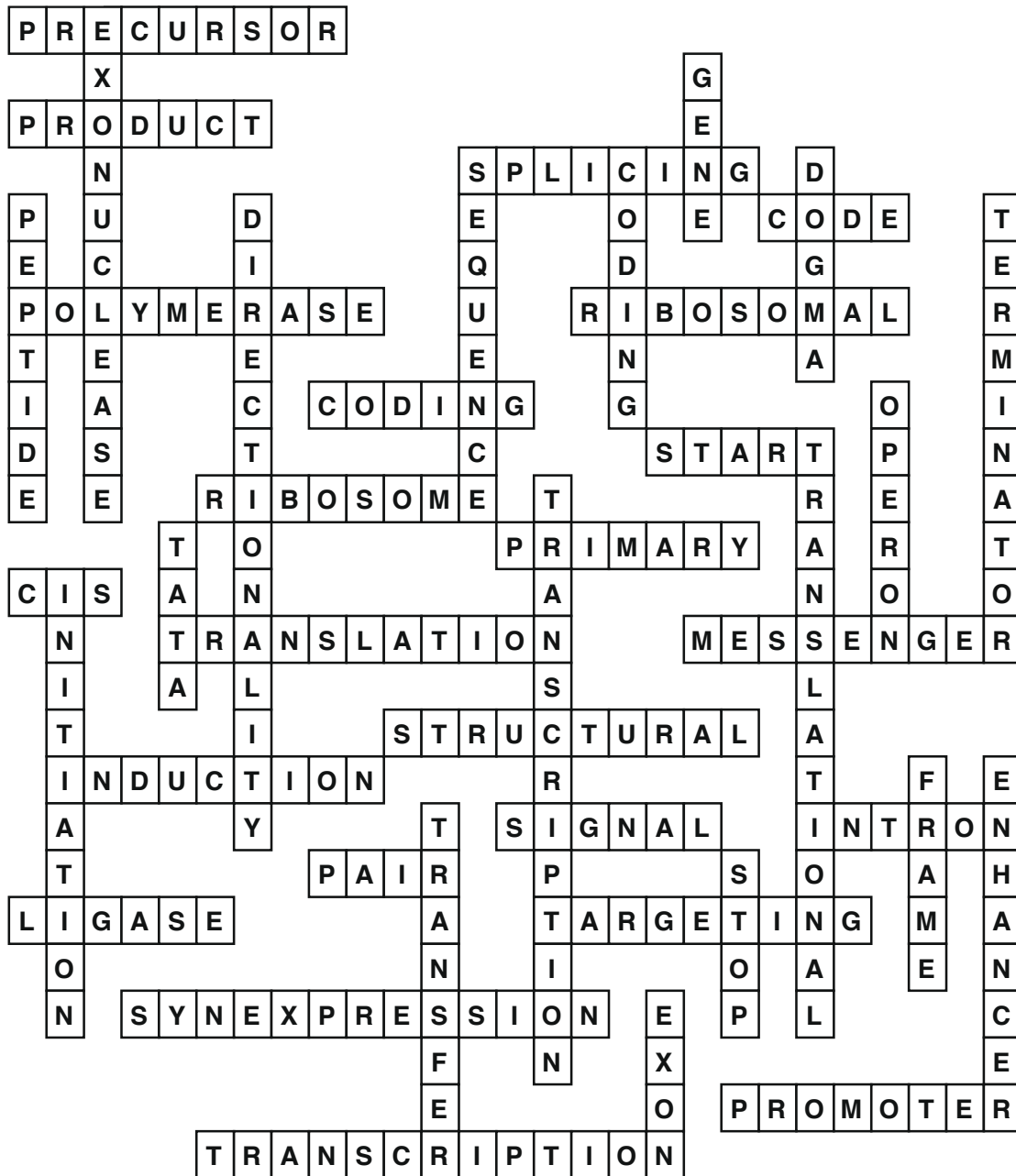
# Energy Metabolism



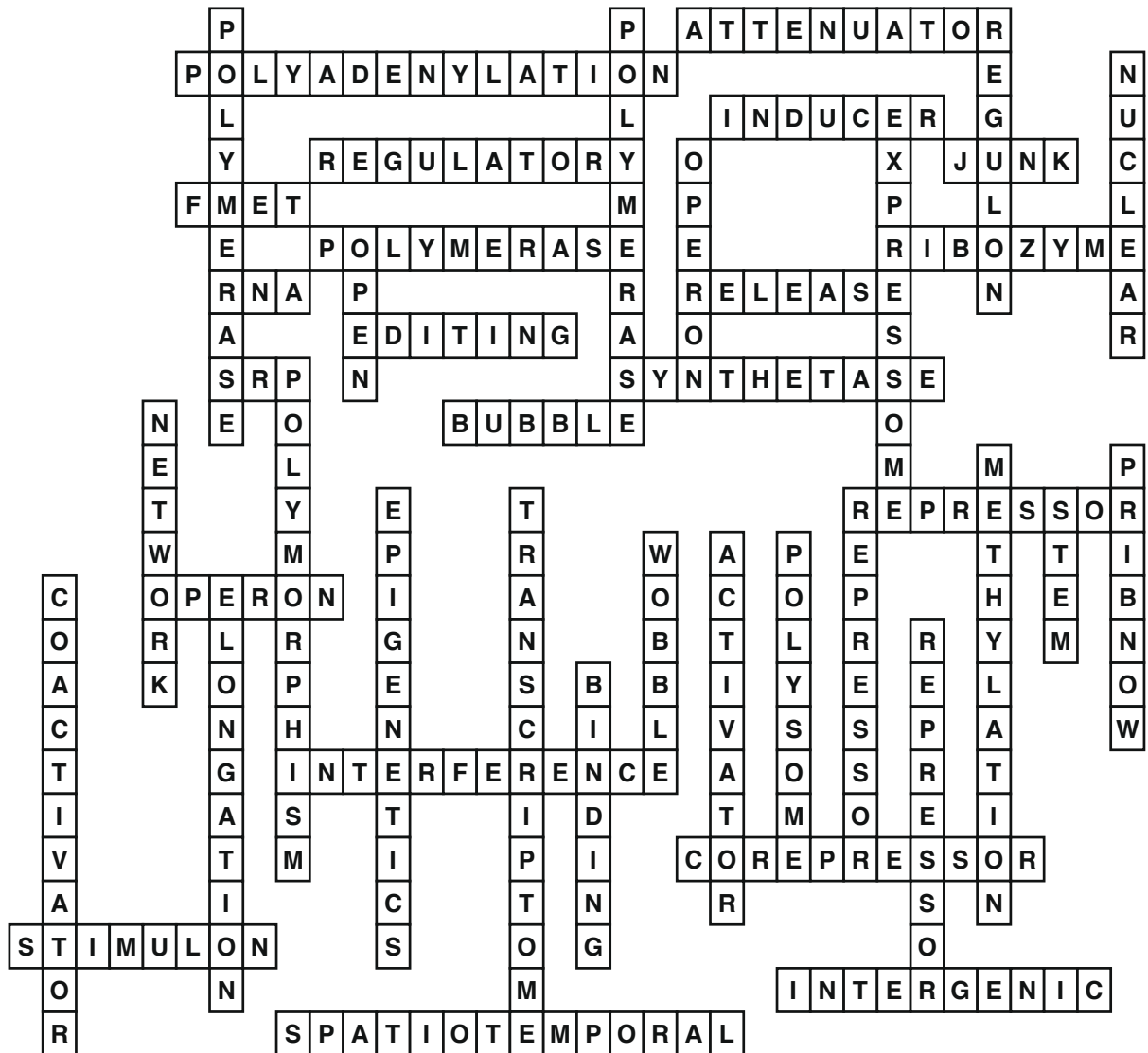
# Metabolic Integration



# Gene Expression - Part 1

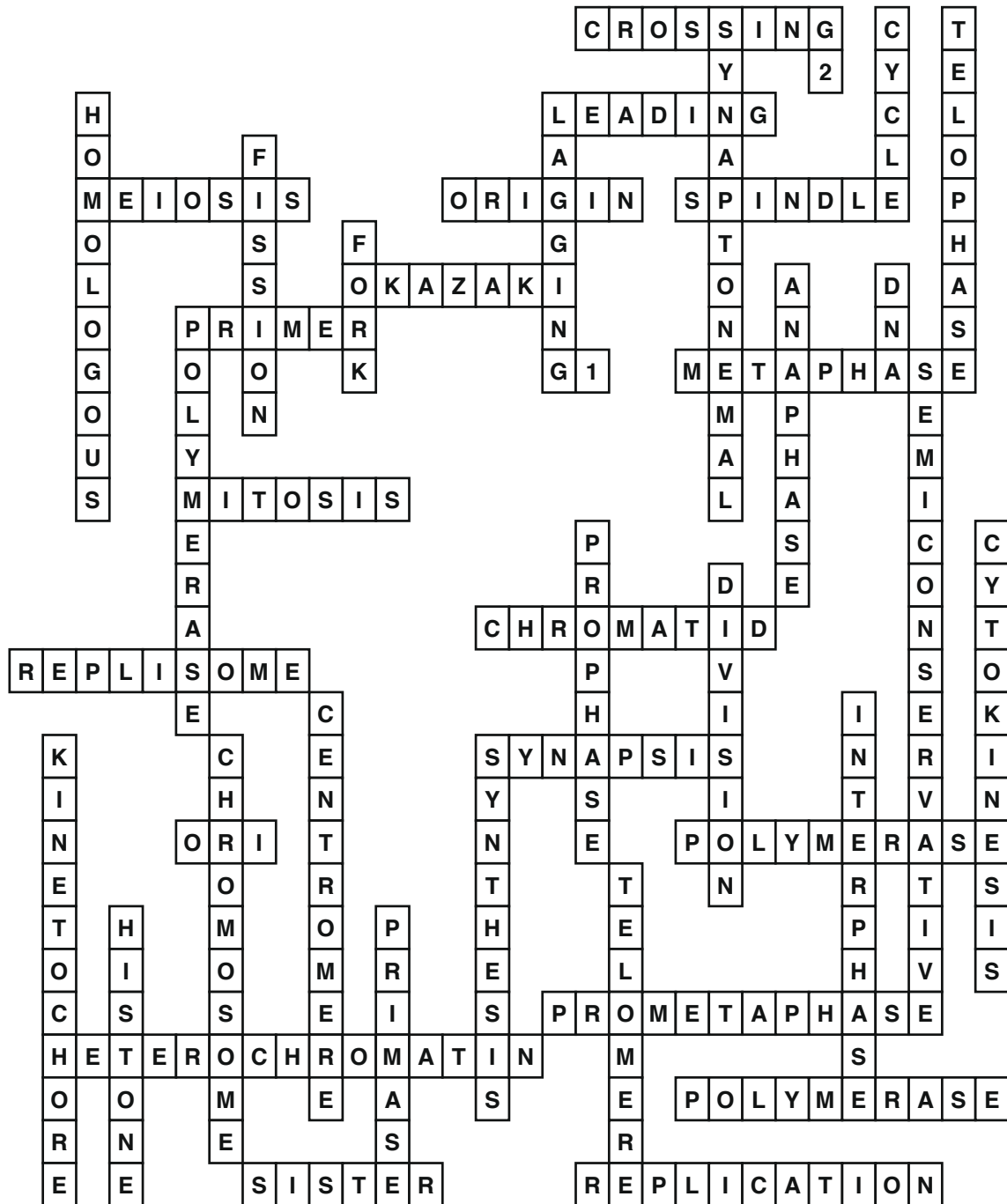


## Gene Expression - Part 2

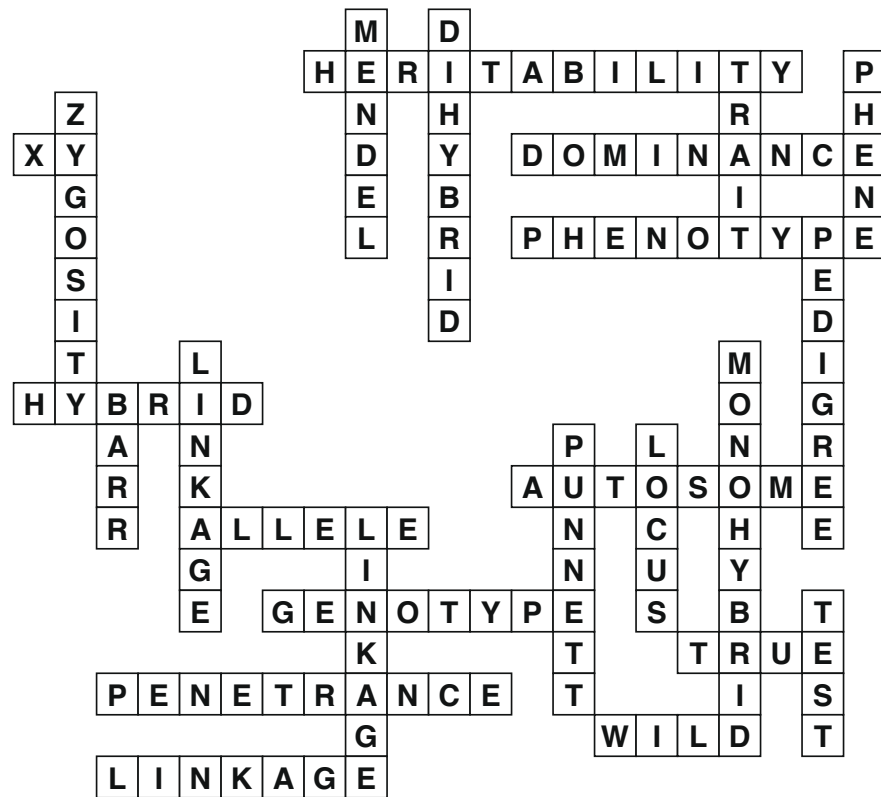




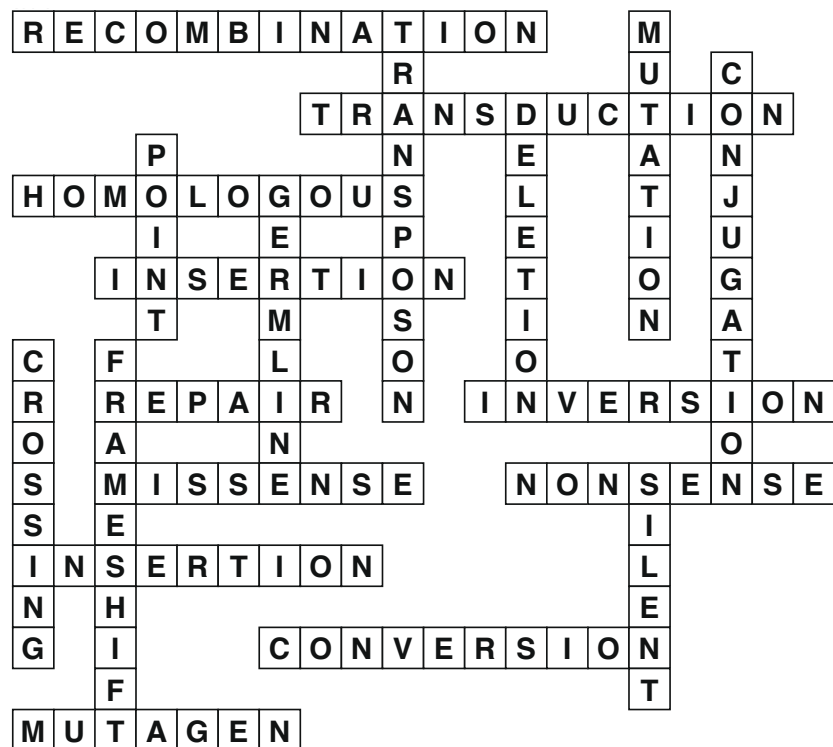
# Cellular Reproduction



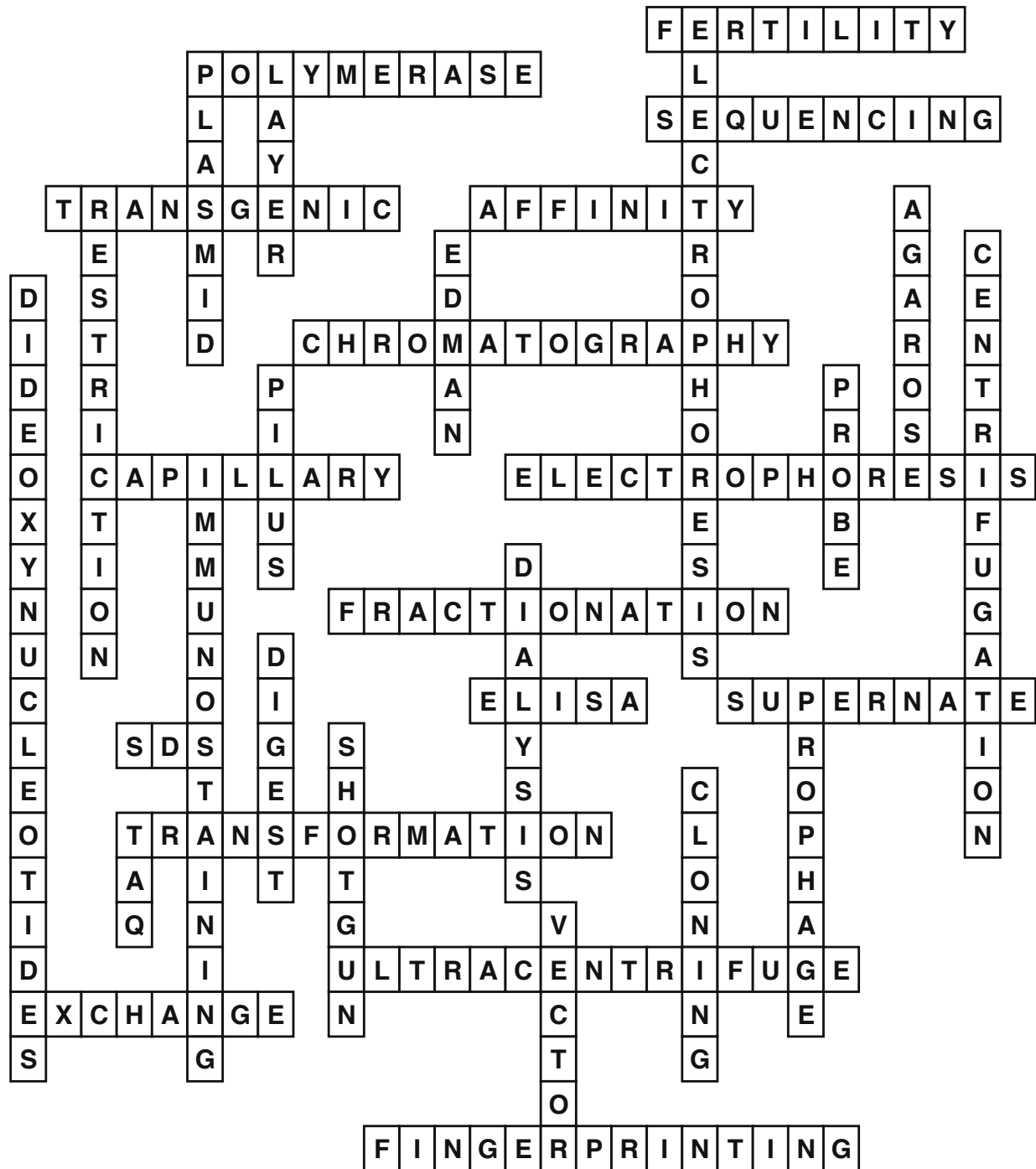
# Transmission Genetics



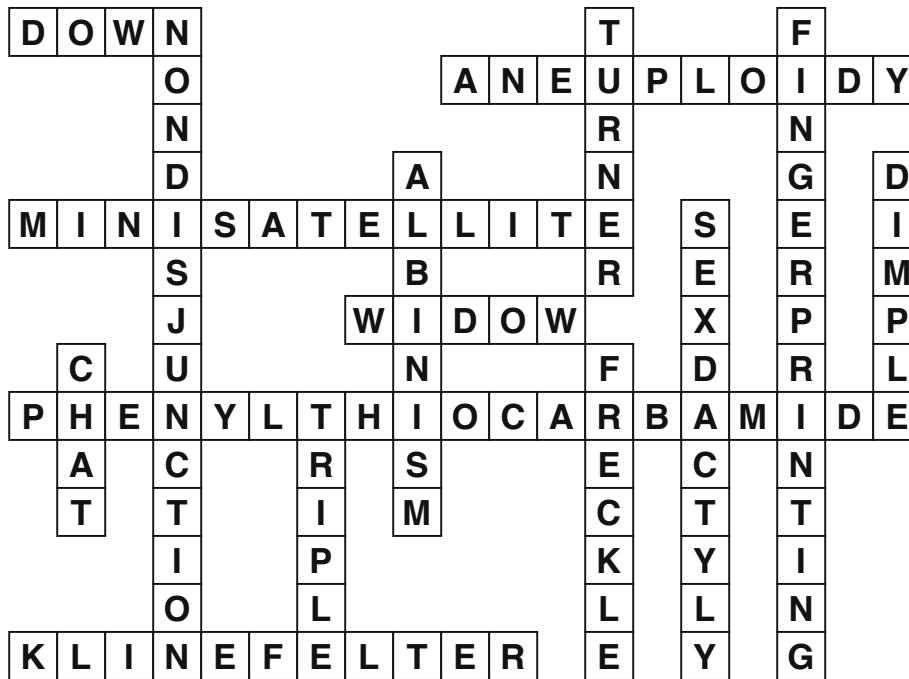
# Mutation



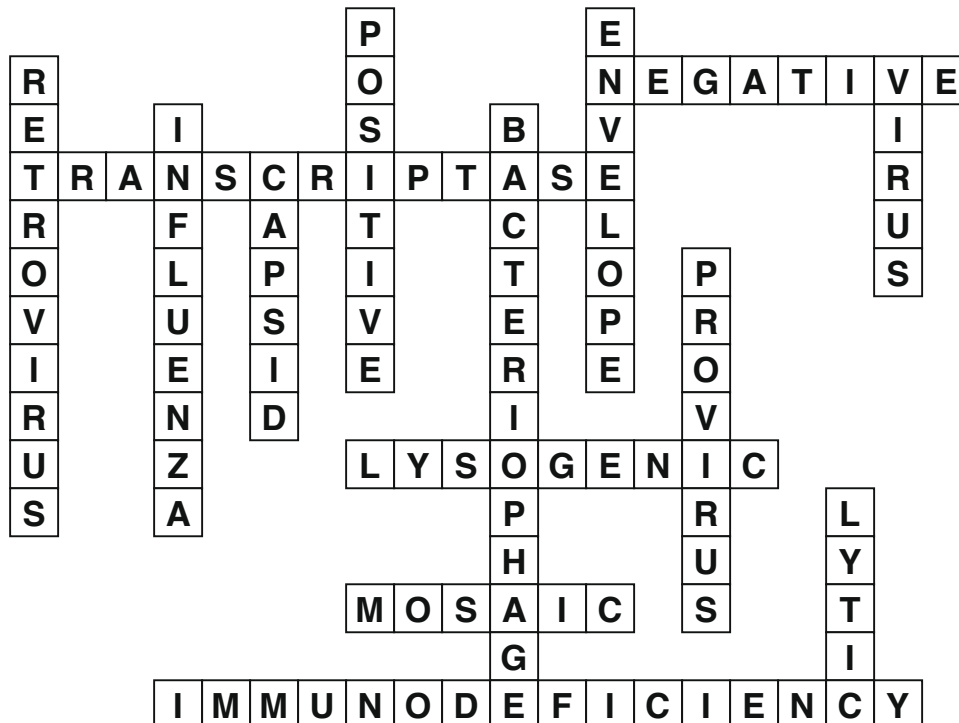
# Genomics Laboratory



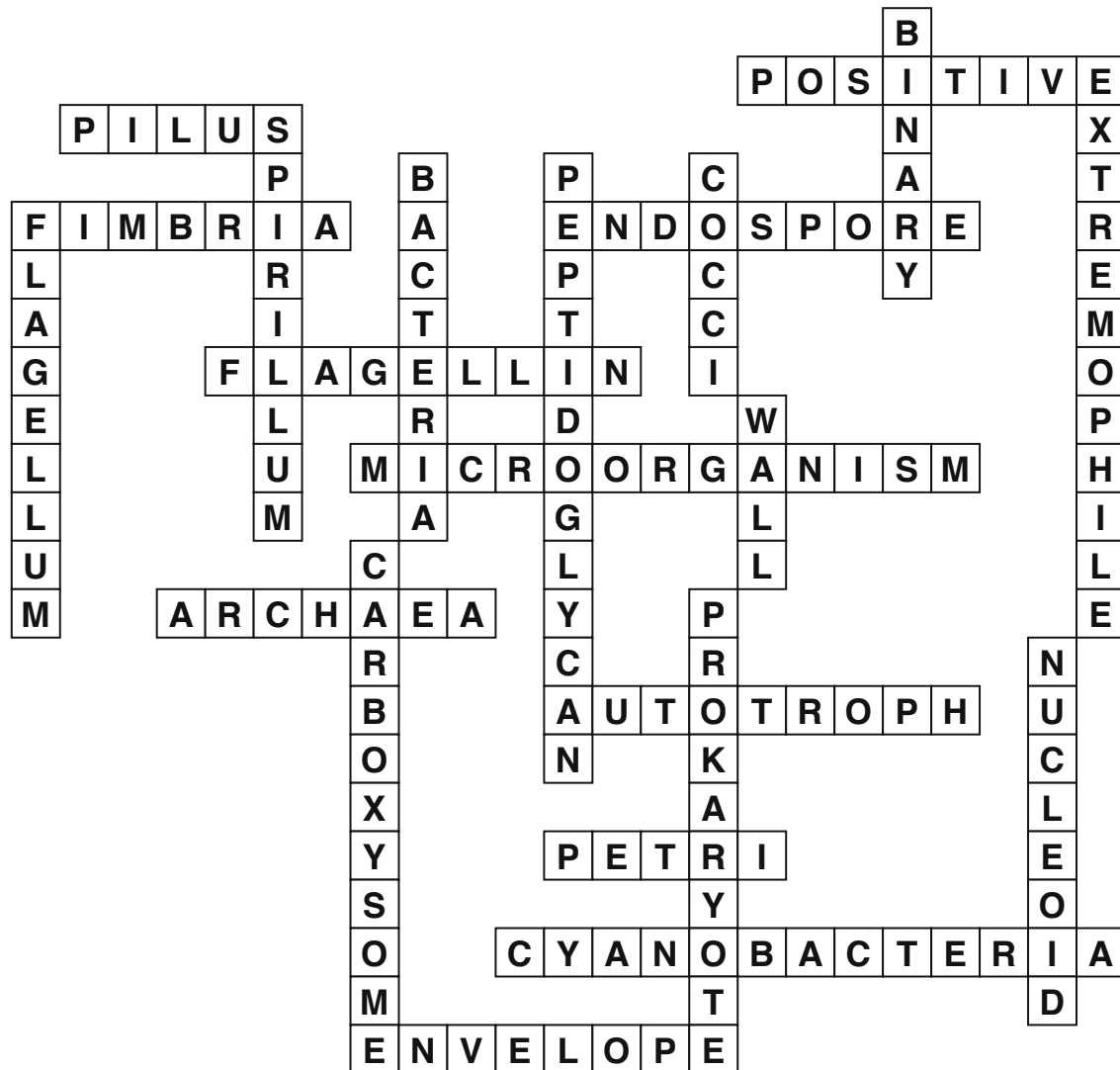
## Human Genetics



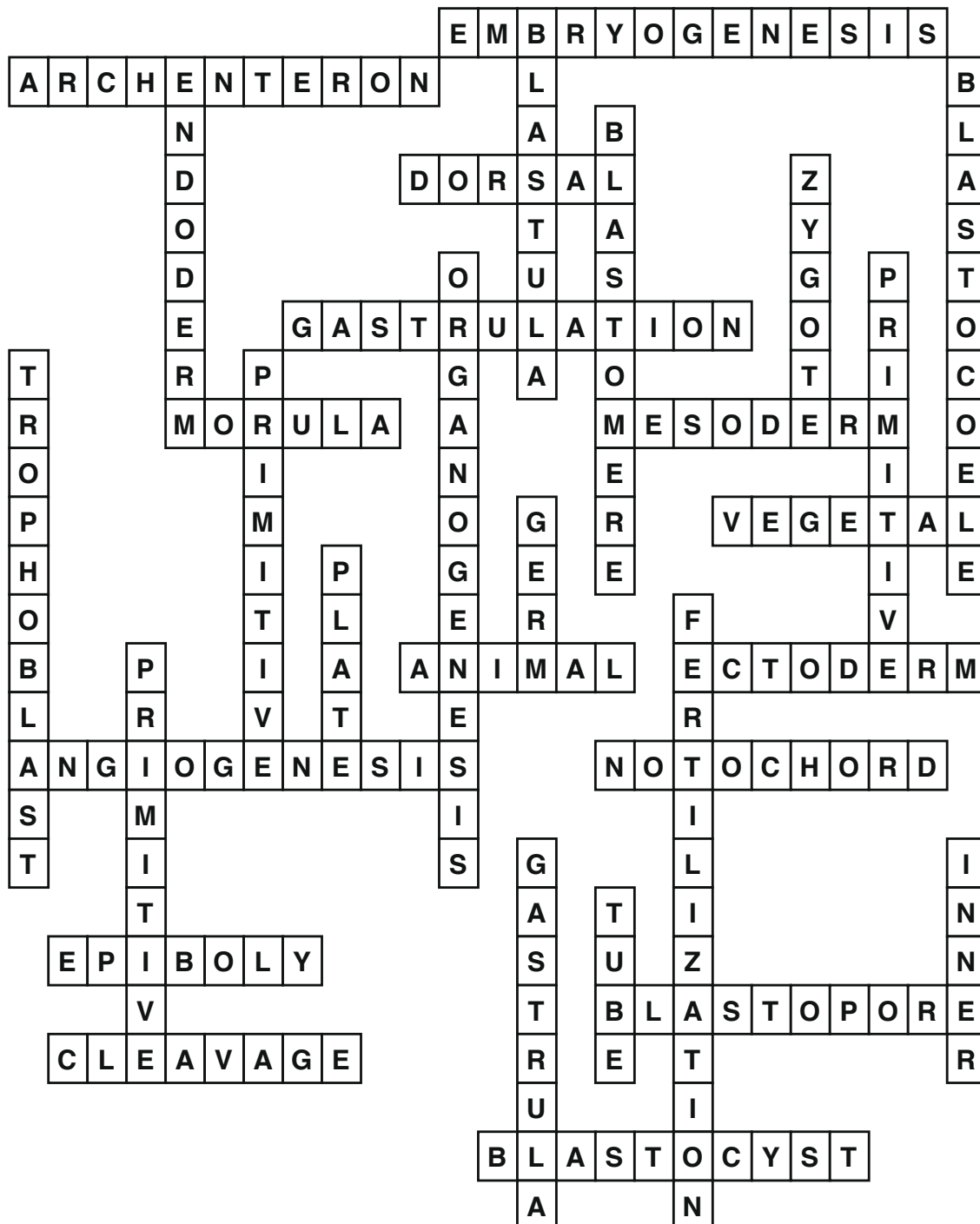
## Viruses



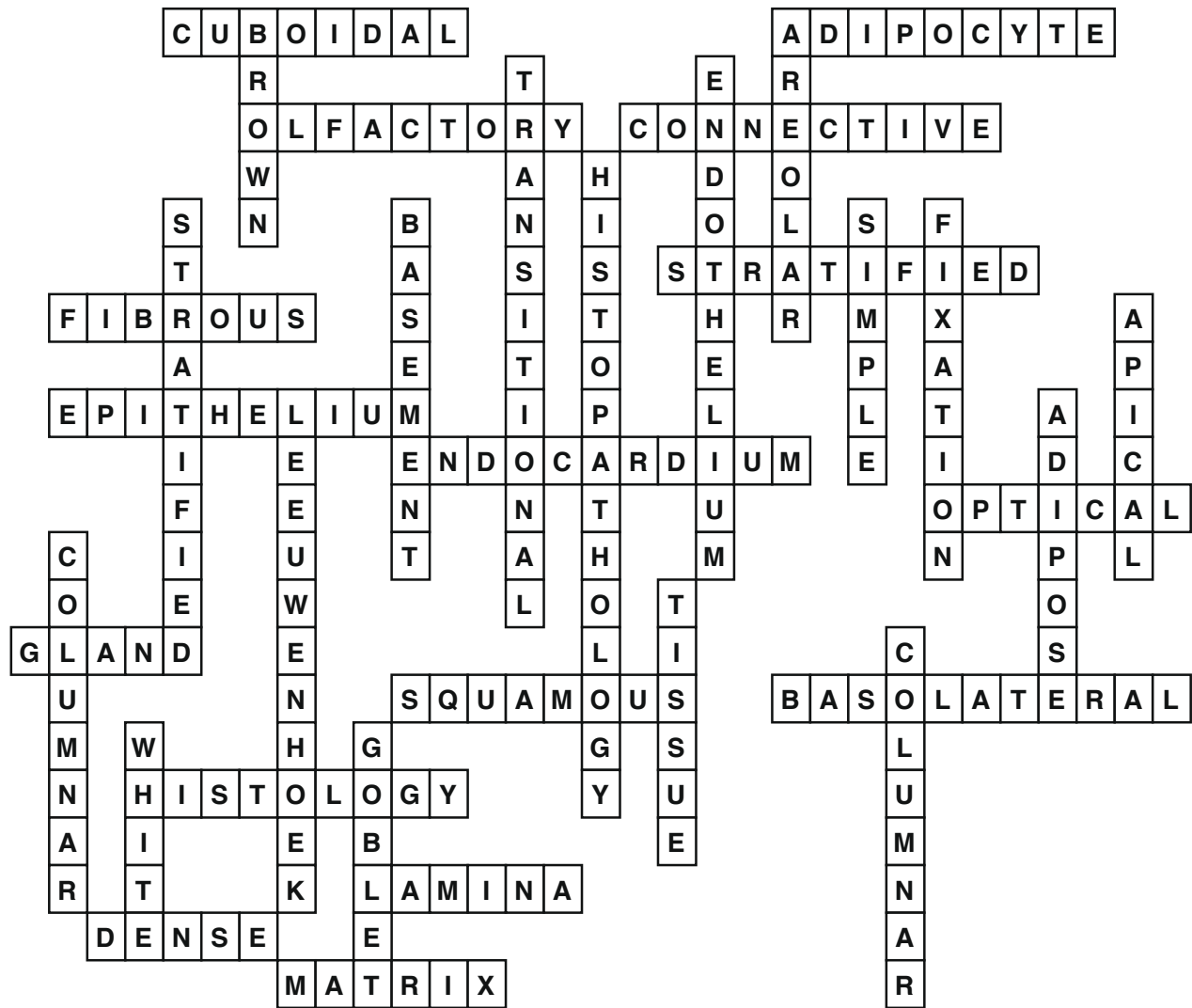
# Bacteria



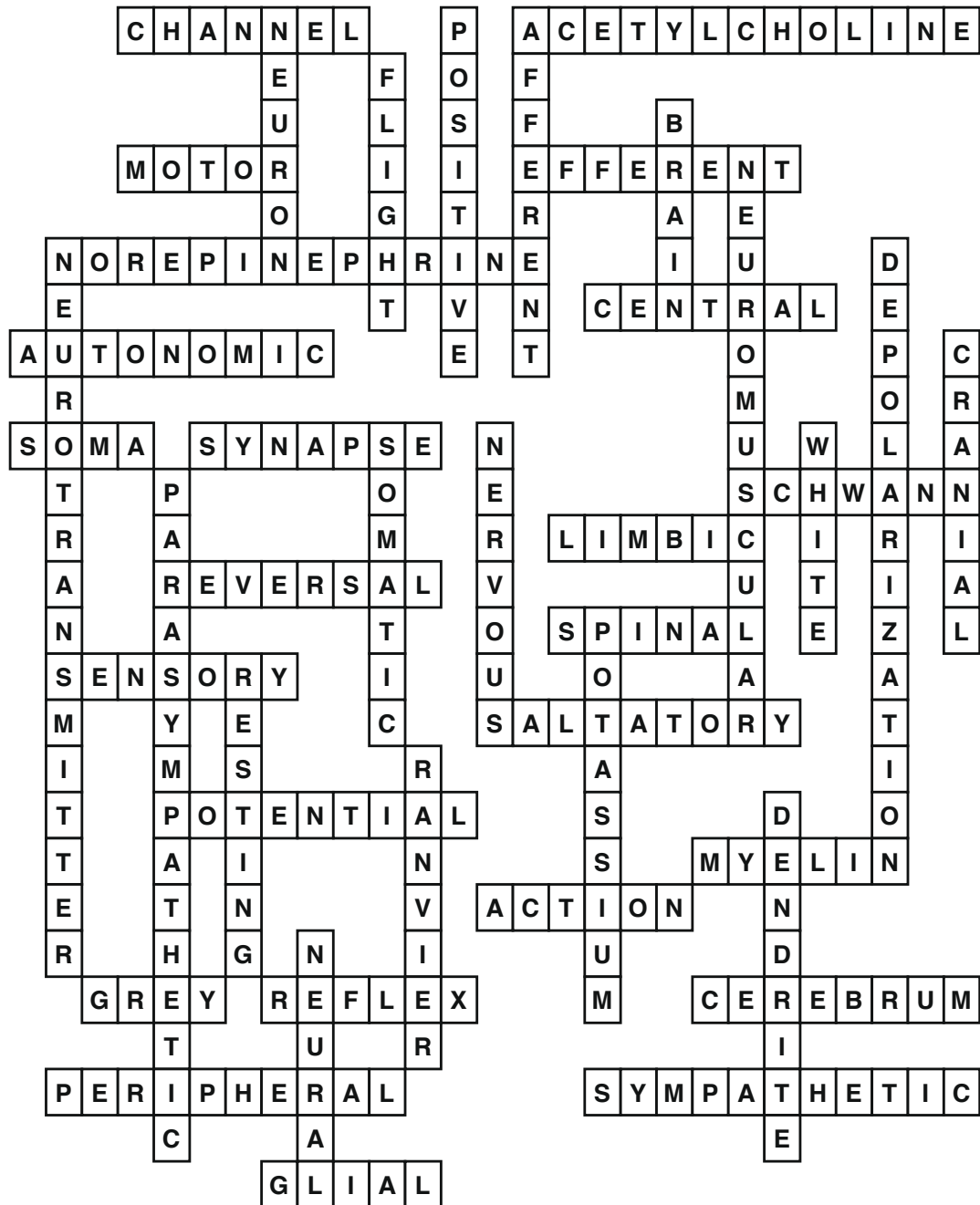
# Embryology



# Animal Tissues

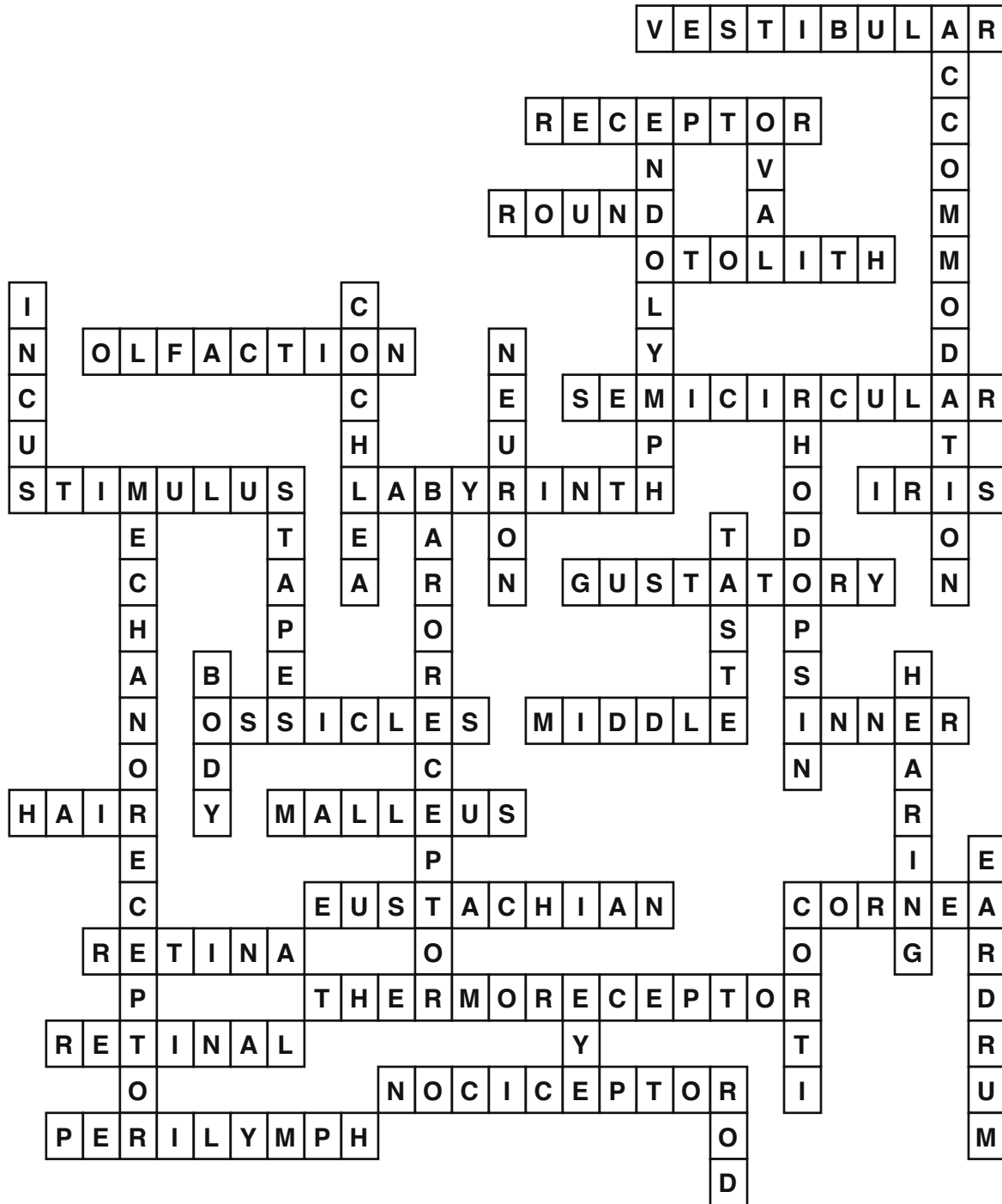


# Nervous System

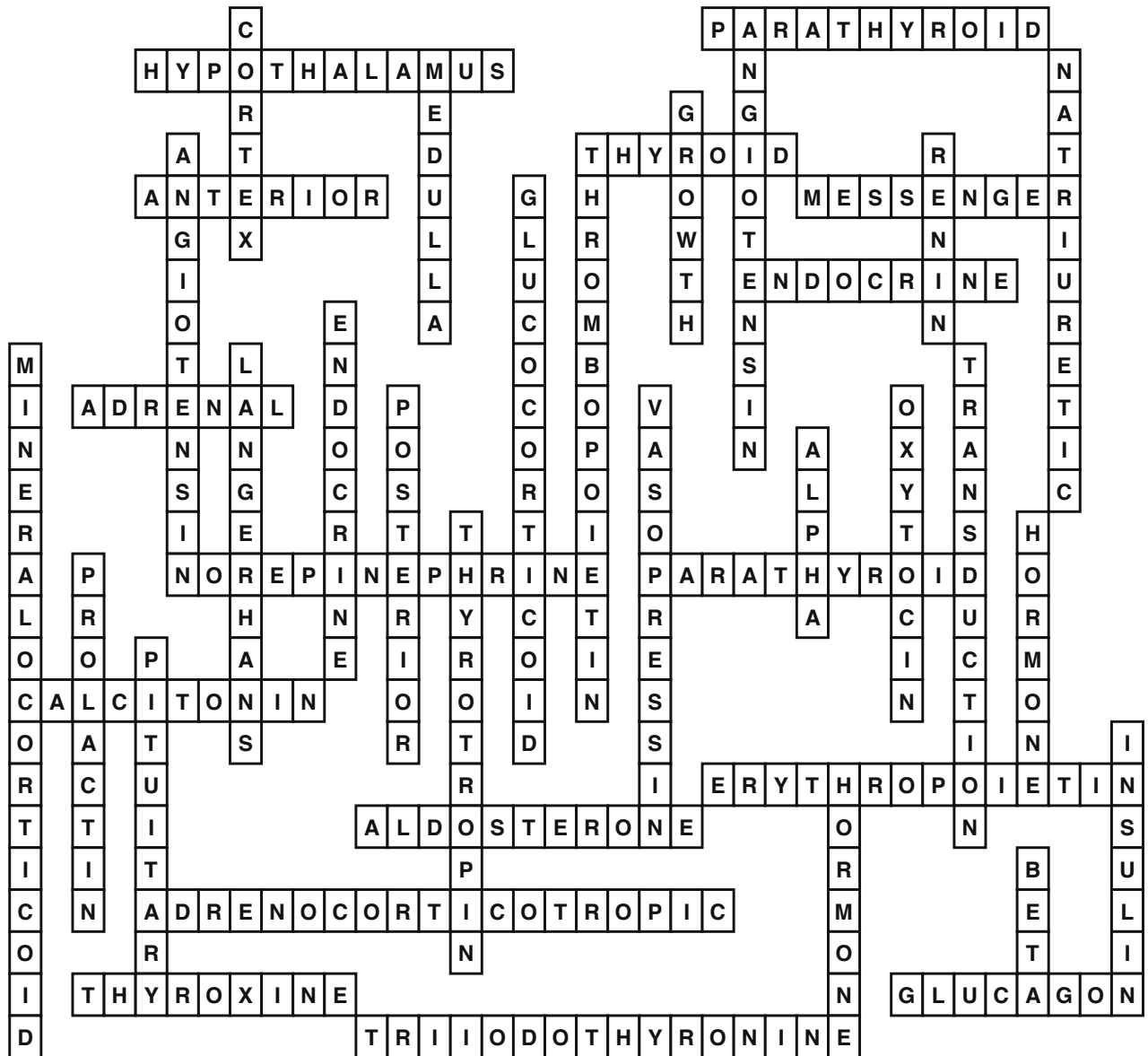




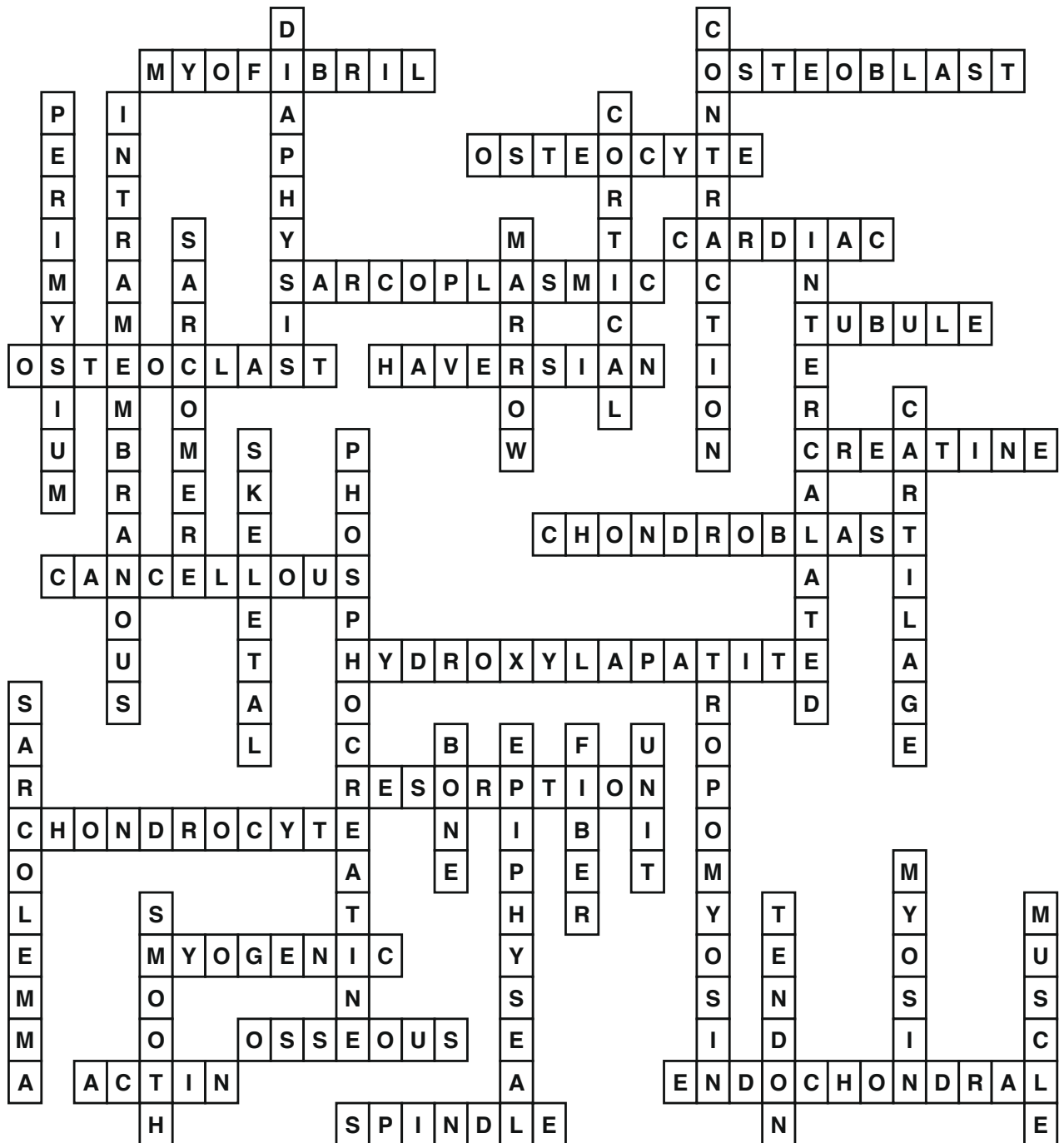
# Sensory Systems



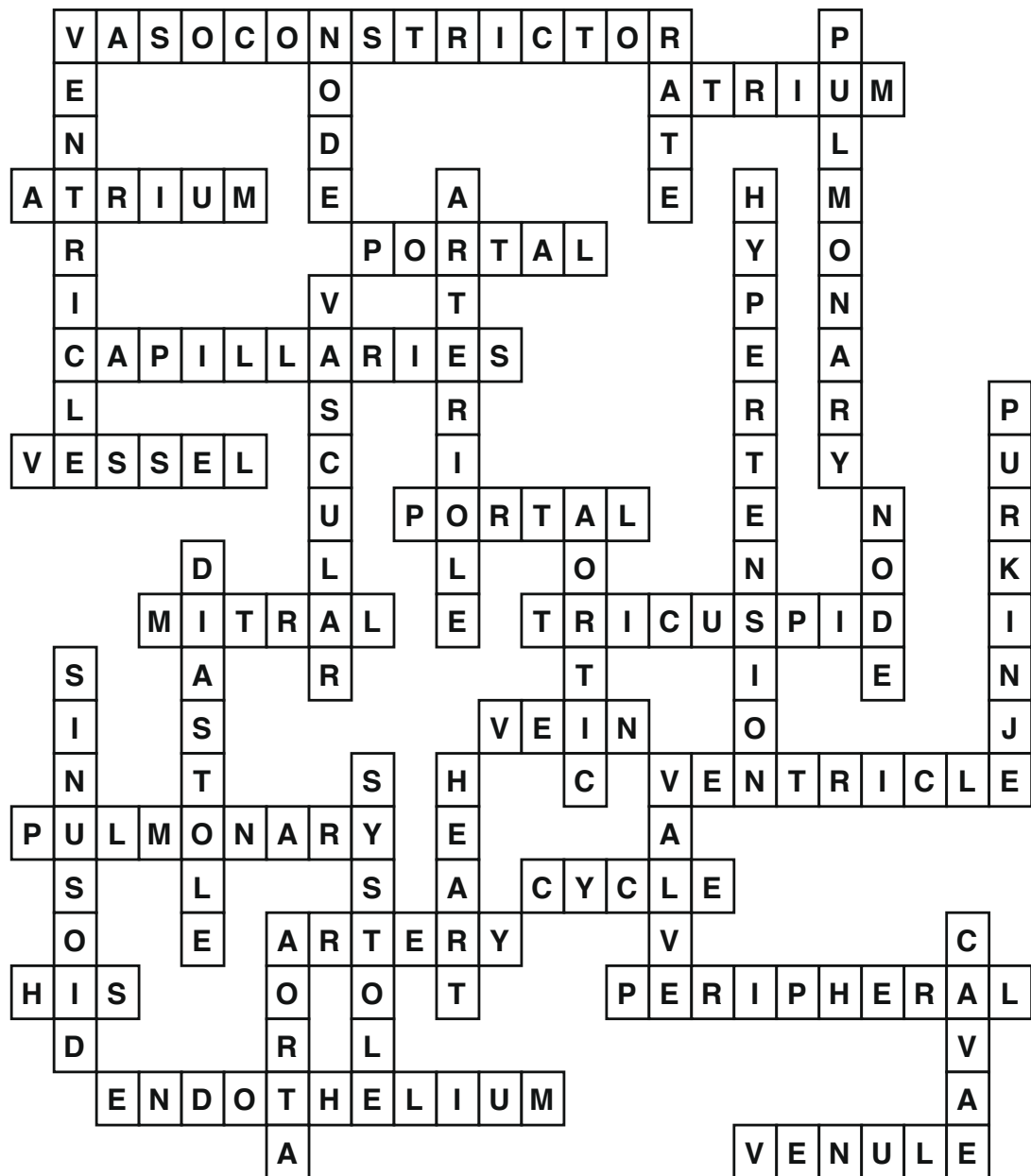
# Endocrine System



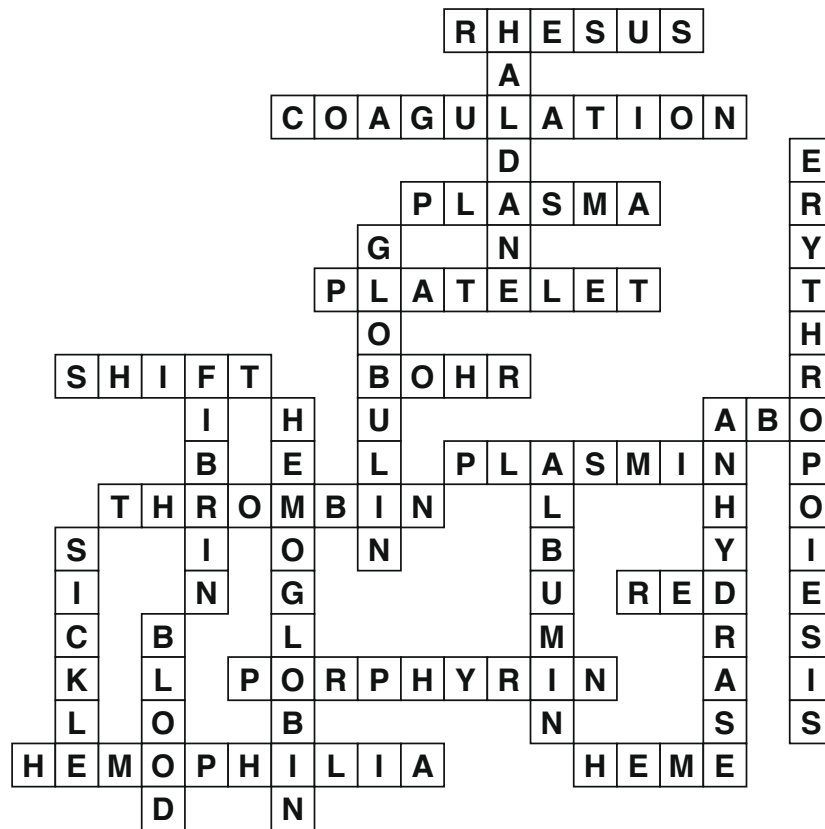
# Musculoskeletal System



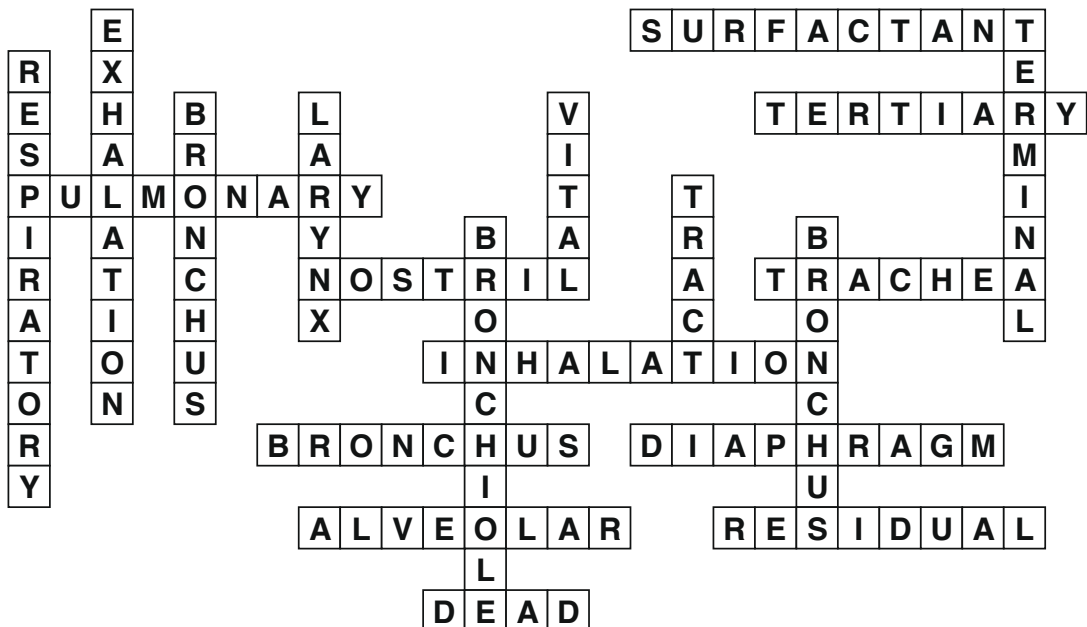
# Cardiovascular System



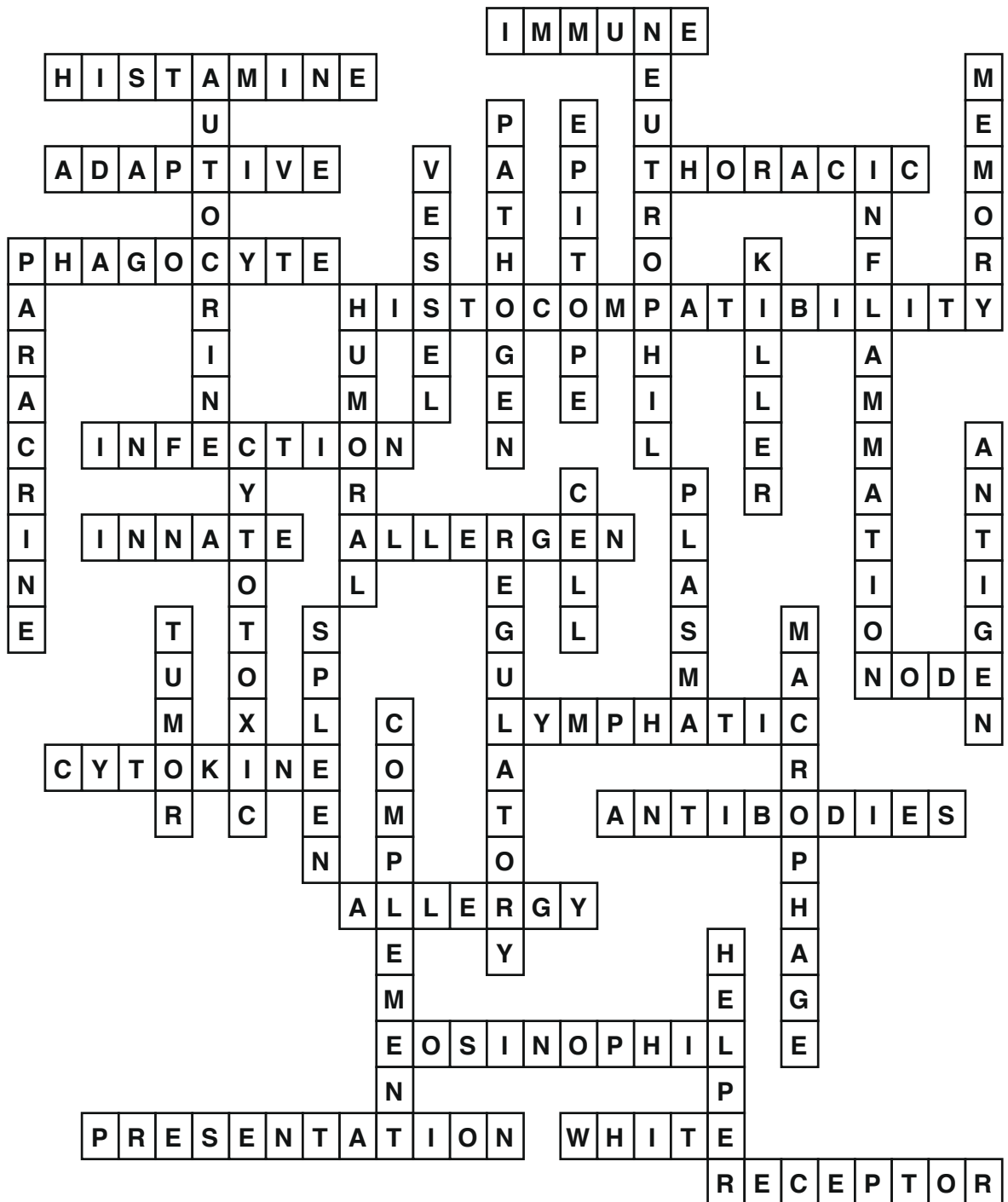
## Blood



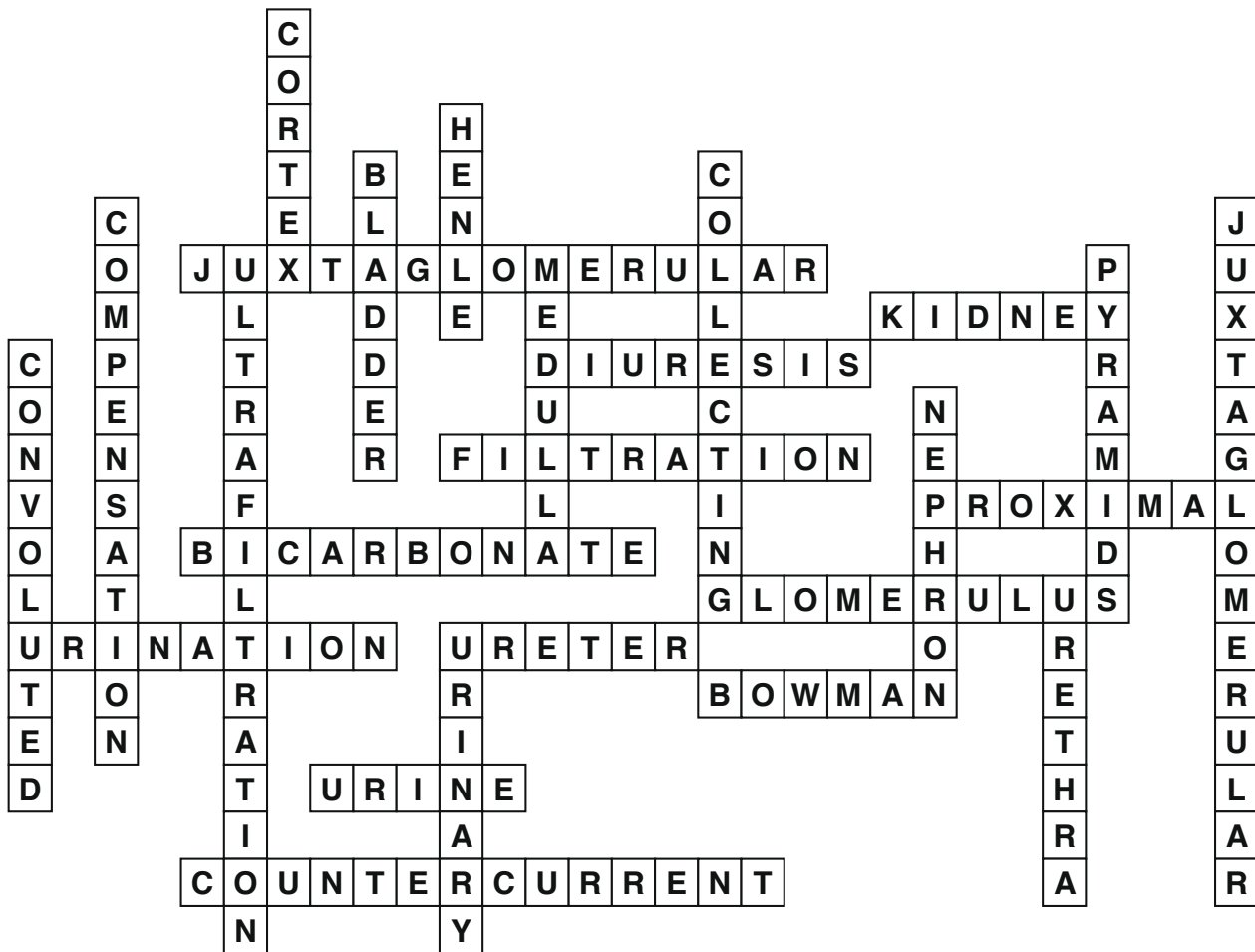
## Respiratory System



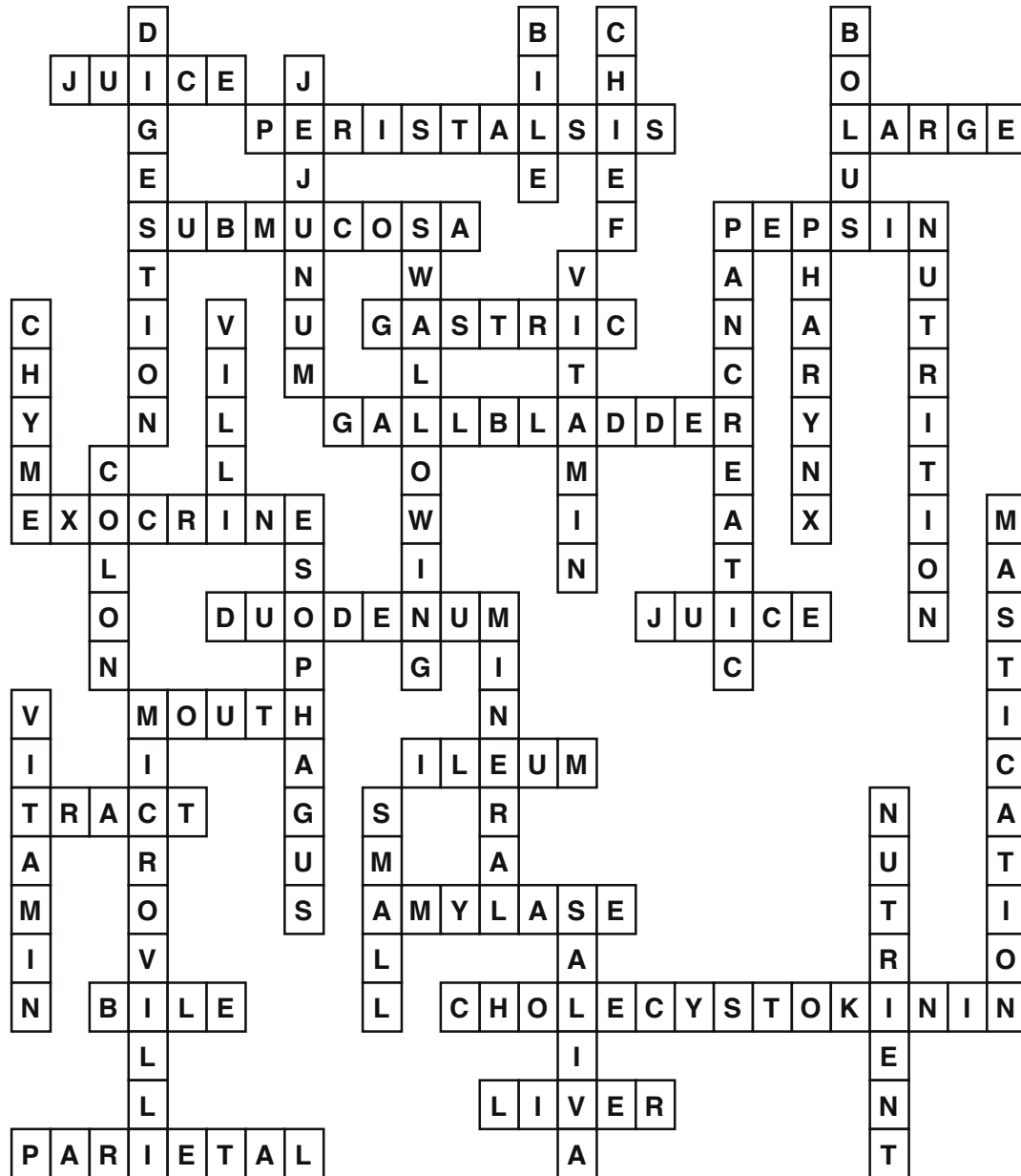
# Immunity



# Urinary System

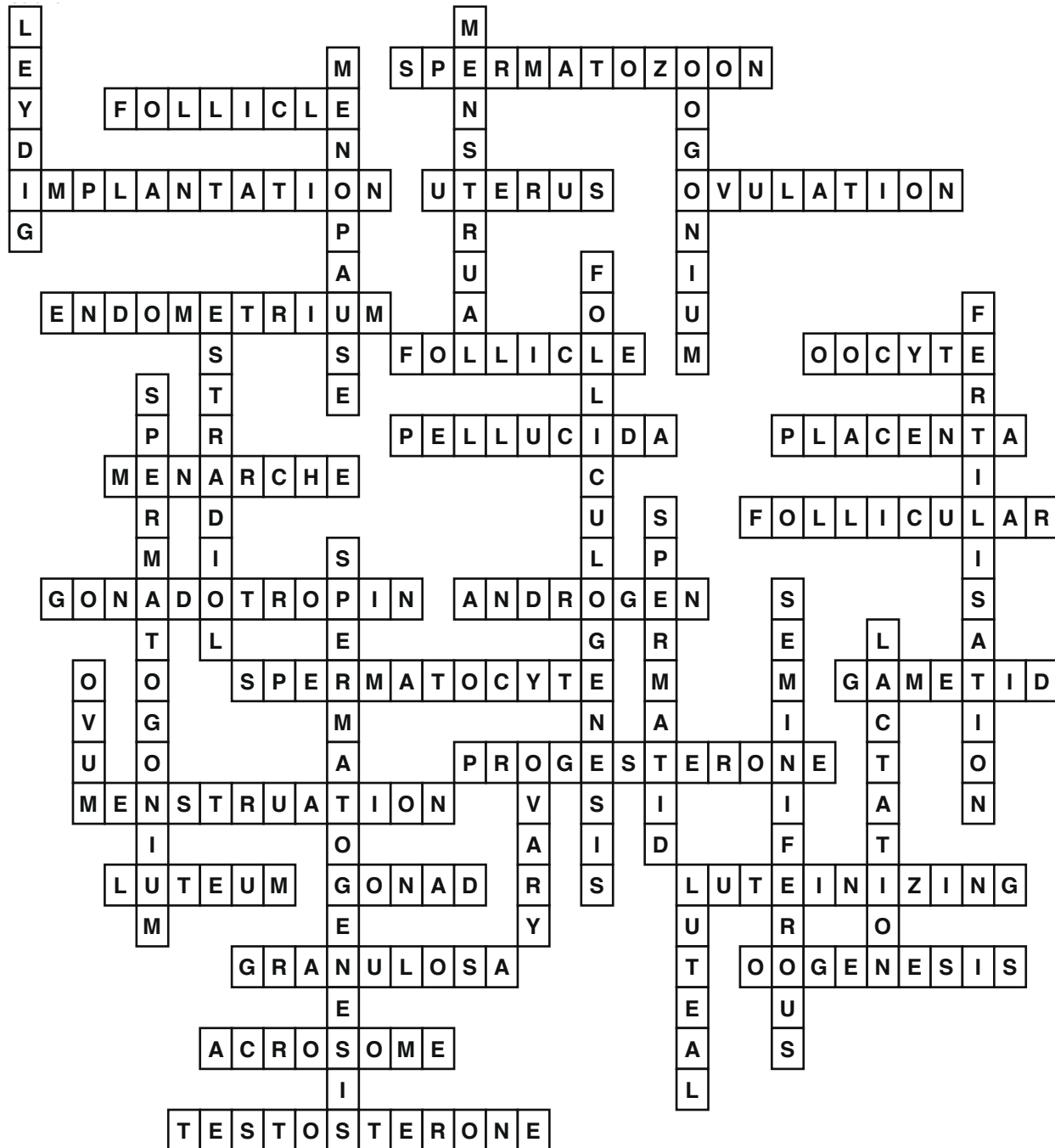


# Digestive System





# Reproductive System



# Evolution

