

National Biology Bee – Final Round (V-JV)

Regulation Tossups

(1) This substance contains sugars called HMOs that help regulate bacteria in the gut microbiome. Either BSA or a dry form of this substance are used as blocking agents during a (+) Western blot. The antibody IgA is highly concentrated in a yellowish form of this substance called colostrum. Oxytocin stimulates the (*) "let-down reflex" to release this substance, which is rich in lactoferrin. FTP, name this substance secreted by mammary glands during the process of breast feeding.

ANSWER: milk (accept breast milk or human milk or dry milk)

(2) A 1967 paper by W. D. Hamilton likened changes in this quantity to an "unbeatable strategy" in game theory. This quantity can change based on maternal health, according to the Trivers-Willard hypothesis. (+) Climate change can skew this quantity in populations of reptiles for whom it is temperature dependent. Ronald Fisher stated a principle that this quantity is roughly (*) one to one in most species. For the points, name this quantity which describes the amount of males to females in a population.

ANSWER: sex ratio (accept human sex ratio)

(3) Pathological or normal examples of this protein are distinguished with a Verhoeff's stain. Layers of this protein surrounded by oxytalan fibers form a compound that is found in the periodontal fibers of (+) teeth. This protein's amorphous form makes up its namesake fibers, along with fibrillin. Along with (*) collagen, this is the primary protein found in the extracellular matrix. For the points, name this protein that allows the body to maintain its shape after stretching.

ANSWER: elastin

(4) Sean Cutler developed a sulfonamide mimic of this hormone called pyrabactin, and this hormone can be further oxidized into phaseic acid. When produced from its precursor xanthoxin in (+) roots, this hormone will cause stomata to close and lower water loss in leaves under severe drought conditions or extreme (*) temperatures. For the points, name this plant hormone that regulates bud dormancy which was once thought to be involved in causing leaves to fall from trees.

ANSWER: abscisic acid (or ABA; or abscisin two; or dormin)

(5) The repression of this process correlates with trimethylation at "H-three-K-twenty-seven" positions. The enzyme that performs this process uses repeated cycles of (+) "scrunching" to stop and restart during abortive initiation. In bacteria, this process begins when a sigma factor recognizes the (*) minus 35 and minus 10 elements, which are analogous to the eukaryotic TATA box. RNA polymerase binds to a promoter sequence to begin, for the point, what process in which RNA is produced from a DNA template?

ANSWER: transcription

(6) **This man founded the world's first seed bank at the Institute of Plant Industry in Leningrad. This man names a form of mimicry which produced secondary crops like rye and in which weeds share similarities with (+) crops. A feud with Trofim Lysenko led this youngest member of the Academy of Sciences of the Soviet Union to be sent to prison, where he died during the (*) Stalinist era. For the points, name this Soviet scientist who identified eight "centers of origin" where crops first originated.**

ANSWER: Nikolai **Vavilov** (or Nikolai Ivanovich **Vavilov**; accept **Vavilov** center; accept **Vavilovian** mimicry; accept **Vavilov** Institute of Plant Industry; accept N. I. **Vavilov** All-Russian Institute of Plant Genetic Resources)

(7) **Dichroic mirrors and obscuration bars can be used in this technique, in which forward scatter and side scatter measurements are captured. Data from this technique can be selected for analysis via gating. Like (+) Coulter counters, this technique can take advantage of hydrodynamic focusing when finding the size of cells, and, in this technique, fluorescence spillover can be corrected via (*) compensation. Thousands of cells can be analyzed using a laser in, for the points, what technique, which uses fluorochromes?**

ANSWER: **flow cytometry** (or **FC**; accept **FACS** or **fluorescence activated cell sorting**; prompt on "flow" or "cytometry")

(8) **Patients with Li-Fraumeni syndrome have mutations in this protein, which is kept at low cellular levels by the E3 ligase MDM2. HPV can cause cervical (+) growths because its E6 gene helps degrade this protein. If DNA damage is detected, this protein (*) arrests the cell cycle at the G1 to S transition, which is why it is the most mutated protein in all human cancers. For the points, name this tumor suppressor protein often called "the guardian of the genome."**

ANSWER: **p53** (or **TP53**; accept tumor protein **p53**)

(9) **Whether this compound can be split off an amino acid can be determined with Kovács's reagent. Identifying bacteria in the coliform group can be done with the IMViC test, where the "I" test checks for the release of this compound that forms the (+) side chain of tryptophan. A phenylhydrazine and an aldehyde are reacted to create this compound in a synthesis discovered by Emil (*) Fischer. For the points, name this aromatic compound which occurs in feces and has a name that is a portmanteau of "indigo" and "oleum."**

ANSWER: **indole** (or **indolyl**; accept Fischer **indole** synthesis; accept **indole** test)

(10) **This person argued the use of the optic chiasm in a visual map theory of eyesight. This person was the first to describe the regeneration of a neurite in the actin-driven growth cone. Membrane-less coiled (+) bodies in the nucleus are also named for this scientist, who used silver staining developed by an Italian scientist to understand the central nervous system and formulate the (*) neuron doctrine. For the points, name this Spanish Nobel Prize winner and pioneering neuroscientist.**

ANSWER: Santiago Ramón y **Cajal** [[kah-HAL]] (accept **Cajal** bodies)

(11) **The Lowe-Thorneley kinetic model of this process describes a group of enzymes encoded by Nif genes. This process is promoted by Nod signaling factors that stimulate production of (+) leghemoglobin. This process requires a molybdenum-containing cofactor called FeMoCo that is used by diazotrophic bacteria like (*) Rhizobia that live in the root nodules of legumes. For the points, name this process in which an atmospheric element is converted to ammonia in a geochemical cycle.**

ANSWER: **nitrogen fixation** (or **nitrogen fixing**)

(12) **A bilateral lesion of this structure stemming from Urbach-Wiethe disease was extensively studied in a patient known as "S.M." Daniel Goleman proposed that this structure "hijacks" brain function in the face of a perceived (+) threat. The basolateral complex in this structure receives input from the hippocampus to help encode long-term memories. This (*) limbic system structure is responsible for regulating the fear and aggression responses. For the points, name this temporal lobe structure whose Latin name refers to its almond-like shape.**

ANSWER: **amygdala** (accept **amygdala** hijack; prompt on "temporal lobe")

(13) **The number of people with this condition increased after an immunization effort in response to the 1977 swine flu outbreak. About thirty percent of cases of this condition are caused by infection with the (+) Campylobacter jejuni bacteria. This condition has subtypes like Miller Fisher syndrome, as well as acute motor axonal neuropathy that is caused by (*) demyelination. For the points, identify this autoimmune condition that leads to rapid muscle weakness in the hands and feet, named for two French neurologists.**

ANSWER: **Guillain-Barré** syndrome [["GEE-yawn bah-RAY"]] (or **Guillain-Barré-Strohl** syndrome; or **GBS**; or **Landry's** paralysis; or **postinfectious polyneuritis**; or **Acute Inflammatory Demyelinating Polyneuropathy**)

(14) **The transfer of this protein is scaffolded by proteins with a RING finger domain. Targeted addition of this protein is facilitated by "molecular glues" or drugs such as PROTACs. (+) SUMO proteins are similar to this one, which is transferred in a three-step process by enzymes denoted E1, E2, and E3. This protein is attached to (*) target proteins which are then degraded in the proteasome. For the points, name this protein which represents the "molecular kiss of death" and which is named for its pervasiveness in eukaryotes.**

ANSWER: **ubiquitin** [[yoo-BIK-kwuh-tin]] (accept **ubiquitination**; prompt on "Ub")

(15) **This man lends his name to seemingly striped cone-shaped structures, which are the renal pyramids of the kidney. A "body" named for this man includes the glomerulus and (+) Bowman's capsule. This man, the first to observe capillaries in the bodies of animals, was able to discover that insects use openings called tracheae to breathe rather than depending on (*) lungs. For the points, name this Italian biologist who lends his name to a tubule system in insects.**

ANSWER: Marcello **Malpighi** [[mal-PEE-gee]] (accept **malpighian** pyramids; accept **Malpighi's** pyramids; accept **Malpighian** body; accept **Malpighian** corpuscles; accept **Malpighian** tubule system)

(16) **This process is induced by buffers such as NP-40 and RIPA, which often contains one percent Triton X-100. This process can be performed using agitative techniques such as bead-beating or with (+) high-frequency sound waves during sonication. Virulent phages follow a life cycle named for this process that is contrasted with the (*) lysogenic cycle.** This process occurs when cells are placed in a strongly hypotonic solution, which causes water to osmose into the cell. For the points, name this process in which a cell bursts open.

ANSWER: **lysis** (or cell **lysis**; accept cyto**lysis** or plasmol**lysis** or **lysis** buffer or **lytic** cycle; prompt on “cell death” or “killing” or “bursting” or “homogenization” or “solubilization”)

(17) **The largest class of these things is derived from the 7SL RNA that encodes part of the signal recognition particle. The Tc1/mariner class of these things were adapted into the (+) Sleeping Beauty system used for insertional mutagenesis. The Class One type of these things uses a "copy and paste" mechanism and has the prefix (*) "retro-".** These sequences were discovered in maize by Barbara McClintock, winning her a Nobel Prize. For the points, name these DNA sequences which are mobile genetic elements that can move around in a genome.

ANSWER: **transposons** (or **transposable** elements; or **TEs**; or **jumping genes**; accept **Alu elements** or retro**transposons**)

(18) **When growing inward, these structures can form a region of mutualistic activity called a Hartig net. E. J. H. Corner classified systems of these structures to be monomitic, dimitic, or trimitic, and they can have (+) septate forms. Ascocarps contain many asci, as well as intertwined instances of these structures. Networks of these structures interact with (*) roots to create mycorrhizal [[mai-COR-hiz-al]] networks.** For the points, fungi grow via what branching structures that form larger mycelium structures?

ANSWER: **hyphae** [[HY-fay]] (prompt on “mycelium” or “mycelia”)

(19) **These organisms were the first species discovered to have noggin proteins. A cyclin-Cdk complex first discovered in the eggs of these organisms is known as maturation promoting factor. The widespread use of these organisms as a (+) pregnancy test led to the global spread of chytridiomycosis. These organisms are used to study embryo development due to their large brood size and eggs that are (*) visible to the naked eye.** For the points, name this amphibian, a common model organism.

ANSWER: **African clawed frog** (or **Xenopus**; or **Xenopus tropicalis**; or **Xenopus laevis**; accept **X. laevis**; prompt on “frog”)

(20) **One of these proteins in bacteria called Glpf is part of the major intrinsic protein family. Peter Agre won the 2003 Nobel Prize in Chemistry for discovering these proteins, which have an (+) asparagine-proline-alanine, or NPA, motif, and use an aromatic/arginine filter to maintain selectivity. Vasopressin upregulates these proteins in the (*) collecting duct of the kidney to promote reabsorption of water from the urine.** For the points, name these transmembrane proteins that transport water between cells.

ANSWER: **aquaporins** (or **water channels**; prompt on “channels” or “porins”)

(21) **In certain primitive angiosperms, such as water lilies, the stamen and this structure are arranged in a spiral rather than whorls. This structure can be described as "monochlamydeous" if it has only one whorl, or "dichlamydeous" if it has both a (+) calyx and a corolla. Parts of this non-reproductive structure in tulips are described by the term "tepala" when they look identical, though they actually consist of (*) sepals and petals. For the points, name this structure which encapsulates the entire outer envelope of a flower.**

ANSWER: **perianth** (or **perigonium**; or **perigon**; or **perigone**; prompt on "flower")

(22) **A oviraptorosaur found at this formation is a bird-like dinosaur species called *Anzu wyliei*. This formation is often referred to as the "Somber Beds" due to its characteristic dark and muted sandstones and (+) mudstone. The first known specimen of *Tyrannosaurus rex* was discovered by Barnum Brown in this formation in 1902. (*) For the points, name this Upper Cretaceous geological formation which spans Montana, Wyoming, North Dakota, and South Dakota.**

ANSWER: **Hell Creek** Formation

(23) **The fraction of the total form of this quantity that is caused by nitrate was first stated by Richard Eppley and Bruce Peterson as the f-ratio. The net form of this quantity takes into account (+) cellular respiration, while the gross form does not. This quantity can be measured with units calculating the mass of carbon over an area per (*) year. Made possible by autotrophs, for the points, what ecological quantity measures the creation of organic compounds from carbon dioxide?**

ANSWER: **primary production** (or **primary productivity**; accept total **primary production** or net **primary production** or gross **primary production**; prompt on "production" or "productivity")

(24) **Swelling of these things can occur due to African sleeping sickness in Winterbottom's sign. Certain biopsy procedures remove sentinel examples of these things, which are used in the (+) TNM staging system to understand the extent of cancer spread. These things have a region called the paracortex, and axillary examples of these things lie in the (*) armpit, while cervical instances are located in the neck. For the points, what secondary organs in the adaptive immune system contain B and T cells?**

ANSWER: **lymph nodes** (or **lymph gland**; accept sentinel **lymph node**; accept sentinel **lymph node** biopsy)

(25) **Some species in this order evolved the ability to jam echolocation as a form of acoustic aposematism. A "peppered" species in this order is a classic example of evolution by (+) natural selection, as its population changed color when industrial pollution darkened tree bark. One species in this order, which feeds solely on (*) milkweed and makes a migration across North America, is known as the monarch. For the points, name this order of insects that includes butterflies and moths.**

ANSWER: **Lepidoptera** (prompt on "butterflies" or "moths" before mentioned)

(26) **A test for this condition checks whether the thumb reaches beyond the palm when curled into a fist, which is the Steinberg sign. This condition can be diagnosed with the Ghent criteria, which considers upward dislocation of the (+) eye's lens and dilation of the aortic root that often leads to aneurysms. This autosomal dominant disease is caused by a mutation in the gene for fibrillin. (*)** For the points, what genetic disorder causes people to be tall and thin with flexible joints, and may have affected Abraham Lincoln?

ANSWER: **Marfan** syndrome (or **MFS**)

(27) **Eating improperly stored fish with high levels of this compound leads to scombroid poisoning. This compound is metabolized by diamine oxidase and its release by (+) enterochromaffin-like cells triggers parietal cells to secrete intrinsic factor. Both heparin and this compound are released when IgE antibodies cause degranulation of (*) basophils and mast cells, which may lead to anaphylaxis. For the points, name this organic compound that mediates the inflammatory response in allergic reactions.**

ANSWER: **histamine** (do not accept "histidine")

(28) **A rare freshwater type of these objects is found in Lake Bacalar in the Yucatán. These objects are distinguished from spherical oncolites by forming a (+) columnar structure. Modern examples of these objects are found in Shark Bay, Australia, where they were formed as calcium carbonate precipitated around ancient mats of (*) cyanobacteria. For the points, name these layers of sedimentary rock which contain the remains of early Precambrian life, the oldest known fossils on Earth.**

ANSWER: **stromatolites** (or **stromatolith**)

(29) **These molecules activate an inducible degron system used to deplete target proteins in cells expressing the receptor TIR1. These hormones activate expansins in the (+) cell wall in Achim Hager and Robert Cleland's acid-growth hypothesis. PIN proteins mediate the (*) polar transport of these hormones, which mediate apical dominance and include indole-3-acetic acid. For the points, identify this group of plant growth hormones that stimulate plants to lean towards sunlight.**

ANSWER: **auxins**

(30) **Cancer developing from these cells is frequently caused by a V-600-E mutation in the BRAF gene. These specialized cells are derived from the neural crest residue in the (+) stratum basale, and cancer of them is detected using the ABCDE mnemonic. These cells use long, slender processes to transfer organelles containing the enzyme tyrosinase to neighboring (*) keratinocytes, which facilitates optimal sun protection. For the points, name these cells which synthesize the pigment responsible for skin, hair, and eye color.**

ANSWER: **melanocytes** (prompt on "melanin" or "melanoma" or "skin cells")

Extra Questions

(1) **This animal's rufous species has one of the longest migrations of its taxonomic class, journeying semiannually between Alaska and Mexico. This animal is exceptional within its class for having the most diverse array of male (+) coloration, as well as its figure-eight aerodynamics. This creature has the highest mass-specific metabolic rate of any homeothermic animal. The world's (*) smallest known avian is, for the points, what bird that can flap its wing up to 5,400 times a minute?**

ANSWER: **hummingbird** (accept rufous **hummingbird**; accept Anna's **hummingbird**; accept bee **hummingbird**; prompt on "bird")

(2) **In animals with this quality, Hox genes are expressed in staggered domains. Depending on whether the blastopore develops into an anus or a mouth, animals with this quality are divided into (+) deuterostomes and protostomes. This quality is the namesake of a basal animal clade which is usually considered sister to the cnidarians. Echinodermata possess this quality in their larval stage, but (*) later develop pentaradial symmetry. For the points, name this property of having identical right and left halves.**

ANSWER: **bilateral** symmetry (accept **bilateria**; prompt on "symmetry")