40th NATIONAL SCIENCE OLYMPIAD: 4 March 2004
QUESTIONS AND SOLUTIONS: BIOLOGY

1. Which order of the class Reptilia is not found in Southern Africa?

   1 Chelonia (Turtles and marine turtles)
   2 Crocodilia (Crocodiles)
   3 Alligatoria (Alligators)
   4 Rhynchocephalia (Tuatara)
   5 Squamata (Lizards and snakes)

Answer: 4 (Encyclopaedia Britannica)

The living reptiles belong to four orders: the Squamata (lizards, snakes, and amphisbaenians), the Rhynchocephalia (one rare species, the tuatara of New Zealand), the Chelonia (turtles), and the Crocodylia (crocodiles and alligators).

The tuatara is a lizard-like animal and the sole surviving member of the order Rhynchocephalia,that may have appeared as early as the Late Triassic Epoch (about 227 to 206 million years ago). Until recently the tuatara lived on the two main islands of New Zealand. Today it is found only on certain islets in Cook Strait between the main islands and on islets between East Cape and North Cape of the North Island of New Zealand. Tuataras are essentially solitary, nocturnal, burrowing animals, seldom travelling more than a few metres from their burrows during the day. Feeding takes place mainly at night. The principal diet of the young is insects; adults eat—in addition to insects—snails, lizards, young seabird chicks, and eggs. They will drink water if it is available but can survive for months on water obtained from dew and solid food. Male tuataras may attain a length of 60 centimetres (about 24 inches) and a weight of 1,000 grams (about 2.2 pounds). Females grow to about 50 centimetres (20 inches) and sometimes weigh as much as 500 grams (1.1 pounds). Eight to 15 eggs are laid in a nesting burrow covered by several centimetres of soil. The young emerge about 13 months later, in early summer to midsummer. Adult size is not reached for 50 to 60 years, and the animal may live to the age of 100. Sexual maturity is believed to occur after about 20 years.

2. Which animals are responsible for the most deaths in humans?

   1 Crocodiles
   2 Snakes
   3 Mosquitoes
   4 Lions
   5 Sharks

Answer: 3 (Encyclopaedia Britannica)

Mosquitoes are vectors for malaria; a serious, relapsing infection in humans characterized by periodic attacks of chills and fever, anaemia, splenomegaly (enlargement of the spleen), and often fatal complications. It is caused by one-celled

parasites of the genus Plasmodium that are transmitted to humans by the bite of Anopheles mosquitoes. Malaria can occur in temperate regions, but it is most common in the tropics and subtropics. In many parts of sub-Saharan Africa, entire populations are infected more or less constantly. Malaria is also common in Central America, the northern half of South America, and in South and Southeast Asia. The disease also occurs in countries bordering on the Mediterranean, in the Middle East, and in East Asia. In Europe, North America, and the developed countries of East Asia, malaria is still encountered in travellers arriving or returning from affected tropical zones. Annual cases of malaria worldwide are estimated at 250 million, with more than one million deaths resulting—most of them young children in Africa.

3. Which fact about crocodiles is incorrect?

1 In South Africa, they are only found in rivers that flow in an easterly direction
2 The main swimming organ is the tail
3 They can stay under water for up to one hour
4 the sex of the hatchlings is determined by the average temperature
5 Older crocodiles starve to death because teeth are only replaced twice

Answer: 5 (Encyclopaedia Britannica)

Crocodiles are generally large, ponderous, amphibious animals, somewhat lizardlike in appearance, and carnivorous in habit. They have powerful jaws with many conical teeth and short legs with clawed, webbed toes. The tail is long and massive and the skin thick and plated. About 20 species are recognized. The crocodiles are the largest and the heaviest of present-day reptiles. In former times the Nile crocodile (*Crocodilus niloticus*) and the estuarine crocodile (*Crocodilus porosus*) attained a length of almost nine metres (about 30 feet), but today, specimens rarely exceed six metres (20 feet). All crocodiles have a relatively long snout, or muzzle, which varies considerably in proportions and shape. The large horny plates that cover most of the body generally are arranged in a regular pattern. Thick, bony plates occur on the back. The families and genera may be distinguished by anatomical features, principally those of the skull. Crocodiles continuously shed and replace their teeth.

4. Which animal has the longest gestation period?

1 White rhinoceros
2 Atlantic right whale
3 African elephant
4 Giraffe
5 Bottlenose dolphin

Answer: 3 (Encyclopaedia Britannica)

Gestation is the time between conception and birth, during which the embryo or foetus is developing in the uterus. This definition raises occasional difficulties because in some species (e.g., monkeys and man) the exact time of conception may not be known. In these cases the beginning of gestation is usually dated from some well-defined point in the reproductive cycle (e.g., the beginning of the previous menstrual period). The length of gestation varies from species to species. The shortest known gestation is that of the Virginian opossum, about 12 days, and the longest that of the elephant, about 22 months. In the course of evolution the duration of gestation has become adapted to the needs of the species. The degree of ultimate growth is a factor, smaller animals usually having shorter periods of gestation than larger ones. Marsupials generally have short gestations—e.g., 40 days for the largest kangaroos. The young, born in an extremely immature state, transfer to the pouch in which gestation may be said to continue.

White rhinos can live to be 50 years of age. Gestation lasts approximately 16 months, and mothers give birth to one calf every 2-3 years. Females reach sexual maturity between 6 and 7 years of age; males mature between 7 and 10 years of age.

The *North Atlantic Right Whale* (*Eubalaena glacialis*) is a baleen whale, one of three species formerly called classified as the Right Whale belonging to the genus *Eubalaena*. Adult right whales average 35-55 feet (10.7-16.8 meters) in length and weigh up to 70 tons (63,500 kilograms); the largest measured have been 60 feet long and 117 tons (106,500 kilograms). Females are larger than males and first give birth at age nine or 10 after a yearlong gestation. Calves are 13-15 feet long at birth. There is little data on their life span, but it's believed to be at least 50 years, and closely related species may live more than a century.

Giraffe females first breed at four or five years of age. Gestation is 15 months, and, though most calves are born in dry months in some areas, births can take place in any month of the year. The single offspring is about 2 metres (6 feet) tall and weighs 100 kg (220 pounds). For a week the mother licks and nuzzles her calf in isolation while they learn each other's scent. Thereafter, the calf joins a “nursery group” of similar-aged youngsters, while mothers forage at variable distances. If lions or hyenas attack, a mother sometimes stands over her calf, kicking at the predators with front and back legs.

The average gestation period in *bottlenose dolphins* is 12 months. The young are born in shallow water, sometimes assisted by a "midwife" (which may be male). A single calf is born, about 1 m (3 ft) long at birth. To speed up the nursing process, the mother can eject milk from her mammary glands. There are two slits, one on either side of the genital slit, each housing one nipple. The calf is nursed for 12 to 18 months. The young live closely with their mother for up to 6 years; the males are not involved in the

raising of their mother's subsequent offspring.

5. What are “loggerheads and leatherbacks”

   1 Marine turtles
   2 Ostriches
   3 Whales
   4 Ticks
   5 Spiders

Answer 1: (Encyclopaedia Britannica)

The leatherback turtle (*Dermochelys coriacea*) is the largest of living turtles and may attain a total length of about 2.1 metres (7 feet) with a weight of about 540 kilograms (1,200 pounds) and a span of about 2.7 m from the tip of one front flipper to the tip of the other. Maximum reported lengths and weights range up to 3 m and about 900 kg but are poorly authenticated. The leatherback has no visible shell. A shell is present but consists of bones buried in the dark brown or blackish skin. There are seven pronounced longitudinal ridges on the back of the turtle and five on the underside. The leatherback is a strong swimmer and inhabits open seas throughout the world. It apparently is omnivorous and takes both animal and plant material.

The loggerhead (*Caretta caretta*) is a large turtle similar to the green turtle but with a relatively larger head. It is reddish brown or brown in colour. The loggerhead attains a shell length of about 0.7–2.1 m. A large specimen usually weighs about 135 kg, but weights of almost 400 kg have been recorded. The loggerhead, found in oceans throughout the world, is a carnivorous reptile with a reportedly bad disposition.

6. Robben Island is a world heritage site but feral cats have had a huge impact on the ground nesting bird populations. What is the most humane method used to control the cat population?

   1 Hunting
   2 Poisoning
   3 Euthanasia
   4 Biological control by infecting them with feline parvovirus
   5 Caught, sterilised and released

Answer: 4 (Encyclopaedia Britannica)

Hunting would be too expensive, requiring manpower. *Euthanasia* (merciful killing) or *Catching, sterilising and releasing* the cats would be even more expensive and labour intensive. Poisoning will not be specific (no poison can kill wild cats exclusively!). Thus, the only option is biological control.

Parvovirus, commonly abbreviated to parvo, is a genus of the Parvoviridae family linear, non-segmented single stranded DNA viruses with an average genome size of 5 kbp. Parvoviruses are some of the smallest viruses found in nature (hence the name, from Latin parvus meaning small). Many types of mammalian species have a strain of

parvovirus associated with them. Parvoviruses tend to be specific about the taxon of animal they will infect, but this is a somewhat flexible characteristic. Thus, all strains of canine parvovirus will affect dogs, wolves, and foxes, but only some of them will infect cats. No members of the genus Parvovirus are currently known to infect humans, but humans can be infected by viruses from three other genera from the Family Parvoviridae. Feline panleukopenia, more commonly known as feline distemper, is a viral infection affecting cats caused by feline parvovirus. The virus primarily attacks the lining of the gastrointestinal tract, causing internal ulceration and, ultimately, total sloughing of the intestinal epithelium. This results in profuse, usually bloody diarrhea, causing severe dehydration, malnutrition, anemia, and often death; mortality rate 60-90%.

7. The relationship between a clownfish and anemones.

1 Mutualism
2 Parasitism
3 Commensalism
4 Altruism
5 Saprophytic

Answer: 1 (Encyclopaedia Britannica)

One of the best known cnidarian symbioses is the mutualism between 10 species of tropical anemones and 26 species of anemone fish (such as the clown fish). These fishes live within the protective field of anemone tentacles, where they take refuge when a predator threatens. Immunity of the fishes to the stings of the nematocytes results from the thin layer of mucus that covers their bodies. It is unclear whether the mucous is made by the fishes themselves, or acquired by contact with the anemone's tentacles. Without its mucus, the clown fish, like any other small fish, may be stung to death and eaten by the anemone. Anemone fishes serve their hosts by driving away fishes that prey on anemones. Other fishes have a similar association with large medusae.

8. What will probably occur if all primary consumers are removed from a closed ecosystem?

1 The producers will be destroyed
2 Number of secondary consumers will increase
3 Carnivores will start to die
4 Number of herbivores will decrease
5 The carrying capacity of the land will decrease

Answer: 3 (Encyclopaedia Britannica)

An ecosystem can be categorized into its abiotic constituents, including minerals, climate, soil, water, sunlight, and all other nonliving elements, and its biotic constituents, consisting of all its living members. Linking these constituents together are two major forces: the flow of

energy through the ecosystem, and the cycling of nutrients within the ecosystem. The fundamental source of energy in almost all ecosystems is radiant energy from the sun. The energy of sunlight is used by the ecosystem's autotrophic, or self-sustaining, organisms. Consisting largely of green vegetation, these organisms are capable of photosynthesis—*i.e.,* they can use the energy of sunlight to convert carbon dioxide and water into simple, energy-rich carbohydrates. The autotrophs use the energy stored within the simple carbohydrates to produce the more complex organic compounds, such as proteins, lipids, and starches, that maintain the organisms' life processes. The autotrophic segment of the ecosystem is commonly referred to as the producer level. Organic matter generated by autotrophs directly or indirectly sustains heterotrophic organisms. Heterotrophs are the consumers of the ecosystem; they cannot make their own food. They use, rearrange, and ultimately decompose the complex organic materials built up by the autotrophs. All animals and fungi are heterotrophs, as are most bacteria and many other microorganisms. Together, the autotrophs and heterotrophs form various trophic (feeding) levels in the ecosystem: the producer level, composed of those organisms that make their own food; the primary-consumer level, composed of those organisms that feed on producers; the secondary-consumer level, composed of those organisms that feed on primary consumers; and so on. The movement of organic matter and energy from the producer level through various consumer levels makes up a food chain. For example, a typical food chain in a grassland might be grass (producer) → mouse (primary consumer) → snake (secondary consumer) → hawk (tertiary consumer). Actually, in many cases the food chains of the ecosystem overlap and interconnect, forming what ecologists call a food web. The final link in all food chains is made up of decomposers, those heterotrophs that break down dead organisms and organic wastes.

9. Where do ticks and fleas spend most of their time?

1 In tall grass waiting for a host
2 In egg form
3 On the host
4 In the larval stage in sand
5 In the larval stage in water

Answer: 1 (Encyclopaedia Britannica)

A tick is any of about 825 species of invertebrates in the order Parasitiformes (subclass Acari). Ticks are important parasites of large wild and domestic animals and are also significant as carriers of serious diseases. Although no species is primarily a human parasite, some occasionally attack humans. Hard ticks, such as the American dog tick (*Dermacentor variabilis*), attach to their hosts and feed continuously on blood for several days during each life stage. When an adult female has obtained a blood

meal, she mates, drops from the host, and finds a suitable site where she lays her eggs in a mass and dies. Six-legged larvae hatch from the eggs, move up on blades of grass, and wait for a suitable host (usually a mammal) to pass by. The odour of butyric acid, emanated by all mammals, stimulates the larvae to drop onto and attach to a host. After filling themselves with the host's blood, the larvae detach and moult, becoming eight-legged nymphs. Nymphs also wait for, and board, a suitable host in the same way as larvae. After they have found a host and engorged themselves, they also fall off, and then they moult into adult males or females. Adults may wait for a host for as long as three years. Most hard ticks live in fields and woods, but a few, such as the brown dog tick (*Rhipicephalus sanguineus*), are household pests. Soft ticks differ from hard ticks by feeding intermittently, laying several batches of eggs, passing through several nymphal stages, and carrying on their developmental cycles in the home or nest of the host rather than in fields. Hard ticks damage the host by drawing large amounts of blood, by secreting neurotoxins (nerve poisons) that sometimes produce paralysis or death, and by transmitting diseases, including Lyme disease, Texas cattle fever, anaplasmosis, Rocky Mountain spotted fever, Q fever, tularemia, hemorrhagic fever, and a form of encephalitis. Soft ticks also are carriers of diseases. Adults range in size up to 30 mm (slightly more than 1 inch), but most species are 15 mm or less. They may be distinguished from their close relatives, the mites, by the presence of a sensory pit (Haller's organ) on the end segment of the first of four pairs of legs. Eyes may be present or absent. This group has a worldwide distribution, and all species are assigned to three families: Argasidae, comprising the soft ticks, and Nuttalliellidae and Ixodidae, together comprising the hard ticks. The family Nuttalliellidae is represented by one rare African species.

10. In order to continue to exist a butterfly has to sit frequently. Which one is not a reason for this behaviour?

    1 They have to take in water frequently. Water is relatively heavy and influences the ability to fly
    2 They have to take in glucose frequently. Flying uses a lot of energy
    3 They cannot store water and food in large quantities
    4 Females have to lay eggs over a large area
    5 To pollinate flowers

Answer: 5

Butterflies do not consciously seek flowers to pollinate them! Through eons, flowering plants evolved traits that attracted insects to land on their flowers (for feeding) and inadvertently transfer them pollen grains as they flew from flower to flower. Lepidopterans (butterflies and moths) are

attracted to flowers that are brightly coloured and produce nectar. Typical moth flowers—*e.g.,* jimsonweed, stephanotis, and honeysuckle—are light-coloured, often long and narrow, without landing platforms. The petals are sometimes fringed; the copious nectar is often in a spur. They are open and overwhelmingly fragrant at night. Butterfly flowers—*e.g.,* those of butterfly bush, milkweed, and verbena—are conspicuously coloured, often red, generally smaller than moth flowers, but grouped together in erect, flat-topped inflorescences that provide landing space for the butterflies.

11. The stick insect makes use of ….

1 protective coloration
2 warning coloration
3 disruptive coloration
4 camouflage
5 mimicry

Answer: 4 (Encyclopaedia Britannica)

Walking stick, also called stick insect is any of about 2,000 species of slow-moving insects that are green or brown in colour and bear a resemblance to twigs as a protective device. Some species also have sharp spines, an offensive odour, or the ability to force their blood, which contains toxic, distasteful chemicals, through special joints in the exoskeleton. In many species the eggs closely resemble seeds. Walkingsticks are unusual among the insects in that they have the ability to regenerate legs and antennae. The front wings of some species are short and leathery, whereas others have large, colourful hind wings that are kept folded over the abdomen. Walkingsticks found in the tropics are the largest and most abundant. Certain species, such as the Asiatic Palophus and the East Indian Pharnacia, are more than 30 cm (12 inches) in length. The North American species Diapheromera femorata may defoliate oak trees during heavy infestations. Some authorities place walkingsticks in the order Phasmatodea, and some consider them as a suborder (Phasmatodea) of the order Orthoptera. Immobility usually makes detection less likely. For stick insects and other animals resembling twigs or leaves, when immobility itself becomes conspicuous against moving foliage, the animals' compensatory swaying increases the camouflage effect.

12. Which difference between Monocotyledon and Dicotyledon plants is **correct**?

Monocot	**Dicot**
1 Net venated leaves	Parallel venated leaves
2 Petiole absent	Petiole present
3 Compound leaves	Simple leaves
4 Tap root system	Adventitious root system
5 Seeds have 2 lobes	Seeds have 1 lobe

Answer: 2 (Wikipedia)

Aside from cotyledon number, other broad differences have been noted between monocots and dicots, although these have proven to be differences primarily between monocots and eudicots. Many early-diverging dicot groups have "monocot" characteristics such as scattered vascular bundles, trimerous flowers, and non-tricolpate pollen. In addition, some monocots have "dicot" characteristics such as reticulated leaf veins. Seeds: The embryo of the monocot has one cotyledon while the embryo of the dicot has two. Flowers: The flower parts in monocots are multiples of three while in dicots are multiples of four or five. Stems: In monocots, the stem vascular bundles are scattered, while in dicots they are in a ring. Secondary growth: In monocots, stems rarely show secondary growth; in dicots, stems frequently have secondary growth. Pollen: In monocots, pollen has one furrow or pore while in dicots they have three. Roots: The roots are adventitious in monocots, while in dicots they develop from the radicle. Leaves: In monocots, the major leaf veins are parallel, while in dicots they are reticulated.

13. Wind pollinated flowers usually have

1 large petals
2 strong aromas
3 large amounts of pollen all and dry
4 stamens and stigmas re situated inside the flower
5 brightly coloured petals

Answer: 3 (Encyclopaedia Britannica)

Wind-pollinated flowers are inconspicuous, being devoid of insect attractants and rewards, such as fragrance, showy petals, and nectar. To facilitate exposure of the flowers to the wind, blooming often takes place before the leaves are out in spring, or the flowers may be placed very high on the plant. Inflorescences, flowers, or the stamens themselves move easily in the breeze, shaking out the pollen, or the pollen containers (anthers) burst open in an explosive fashion when the sun hits them, scattering the pollen widely into the air. The stigmas often are long and divided into arms or lobes, so that a large area is available for catching pollen grains. Moreover, in open areas wind-pollinated plants of one species often grow together in dense populations. The chance of self-pollination, high by the very nature of wind pollination, is minimized by the fact that many species are dioecious or (like hazel) have separate male and female flowers on each plant. Familiar flowering plants relying on wind pollination are grasses, rushes, sedges, cattail, sorrel, lamb's-quarters, hemp, nettle, plantain, alder, hazel, birch, poplar, and oak. (Tropical oaks, however, may be insect-pollinated.)

14. Which one has **no** DNA or RNA?

1 Red blood corpuscles
2 Viruses
3 Nucleus
4 Gamete

5 Zygotes

Answer: 1 (Encyclopaedia Britannica)

Erythrocytes, also called red blood cells or red blood corpuscles, are cellular component of blood, millions of which in the circulation of vertebrates give the blood its characteristic colour and carry oxygen from the lungs to the tissues. The mature human erythrocyte is small, round, and biconcave; it appears dumbbell-shaped in profile. The cell is flexible and assumes a bell shape as it passes through extremely small blood vessels. It is covered with a membrane composed of lipids and proteins, lacks a nucleus (thus no DNA or RNA), and contains hemoglobin—a red, iron-rich protein that binds oxygen. The function of the red cell and its hemoglobin is to carry oxygen from the lungs or gills to all the body tissues and to carry carbon dioxide, a waste product of metabolism, to the lungs, where it is excreted. The mammalian erythrocyte is further adapted by lacking a nucleus—the amount of oxygen required by the cell for its own metabolism is thus very low, and most oxygen carried can be freed into the tissues. The biconcave shape of the cell allows oxygen exchange at a constant rate over the largest possible area. he erythrocyte develops in bone marrow in several stages: from a hemocytoblast, a multipotential cell in the mesenchyme, it becomes an erythroblast (normoblast); during two to five days of development, the erythroblast gradually fills with hemoglobin, and its nucleus and mitochondria (particles in the cytoplasm that provide energy for the cell) disappear. In a late stage the cell is called a reticulocyte, which ultimately becomes a fully mature erythrocyte. The average red cell in humans lives 100–120 days; there are some 5.2 million red cells per cubic millimetre of blood in the adult human.

15. In which organelle is ATP found abundantly?

1 Golgi apparatus
2 Chloroplast
3 Mitochondrion
4 Ribosome
5 Nucleus

Answer: 3 (Encyclopaedia Britannica)

Mitochondria and chloroplasts are the powerhouses of the cell. Mitochondria appear in both plant and animal cells as elongated cylindrical bodies, roughly one micrometre in length and closely packed in regions actively using metabolic energy. Mitochondria oxidize the products of cytoplasmic metabolism to generate adenosine triphosphate (ATP), the energy currency of the cell. Chloroplasts are the photosynthetic organelles in plants and some algae. They trap light energy and convert it partly into ATP but mainly into certain chemically reduced molecules that, together with ATP, are used in the first steps of carbohydrate production. Mitochondria and chloroplasts share a certain structural resemblance, and both have a somewhat independent existence within the cell,

synthesizing some proteins from instructions supplied by their own DNA.

The Golgi complex is the site of the modification, completion, and export of secretory proteins and glycoproteins. This organelle, first described by the Italian cytologist Camillo Golgi in 1898, has a characteristic structure composed of five to eight flattened, disk-shaped, membrane-defined cisternae arranged in a stack. Secretory proteins and glycoproteins, cell membrane proteins and glycoproteins, lysosomal proteins, and some glycolipids all pass through the Golgi structure at some point in their maturation. In plant cells, much of the cell wall material passes through the Golgi as well. As the secretory proteins move through the Golgi, a number of chemical modifications may transpire. Important among these is the modification of carbohydrate groups. As described above, many secretory proteins are glycosylated in the ER. In the Golgi, specific enzymes modify the oligosaccharide chains of the glycoproteins by removing certain mannose residues and adding other sugars, such as galactose and sialic acid. These enzymes are known collectively as glycosidases and glycosyltransferases. Some secretory proteins will cease to be transported if their carbohydrate groups are modified incorrectly or not permitted to form. In some cases the carbohydrate groups are necessary for the stability or activity of the protein or for targeting the molecule for a specific destination.

Ribosomes are tiny particle that is present in large numbers in all living cells and serves as the site of protein synthesis. Ribosomes occur both as free particles in prokaryotic and eukaryotic cells and as particles attached to the membranes of the endoplasmic reticulum in eukaryotic cells. Ribosomes can vary in size, although an average ribosome measures about 200 angstroms in diameter and consists of about 40 percent protein and 60 percent RNA. Ribosomes are usually made up of three or four RNA molecules and anywhere from 40 to 80 different proteins. In shape the ribosome is composed of two subunits, a larger one and a smaller one, each of which has a characteristic shape. Ribosomes are very numerous in a cell and account for a large proportion of its total RNA. Ribosomes are the sites at which information carried in the genetic code is converted into protein molecules. Ribosomal molecules of messenger RNA (mRNA) determine the order of transfer RNA (tRNA) molecules that are bound to triplets of amino acids (codons). The order of tRNA molecules ultimately determines the amino acid sequence of a protein because molecules of tRNA catalyze the formation of peptide bonds between the amino acids, linking them together to form proteins. The newly formed proteins detach themselves from the ribosome site and migrate to other parts of the cell for use.

The nucleus is a specialized structure occurring in most cells (except bacteria and blue-green algae) and separated from the

rest of the cell by a double layer, the nuclear membrane. This membrane seems to be continuous with the endoplasmic reticulum (a membranous network) of the cell and has pores, which probably permit the entrance of large molecules. The nucleus controls and regulates the activities of the cell (e.g., growth and metabolism) and carries the genes, structures that contain the hereditary information. Nucleoli are small bodies often seen within the nucleus; they play an important part in the synthesis of ribonucleic acid (RNA) and protein. The gellike matrix in which the nuclear components are suspended is the nucleoplasm. A cell normally contains only one nucleus; under some conditions, however, the nucleus divides but the cytoplasm does not. This produces a multinucleate cell (syncytium) such as occurs in skeletal muscle fibres. Some cells—e.g., the human red blood cell—lose their nuclei upon maturation.

16. Which epidermal tissue in plants has no cuticle?

1 Lower epidermis of leaf
2 Xylem
3 Epidermal hair
4 Root hair
5 Skin of fruit

Answer: 4 (Encyclopaedia Britannica)

The cuticle is the outer layer or part of an organism that comes in contact with the environment. In many invertebrates the dead, noncellular cuticle is secreted by the epidermis. This layer may, as in the arthropods, contain pigments and chitin; in humans the cuticle is the epidermis. In some higher plants, the cuticle is a water-impervious protective layer covering the epidermal cells of leaves, young shoots and all other aerial plant organs without periderm and limiting water loss. It consists of cutin, a waxy, water-repellent substance allied to suberin, which is found in the cell walls of corky tissue. Cutin is especially noticeable on many fruits—e.g., apple, nectarine, and cherry, which can be buffed to a high gloss.

17. Which gland is not found in the human skin?

1 Sebaceous glands
2 Talc glands
3 Sweat glands
4 Mammary glands
5 Mucous glands

Answer: 2 (Encyclopaedia Britannica)

Talc is a common silicate mineral that is distinguished from almost all other minerals by its extreme softness (it has the lowest rating [1] on the Mohs scale of hardness). Its soapy or greasy feel accounts for the name soapstone given to compact aggregates of talc and other rock-forming minerals. Dense aggregates of high-purity talc are called steatite. Since ancient times, soapstones have been employed for carvings, ornaments, and utensils; Assyrian cylinder seals, Egyptian scarabs, and Chinese statuary are notable examples. Talc is also

used in lubricants, leather dressings, toilet and dusting powders, and certain marking pencils. It is used as a filler in ceramics, paint, paper, roofing materials, plastic, and rubber; as a carrier in insecticides; and as a mild abrasive in the polishing of cereal grains such as rice and corn. One of the remarkable features of talc is its simple, almost constant composition; talc is a basic magnesium silicate, $Mg_3Si_4O_{10}(OH)_2$. Unlike other silicates, even closely related ones, talc appears to be unable to accept iron or aluminium into its structure to form chemical-replacement series, even though an iron analogue of talc is known, and the structurally related chlorite forms at least a partial series between iron and magnesium end-members.

The glands of the skin are all exocrine, that is, they secrete their products, usually through ducts, to the epidermal surface. They may be unicellular, as are the goblet cells of fishes, or multicellular, as are the sweat glands of humans. Some multicellular glands are tubular and extrude their secretion into a central space or lumen; some, like the oil-producing sebaceous glands of mammals, form their product by complete breakdown of the cells, a method of secretion known as holocrine. Glands may consist of tubes or sacs, and they may be singular, clustered, or branched; some even contain units of more than one type. They may secrete their product continuously, periodically, or only once. Mucous glands secrete a protein called mucin, which with water forms the substance known as mucus; this slimy material serves to lubricate the body, thus lessening friction and aiding locomotion in swimming animals. Serous glands produce a watery secretion; sweat glands of mammals are of this type. Sebaceous glands secrete oil, ceruminous glands secrete wax, mammary glands they are modified sweat glands!) secrete milk, poison glands secrete various toxins, and scent glands secrete a variety of odoriferous substances. Further, certain epidermal glands may be modified into light-producing structures called photophores, seen in the skin of many deep-sea fishes.

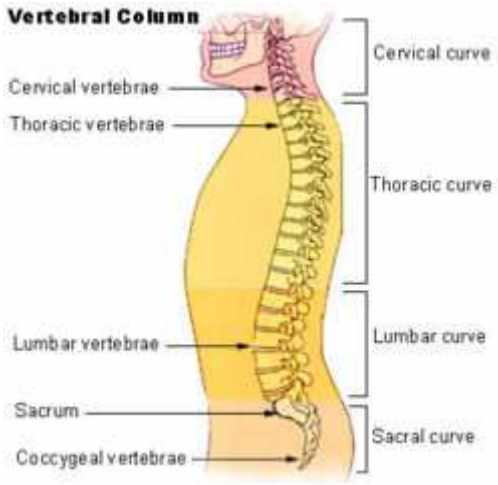
18. Which human vertebrae are fused?

1 Sacral vertebrae
2 Cervical vertebrae
3 Thoracic vertebrae
4 Lumbar vertebrae
5 Atlas and axis

Answer: 1 (Wikipedia)

Please refer to the picture below. The sacrum, (plural Sacra) is the wedge-shaped triangular bone at the base of the vertebral column, above the caudal (tail) vertebrae, or coccyx, that articulates (connects) with the pelvic girdle. In humans it is usually composed of five vertebrae, which fuse in early adulthood. The top of the first (uppermost) sacral vertebra articulates with the last (lowest) lumbar vertebra. The transverse processes of the first three sacral vertebrae are fused to form wide lateral

wings, or alae, and articulate with the centre-back portions of the blades of the ilia to complete the pelvic girdle. The sacrum is held in place in this joint, which is called the sacroiliac, by a complex mesh of ligaments. Between the fused transverse processes of the lower sacral vertebrae, on each side, are a series of four openings (sacral foramina); the sacral nerves and blood vessels pass through these openings. A sacral canal running down through the centre of the sacrum represents the end of the vertebral canal; the functional spinal cord ends at about the level of the first sacral vertebra, but its continuation, the filum terminale, can be traced through the sacrum to the first coccygeal vertebra.

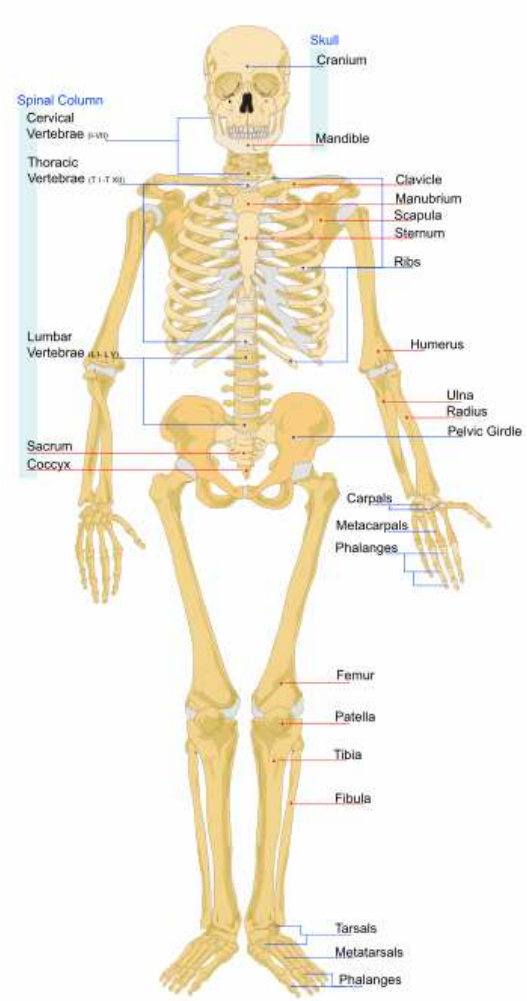


19. Which is the longest bone in the human skeleton

1 Femur
2 Humerus
3 Tibia
4 Ulna
5 Fibula

Answer: 1 (Encyclopaedia Britannica)

See the diagram below.



Also called the thighbone, the *femur* is the upper bone of the leg or hind leg. The head forms a ball-and-socket joint with the hip (at the acetabulum), being held in place by a ligament (ligamentum teres femoris) within the socket and by strong surrounding ligaments. In humans the neck of the femur connects the shaft and head at a 125° angle, which is efficient for walking. A

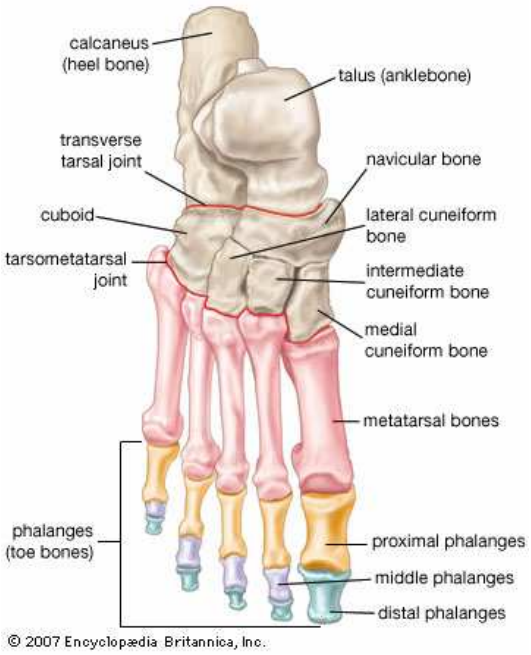
prominence of the femur at the outside top of the thigh provides attachment for the gluteus medius and minimus muscles. The shaft is somewhat convex forward and strengthened behind by a pillar of bone called the linea aspera. Two large prominences, or condyles, on either side of the lower end of the femur form the upper half of the knee joint, which is completed below by the tibia (shin) and patella (kneecap). Internally, the femur shows the development of arcs of bone called trabeculae that are efficiently arranged to transmit pressure and resist stress. In humans, the femur is the longest, most voluminous, and strongest bone and has been shown to be capable of resisting compression forces of 800–1,100 kg (1,800–2,500 pounds).

The *tibia* (also called shin) is the inner and larger of the two bones of the lower leg in vertebrates—the other is the fibula. In humans the tibia forms the lower half of the knee joint above and the inner protuberance of the ankle below. The upper part consists of two fairly flat-topped prominences, or condyles, that articulate with the condyles of the thighbone, or femur, above. The attachment of the ligament of the kneecap, or patella, to the tibial tuberosity in front completes the knee joint. The lateral condyle is larger and includes the point at which the fibula articulates. The tibia's shaft is approximately triangular in cross section; its markings are influenced by the strength of the attached muscles. It is attached to the fibula throughout its length by an interosseous membrane.

20. The biological term for middle foot bones.

1	Phalanges
2	Tarsal bones
3	Carpal bones
4	Metacarpals
5	Metatarsals

Answer: 5 (Encyclopaedia Britannica)



The foot is the terminal part of the leg of a land vertebrate, on which the creature stands. In most two-footed and many four-footed animals, the foot consists of all structures below the ankle joint: heel, arch, digits, and contained bones such as tarsals, metatarsals, and phalanges; in mammals that walk on their toes and in hoofed

mammals, it includes the terminal parts of one or more digits. The major function of the foot in land vertebrates is locomotion. Three types of foot posture exist in mammals: (1) plantigrade, in which the surface of the whole foot touches the ground during locomotion (e.g., human, baboon, bear), (2) digitigrade, in which only the phalanges (toes, fingers) touch the ground, while the ankle and wrist are elevated (e.g., dog, cat), and (3) unguligrade, in which only a hoof (the tip of one or two digits) touches the ground—a specialization of running animals (e.g., horse, deer). In primates the foot, like the hand, has flat nails protecting the tips of the digits, and the undersurface is marked by creases and friction-ridge patterns. In most primates the foot is adapted for grasping (i.e., is prehensile), with the first digit set at an angle from the others. The foot may be used for manipulation in addition to its use in climbing, jumping, or walking. The human foot is nonprehensile and is adapted for a form of bipedalism distinguished by the development of the stride—a long step, during which one leg is behind the vertical axis of the backbone—which allows great distances to be covered with a minimum expenditure of energy.

21. Blood pressure in the arteries is the highest during….

1 ventricular systole
2 ventricular diastole
3 atrial systole
4 atrial diastole
5 rest period when atria refill

Answer: 1 (Encyclopaedia Britannica)

The pressure that develops within the closed vertebrate circulatory system is highest at the pump—the heart—and decreases with distance away from the pump because of friction within the blood vessels. Because the blood vessels can change their diameter, blood pressure can be affected by both the action of the heart and changes in the size of the peripheral blood vessels. Blood is a living fluid—it is viscous and contains cells (45 percent of its volume in human beings)—and yet the effects of the cells on its flow patterns are small. Blood enters the atrium by positive pressure from the venous system or by negative pressure drawing it in by suction. Both mechanisms operate in vertebrates. Muscular movements of the limbs and body, and gravity in land vertebrates, are forces propelling blood to the heart. In birds and mammals the blood arrives at the heart with considerable residual pressure and passes through the auricles into the ventricles, apparently without much additional impetus from contraction of the auricles. The ventricle is the main pumping chamber, the right and left ventricles in birds and mammals function as a volume and a pressure pump, respectively. The thick muscular wall of the left ventricle ensures that it develops a higher pressure during contraction (systole) in order to force blood through the body. It follows that pressures in the aorta and pulmonary artery may be very different. In

human beings aortic pressure is about six times higher.

22. The only artery which carries deoxygenated blood is the …

1 pulmonary vein
2 vena cava superior
3 pulmonary artery
4 aorta
5 vena cava inferior

Answer: 3 (Encyclopaedia Britannica)

An artery is any of the vessels that, with one exception, carry oxygenated blood and nourishment from the heart to the tissues of the body. The exception, the pulmonary artery, carries oxygen-depleted blood to the lungs for oxygenation and removal of excess carbon dioxide. Arteries are muscular and elastic tubes that must transport blood under a high pressure exerted by the pumping action of the heart. The pulse, which can be felt over an artery lying near the surface of the skin, results from the alternate expansion and contraction of the arterial wall as the beating heart forces blood into the arterial system via the aorta. Large arteries branch off from the aorta and in turn give rise to smaller arteries until the level of the smallest arteries, or arterioles, is reached. The threadlike arterioles carry blood to networks of microscopic vessels called capillaries, which supply nourishment and oxygen to the tissues and carry away carbon dioxide and other products of metabolism by way of the veins. The largest artery is the aorta, which arises from the left ventricle of the heart. The aorta arches briefly upward before continuing downward close to the backbone; the arteries that supply blood to the head, neck, and arms arise from this arch and travel upward. As it descends along the backbone, the aorta gives rise to other major arteries that supply the internal organs of the thorax. After descending to the abdomen, the aorta divides into two terminal branches, each of which supplies blood to one leg.

23. The valve at the base of the aorta is the

1 Tricuspid valve
2 Bicuspid valve
3 Semilunar valve
4 Mitral valve
5 Coronary valve

Answer: 3 (Encyclopaedia Britannica)

The aorta is the blood vessel (or vessels) carrying blood from the heart to all the organs and other structures of the body. At the opening from the left ventricle into the aorta is a three-part valve that prevents backflow of blood from the aorta into the heart. The aorta emerges from the heart as the ascending aorta, turns to the left and arches over the heart (the aortic arch), and passes downward as the descending aorta. The left and right coronary arteries branch from the ascending aorta to supply the heart muscle. The three main arteries branch from the aortic arch and give rise to further

branches that supply oxygenated blood to the head, neck, upper limbs, and upper part of the body. The descending aorta runs down through the posterior centre of the trunk past the heart, lungs, and esophagus, through an opening in the diaphragm, and into the abdominal cavity. In the heart there are two valves that prevent backflow of blood from the ventricles into the atria. On the right side of the heart is the tricuspid valve, composed of three flaps of tissue; on the left is the two-piece mitral valve. Once blood has left the heart and entered the aorta, its return is prevented by the semilunar valves, which consist of membranous saclike flaps that open away from the heart. If the flow of blood reverses, the flaps fill and are pressed against each other, thus blocking the reentry of blood into the aorta.

24. The hyphae of *Rhizopus* (bread mould) is coenocytic and is therefore…

1 uninucleate
2 binucleate
3 prokaryote
4 anucleate
5 multinucleate

Answer: 5 (Wikipedia)

A coenocyte is a multinucleate cell. It can result from multiple nuclear divisions without accompanying cell divisions, or from cellular aggregation followed by dissolution of the cell membranes inside the mass. Coenocytes are found in fungi and some protists, such as algae and slime mold. Some plant structures, such as endosperm, are coenocytic as well.

25. For which animal was the highest price paid at a game auction during the 2002/2003 season?

1 Blue crane
2 Buffalo
3 White rhinoceros
4 Black impala
5 Black rhinoceros

Answer: 5 (www.iol.co.za)

This is part of an article that was originally published on page 4 of The Mercury on June 18, 2003.

Six black rhinos will be the star attraction at the 15th Ezemvelo KwaZulu-Natal Wildlife annual game auction in Hluhluwe-Umfolozi Park on Saturday. Two years ago, when this endangered species was last up for auction, a group of six was sold for R3.3-million - R550 000 each. Such is their conservation status that potential black rhino owners must have their properties inspected by KZN Wildlife staff before they can register as bidders. Black rhinos can only be sold to South African game ranches as trade in the species between countries is banned under the Convention on International Trade of Endangered Species (Cites). Forty white rhinos are on offer. Top price of R410 000 was paid last year for a female, while the

average price was R237 500. Forty-one nyala - which averaged R7 400 last year - are also among the animals already captured and being held in the bomas of the Centenary Centre in Umfolozi. The prime purpose of the auction is as a management tool to dispose of surplus game following annual scientific evaluation of the animals in each park managed by KZN Wildlife.

26. Why is the Jacaranda tree a problem plant?

1 The seeds are poisonous
2 Sap from flowers destroy paint
3 They uproot roads and walls
4 They displace natural vegetation
5 They attract a lot of bugs and mosquitoes

Answer: 4 (Encyclopaedia Britannica/Wikipedia/IOL)

Jacarandas are a genus under the plant family Bignoniaceae, especially the two ornamental trees *J. mimosifolia* and *J. cuspidifolia*. They are widely grown in warm parts of the world and in greenhouses for their showy blue or violet flowers and attractive, oppositely paired, compound leaves. The genus includes about 50 species native to Central and South America and to the West Indies. The name jacaranda is also applied to several tree species of the genus Machaerium of the pea family (Leguminosae, or Fabaceae), from which some of the commercial rosewoods are obtained. Jacaranda cabinet wood is a rosewood from the tree species *Dalbergia nigra*, also of the pea family. Pretoria in South Africa is popularly known as The Jacaranda City due to the enormous number of Jacaranda trees planted as street trees and in parks and gardens. In flowering time the city appears blue/purple in colour when seen from the nearby hills because of all the Jacaranda trees. Jacaranda trees are alien and many alien plants become invasive outside their places of origin because they have left behind their natural parasites that would normally keep their propagation in check. Thus, invasive alien plants threaten the indigenous vegetation as they use valuable and limited water resources. Most of them use more water than indigenous plants and are depleting valuable underground water resources. In 2005, the city of Pretoria declared war on alien vegetation and legislated against the planting or propagation of these. The plants have been divided into categories - declared weeds, declared invaders (plants with commercial value, or plants with ornamental value). Declared invaders are plants that must be controlled (removed) on land or water surfaces by all land users. The declared invaders are lantana, pom pom weed, bugweed, azolla, queen of the night, pampas grass, cat's claw creeper, red sesbania, yellow oleander, yellow bells and water hyacinth. These may no longer be planted or propagated and all trade in their seeds, cuttings or any other propagation is

prohibited. Declared invaders are plants that pose a threat to the environment but nevertheless can be exploited for timber, fruits, fuel wood, medical plants, animal fodder or building material. The plants include black wattle, patula pine, sisal, red eye, grey poplar, watercress, Port Jackson willow, guava, cluster pine, honey locust and weeping willow (not to be confused with the indigenous willow), jacaranda, syringa, Australian silk oak, St Joseph's lily, sword fern, tipu tree and New Zealand Christmas tree. Residents have been urged to learn to identify and remove invasive alien plants, join or form a hacking team to remove invaders and plant indigenous (local) plants in their garden. The municipality has also urged residents to buy only indigenous plants from their local nursery and to replace the invasive alien plants with an indigenous plant. Residents should use these methods to control the invasive plants; uprooting, felling, cutting, burning, treatment with registered herbicides, biological control or any other recognised and appropriate method.

27. Which one is not a natural gait or pacing of horses?

1 Walk
2 Trot
3 Canter
4 Gallop
5 Race

Answer: 5 (Encyclopaedia Britannica)

The natural gaits of the horse are the walk, the trot, the canter or slow gallop, and the gallop, although in dressage the canter and gallop are not usually differentiated. A riding horse is trained in each gait and in the change from one to another. During the walk and the gallop the horse's head moves down and forward, then up and back (only at the trot is it still); riders follow these movements with their hands. The walk is a slow, four-beat, rhythmic pace of distinct successive hoof beats in an order such as near (left) hind, near fore, off (right) hind, off fore. Alternately two or three feet may be touching the ground simultaneously. It may be a free, or ordinary, walk in which relaxed extended action allows the horse freedom of its head and neck, but contact with the mouth is maintained; or it may be a collected walk, a short-striding gait full of impulsion, or vigour; or it may be an extended walk of long, unhurried strides. The trot is a two-beat gait, light and balanced, the fore and hind diagonal pairs of legs following each other almost simultaneously—near fore, off hind, off fore, and near hind. Riders can either sit in the saddle and be bumped as the horse springs from one diagonal to the other, or they can rise to the trot, post, by rising out of the saddle slightly and allowing more of their weight to bear on the stirrups when one or the other of the diagonal pairs of legs leaves the ground. Posting reduces the impact of the trot on both horse and rider. As the horse moves faster, its gait changes into the canter, or ordinary gallop, in which the rider does not rise or bump. It is

a three-beat gait, graceful and elegant, characterized by one or the other of the forelegs and both hind legs leading—near hind, off hind, and near fore practically together, then off fore, followed briefly by complete suspension. Cantering can be on the near lead or the off, depending on which is the last foot to leave the ground. The rider's body is more forward than at the trot, the weight taken by the stirrups. An accelerated canter becomes the gallop, in which the rider's weight is brought sharply forward as the horse reaches speeds up to 30 miles (48 kilometres) an hour. The horse's movements are the same as in the canter. To some authorities, the gallop is a four-beat gait, especially in an extended run. There are a number of disconnected and intermediate gaits, some done only by horses bred to perform them. One is the rack, a four-beat gait, with each beat evenly spaced in perfect cadence and rapid succession. The legs on either side move together, the hind leg striking the ground slightly before the foreleg. The single foot is similar to the rack but slower. In the pace, the legs on either side move and strike the ground together in a two-beat gait. The fox trot and the amble are four-beat gaits, the latter smoother and gliding.

28. Which one of the following animals is not listed in the IUCN Red Data book as threatened?

1 Pelican
2 African Wild Dog
3 African Elephant
4 Jackass Penguin
5 Red-knee Tarantula

Answer: http://www.iucnredlist.org

The IUCN Red List of Threatened Species (also known as the IUCN Red List or Red Data List), created in 1963, is the world's most comprehensive inventory of the global conservation status of plant and animal species. The International Union for the Conservation of Nature and Natural Resources (IUCN) is the world's main authority on the conservation status of species. All the animals listed in the question have appeared in the IUCN redlist and the pelican, as of 2001, was largely of least concern. There are seven or eight species of water birds constituting the family Pelecanidae (order Pelecaniformes), distinguished by their large, elastic throat pouches. Called pelicans, they inhabit lakes, rivers, and seacoasts in many parts of the world. With some species reaching a length of 180 cm (70 inches), having a wingspan of 3 m (10 feet), and weighing up to 13 kg (30 pounds), they are among the largest of living birds. The best-known pelicans are the two species called white pelicans: *Pelecanus erythrorhynchos* of the New World, the North American white pelican, and *P. onocrotalus* of the Old World, the European white pelican. The smaller, 107–137-centimetre brown pelican (*P. occidentalis*) of the New World is a coastal species listed as endangered by the U.S. Fish and Wildlife Service. Though the brown pelican once

bred in enormous colonies, its population declined drastically in the period 1940–70 as a result of DDT and related pesticides. The birds' breeding subsequently improved after DDT was banned. In 2001, only the Dalmatian pelican (*Pelecanus crispus*) was listed as vulnerable.

29. Which set of differences between a plant cell and an animal cell is **correct**?

Plant cell	Animal cell
1 Has chloroplasts	Has chromoplasts
2 Has a vacuole	Has no vacuole
3 Has cell wall and cell membrane	Has only cell wall
4 Has mitochondria	Has mitochondria
5 Can photosynthesise and respire	Can only respire

Answer: 5 (Encyclopaedia Britannica)

A cell is enclosed by a plasma membrane, which forms a selective barrier that allows nutrients to enter and waste products to leave. The interior of the cell is organized into many specialized compartments, or organelles, each surrounded by a separate membrane. One major organelle, the nucleus, contains the genetic information necessary for cell growth and reproduction. Each cell contains only one nucleus, whereas other types of organelles are present in multiple copies in the cellular contents, or cytoplasm. Organelles include mitochondria, which are responsible for the energy transactions necessary for cell survival; lysosomes, which digest unwanted materials within the cell; and the endoplasmic reticulum and the Golgi apparatus, which play important roles in the internal organization of the cell by synthesizing selected molecules and then processing, sorting, and directing them to their proper locations. In addition, plant cells contain chloroplasts, which are responsible for photosynthesis, whereby the energy of sunlight is used to convert molecules of carbon dioxide (CO_2) and water (H_2O) into carbohydrates. Between all these organelles is the space in the cytoplasm called the cytosol. The cytosol contains an organized framework of fibrous molecules that constitute the cytoskeleton, which gives a cell its shape, enables organelles to move within the cell, and provides a mechanism by which the cell itself can move. The cytosol also contains more than 10,000 different kinds of molecules that are involved in cellular biosynthesis, the process of making large biological molecules from small ones.

30. When a piece of liver is put in hydrogen peroxide, oxygen is given off. The chemical in the liver that is responsible for the reaction is….

1 a hormone
2 an enzyme
3 an acid
4 a buffer
5 alcohol

Answer: 2 (Encyclopaedia Britannica)

The enzyme responsible for this reaction (hydrogen peroxide decomposition to water and oxygen) is called catalase. Found extensively in mammalian tissues, catalase prevents the accumulation of and protects the body tissues from damage by peroxide, which is continuously produced by numerous metabolic reactions. All known animals use catalase in every organ, with particularly high concentrations occurring in the liver. One unique use of catalase occurs in bombardier beetle. The beetle has two sets of chemicals ordinarily stored separately in its paired glands. The larger of the pair, the storage chamber or reservoir, contains hydroquinones and hydrogen peroxide, whereas the smaller of the pair, the reaction chamber, contains catalases and peroxidases. To activate the spray, the beetle mixes the contents of the two compartments, causing oxygen to be liberated from hydrogen peroxide. The oxygen oxidizes the hydroquinones and also acts as the propellant. A rare hereditary metabolic disorder caused by lack of the enzyme catalase is called acatalasia. Although a deficiency of catalase activity is noted in many tissues of the body, including the red blood cells, bone marrow, liver, and skin, only about half of the affected persons have symptoms, which consist of recurrent infections of the gums and associated oral structures that may lead to gangrenous lesions. Such lesions are rare after puberty. The disorder has been most frequently reported in Japanese and Korean populations; its estimated frequency in Japan is approximately 2 in 100,000.

31. Bacteria and algae are classified as plants because they….

1 are green
2 have cell walls
3 can produce their own food
4 survive in the form of seed and not in eggs
5 cannot move

Answer: 3 (Encyclopaedia Britannica)

Bacteria and algae are **not** classified as plants but have some similarities to them. Bacteria, archaebacteria, and blue-green algae are prokaryotes and fall under the kingdom Monera. Archaebacteria are unicellular organisms that are prokaryotic (that is, do not have a membrane-bound nucleus and other internal units) but that differ in certain physiological and genetic features from bacteria, the most prominent prokaryotes. Archaea have some features in common with bacteria as well as eukaryotes (organisms whose cells contain nuclear membranes), but evidence suggests that archaea are more closely related to eukaryotes than to bacteria

The blue-green algae, also called cyanobacteria, are traditionally placed with the other algae (e.g., seaweeds) and are studied more by botanists than by microbiologists. Blue-green algae may be either unicellular or filamentous, and they

behave like true plants, photosynthesizing in a way that resembles green plants rather than bacteria. Many move by gliding, as do some bacteria and some true unicellular algae. They are often extremely abundant around hot springs or at the edges of muddy ponds, and, though they are resistant to harsh environments, blue-green algae are killed by many drugs (e.g., antibiotics) used against bacteria. Perhaps they are best regarded as representing a group close to the main evolutionary line that gave rise to the eukaryotic plants.

32. The origin of the basic component of all organic compounds is….

1 CO_2
2 H_2O
3 O_2
4 N_2
5 glucose

Answer: 1 (Encyclopaedia Britannica)

During photosynthesis in green plants, light energy is captured and used to convert water, carbon dioxide, and minerals into oxygen and energy-rich organic compounds. In chemical terms, photosynthesis is a light-energized oxidation–reduction process. (Oxidation refers to the removal of electrons from a molecule; reduction refers to the gain of electrons by a molecule.) In plant photosynthesis, the energy of light is used to drive the oxidation of water (H_2O), producing oxygen gas (O_2), hydrogen ions (H^+), and electrons. Most of the removed electrons and hydrogen ions ultimately are transferred to carbon dioxide (CO_2), which is reduced to organic products. Other electrons and hydrogen ions are used to reduce nitrate and sulfate to amino and sulfhydryl groups in amino acids, which are the building blocks of proteins. In most green cells, carbohydrates—especially starch and the sugar sucrose—are the major direct organic products of photosynthesis. The overall reaction in which carbohydrates—represented by the general formula (CH_2O)—are formed during plant photosynthesis can be indicated by the following equation:

$$CO_2 + 2H_2O \xrightarrow[\text{green plants}]{\text{light}} (CH_2O) + O_2 + H_2O$$

33. Plants do not react to the stimulus of…

1 light
2 water
3 gasses
4 touch
5 gravity

Answer: 3 (Encyclopaedia Britannica)

No experiment can prove that plants grow towards a gas as the gas will have to be contained within an impervious medium, yet the plant will have to sense its presence in order to grow away from or towards it! The response or orientation of a plant or certain lower animals to a stimulus that acts with greater intensity from one direction than another is called tropism. It may be achieved by active movement or by structural

alteration. Forms of tropism include phototropism (response to light), geotropism (response to gravity), chemotropism (response to particular substances), hydrotropism (response to water), thigmotropism (response to mechanical stimulation), traumatotropism (response to wound lesion), and galvanotropism, or electrotropism (response to electric current). Most tropic movements are orthotropic; i.e., they are directed toward the source of the stimulus. Plagiotropic movements are oblique to the direction of stimulus. Diatropic movements are at right angles to the direction of stimulus.

Plants respond to a variety of external stimuli by utilizing hormones as controllers in a stimulus-response system. Directional responses of movement are known as tropisms and are positive when the movement is toward the stimulus and negative when it is away from the stimulus. When a seed germinates, the growing stem turns upward toward the light, and the roots turn downward away from the light. Thus, the stem shows positive phototropism and negative geotropism, while the roots show negative phototropism and positive geotropism. In this example, light and gravity are the stimuli, and directional growth is the response. The controllers are certain hormones synthesized by cells in the tips of the plant stems. These hormones, known as auxins, diffuse through the tissues beneath the stem tip and concentrate toward the shaded side, causing elongation of these cells and, thus, a bending of the tip toward the light. The end result is the maintenance of the plant in an optimal condition with respect to light.

34. Which one is not part of a flower?

1 Petal
2 Anther
3 Sepal
4 Seeds
5 Ovary

Answer: 4 (Encyclopaedia Britannica)

Seeds are found in ripened ovaries, long after the flower has disappeared. A flower is the reproductive portion of any plant in the division Magnoliophyta (Angiospermae), commonly called flowering plants or angiosperms. As popularly used, the term “flower” especially applies when part or all of the reproductive structure is distinctive in colour and form. Basically, each flower consists of a floral axis upon which are borne the essential organs of reproduction (stamens and pistils) and usually accessory organs (sepals and petals); the latter may serve to both attract pollinating insects and protect the essential organs. The floral axis is a greatly modified stem; unlike vegetative stems, which bear leaves, it is usually contracted, so that the parts of the flower are crowded together on the stem tip, the receptacle. The flower parts are usually arrayed in whorls (or cycles) but may also be disposed spirally, especially if the axis is elongate. There are commonly four distinct whorls of flower parts: (1) an outer calyx

consisting of sepals; within it lies (2) the corolla, consisting of petals; (3) the androecium, or group of stamens; and in the centre is (4) the gynoecium, consisting of the pistils. The sepals and petals together make up the perianth, or floral envelope. The sepals are usually greenish and often resemble reduced leaves, while the petals are usually colourful and showy. Sepals and petals that are indistinguishable, as in lilies and tulips, are sometimes referred to as tepals. The androecium, or male parts of the flower comprise the stamens, each of which consists of a supporting filament and an anther, in which pollen is produced. The gynoecium, or female parts of the flower, comprise the pistils, each of which consists of an ovary, with an upright extension, the style, on the top of which rests the stigma, the pollen-receptive surface. The ovary encloses the ovules, or potential seeds. A pistil may be simple, made up of a single carpel, or ovule-bearing modified leaf; or compound, formed from several carpels joined together. A flower having sepals, petals, stamens, and pistils is complete; lacking one or more of such structures, it is said to be incomplete. Stamens and pistils are not present together in all flowers. When both are present the flower is said to be perfect, or bisexual, regardless of a lack of any other part that renders it incomplete (see photograph). A flower that lacks stamens is pistillate, or female, while one that lacks pistils is said to be staminate, or male. When the same plant bears unisexual flowers of both sexes, it is said to be monoecious (e.g., tuberous begonia, hazel, oak, corn); when the male and female flowers are on different plants, the plant is dioecious (e.g., date, holly, cottonwood, willow); when there are male, female, and bisexual flowers on the same plant, the plant is termed polygamous.

35. Which one is not a fruit?

1 Tomato
2 Pumpkin
3 Green Pepper
4 Nuts
5 Green beans

Answer: 4 (Encyclopaedia Britannica)
An uneducated guess would list nuts as the answer but this question is in fact invalid since there is no correct answer! In its strict botanical sense, a fruit is the fleshy or dry ripened ovary of a plant, enclosing the seed or seeds. Thus, apricots, bananas, and grapes, as well as bean pods, corn grains, tomatoes, cucumbers, and (in their shells) acorns and almonds, are all technically fruits. Popularly, however, the term is restricted to the ripened ovaries that are sweet and either succulent or pulpy.

36. Which factor is not needed for the germination of seeds?

1 Water
2 Light
3 Oxygen
4 Heat

5 Growth medium

Answer: 2 (Encyclopaedia Britannica)

Germination is the sprouting of a seed, spore, or other reproductive body, usually after a period of dormancy. Seed germination depends on many factors, both internal and external. The most important external factors include: water, oxygen, temperature, light (for many plants the least critical in the early stages) and the correct soil conditions. Every variety of seed requires a different set of variables for successful germination. This depends greatly on the individual seed variety and is closely linked to the ecological conditions in the plants' natural habitat. Germination sometimes occurs early in the development process; the mangrove (Rhizophora) embryo develops within the ovule, pushing out a swollen rudimentary root through the still-attached flower. In peas and corn (maize), the cotyledons (seed leaves) remain underground; in other species (beans, sunflowers, etc.), the hypocotyl (embryonic stem) grows several inches above the ground, carrying the cotyledons into the light, in which they become green and often leaf-like.

37. Lichens are the symbiotic relationship between….

1 fungi and algae
2 mosses and fungi
3 algae and mosses
4 algae and bacteria
5 mosses and bacteria

Answer: 1 (Encyclopaedia Britannica)

A lichen is any of about 15,000 species of thallophytic plantlike organisms that consist of a symbiotic association of algae (usually green) and fungi (mostly ascomycetes and basidiomycetes). Lichens were once classified as single organisms until the advent of microscopy, when the association of algae and fungi became evident. There is still some discussion about how to classify lichens. Lichens have been used by humans as food and as sources of medicine and dye. They also provide two-thirds of the food supply for the caribou and reindeer that roam the far northern ranges. The composite body of a lichen is called a thallus (plural thalli). The homoeomerous type of thallus consists of numerous algal cells (called the phycobionts) distributed among a lesser number of fungal cells (called the mycobionts). The heteromerous thallus differs in that it has a predominance of fungal cells. Hairlike growths that anchor the thallus to its substrate are called rhizines. Lichens that form a crustlike covering that is thin and tightly bound to the substrate are termed crustose. Squamulose lichens are small and leafy with loose attachments to the substrate. Foliose lichens are large and leafy, reaching diameters of several feet in some species, and are usually attached to the substrate by their large, plate-like thalli at the centre.

38. What does coral consist of?

1 Skeletons of dead fish
2 Small animals' calcium carbonate exoskeletons
3 Minerals excreted by decomposers
4 Silica deposited by small animals
5 Deposits from a saturated sea salt solution

Answer: 2 (Encyclopaedia Britannica)

A coral is any of a variety of invertebrate marine organisms of the class Anthozoa (phylum Cnidaria) that are characterized by skeletons—external or internal—of a stone-like, horny, or leathery consistency. The term coral is also applied to the skeletons of these animals, particularly to those of the stone-like corals. Stony corals (order Madreporaria or Scleractinia) number about 1,000 species; black corals and thorny corals (Antipatharia), about 100 species; horny corals, or gorgonians (Gorgonacea), about 1,200 species; and blue corals (Coenothecalia), one living species. The body of a coral animal consists of a polyp—a hollow, cylindrical structure attached at its lower end to some surface. At the free end is a mouth surrounded by tentacles. The tentacles, which gather food, are more or less extensible and are armed with specialized stinging structures called nematocysts that paralyze prey. Eggs and sperm, usually produced by separate individuals, develop as outgrowths in the gastrovascular cavity and are expelled through the mouth into the open water. Fertilization usually takes place in the water but sometimes occurs in the gastrovascular cavity. The larva, a ciliated form known as a planula, swims about for several days or as long as several weeks, then settles onto a solid surface and develops into a polyp. Reproduction also occurs by budding. The bud remains attached to the original polyp. A colony develops by the constant addition and growth of new buds. As new polyps develop, the old ones beneath die, but the skeletons remain.

39. Where did American Indians obtain poison for their arrow tips?

1 A kind of frog
2 Venomous snakes
3 Butterflies which are poisonous
4 Poisonous plants and berries
5 Scorpions

Answer: 1 (Encyclopaedia Britannica)

Anura (also called Salientia) is one of the major extant orders of the class Amphibia. It includes the frogs and toads, which, because of their wide distribution, are known by most people around the world. The name frog is commonly applied to those forms with long legs and smooth, mucus-covered skins, toad being used for a variety of robust, short-legged anurans, especially those with rough skins. The name toad is applied so unevenly that one member of a family may

be called a toad and a closely related member a frog. The familiar members of the family Bufonidae may be distinguished as “true toads.” Frogs are used as teaching tools from grade school through college. People in various parts of the world eat frog legs, and some kinds of toads are used in insect control. Certain South American Indians use the poisonous secretions of some kinds of frogs for poison arrows and now biochemists are studying the possible medical uses of the constituents of the poison. The frog commonly used for poison harvest is the poison dart frog or poison arrow frog which are vividly coloured, poisonous frogs of the American tropics. Arrow-poison frogs are tiny, usually measuring only 1–5 cm (0.5–2 inches) long, but very conspicuous, coloured in combinations of black with bright red, yellow, pink, orange, green, and blue. They live on or near the ground, and all are members of the family Dendrobatidae, but not all the 170 frog species in this family are toxic. Arrow-poison frogs possess some of the most potent toxins known. Poison glands scattered all over the amphibians' bodies produce alkaloids that affect the nervous system. The most toxic species recorded is the bright yellow *Phyllobates terribilis* of Colombia, capable of injuring a person who merely touches it. The poison can be absorbed through unbroken skin and causes severe irritation. Local people do not kill this frog to extract its poison but merely scrape their blowgun darts across its back before releasing the amphibian. Other arrow-poison frogs are not as fortunate. Several Colombian tribes use different frog species to provide the poisons with which they tip their blowgun darts. The Chocó people force a sharp stick into the frog's mouth and hold it over a fire until it releases a white froth of toxic alkaloids. One frog can provide enough secretion to dip 50 darts, which will remain potent for a year. The bright colours advertising their poisons allow these frogs to hunt boldly by day, feeding on ants, termites, and other small creatures living in the leaf litter of the tropical rainforest.

40. Starch and saliva re mixed at a temperature of 37 ºC and tested with iodine solution. Which colour can be observed?

1 Blue-black
2 Brown-yellow
3 Blue
4 Purple
5 Pink

Answer: 2 (Encyclopaedia Britannica)

Saliva contains salivary amylase, a member of a class of enzymes that catalyze the hydrolysis (splitting of a compound by addition of a water molecule) of starch into smaller carbohydrate molecules such as maltose (a molecule composed of two glucose molecules). Two categories of amylases, denoted alpha and beta, differ in the way they attack the bonds of the starch molecules. Alpha amylase is widespread among living organisms. In the digestive

systems of humans and many other mammals, an alpha-amylase called ptyalin is produced by the salivary glands, whereas pancreatic amylase is secreted by the pancreas into the small intestine. Ptyalin is mixed with food in the mouth, where it acts upon starches. Although the food remains in the mouth for only a short time, the action of ptyalin continues for up to several hours in the stomach—until the food is mixed with the stomach secretions, the high acidity of which inactivates ptyalin. Ptyalin's digestive action depends upon how much acid is in the stomach, how rapidly the stomach contents empty, and how thoroughly the food has mixed with the acid. Under optimal conditions as much as 30 to 40 percent of ingested starches can be broken down to maltose by ptyalin during digestion in the stomach.

After incubation, there will be no starch left since it will have all been broken down to maltose by the action of salivary amylase. Thus, since iodine only detects amylase (starch), the colour of the added iodine solution will persist, i.e., there will be no colour change on its part.

41. What is the main function of the cilia in the respiratory tract of humans? They….

    1 promote the liberation of carbon dioxide
    2 secrete mucus
    3 remove mucus
    4 enlarge the surface area for gaseous exchange
    5 moisten and warm the incoming air

Answer: 3 (Encyclopaedia Britannica)

Cilia are short eyelash-like filaments that are numerous on tissue cells of most animals and provides the means for locomotion of protozoans of the phylum Ciliophora. Cilia may be fused in short transverse rows to form membranelles or in tufts to form cirri. Capable of beating in unison, cilia move mammalian ova through oviducts, generate water currents to carry food and oxygen past the gills of clams, carry food through the digestive systems of snails, circulate cerebrospinal fluid of animals, and clean debris from the respiratory systems of mammals. The respiratory tract is covered in an epithelium, the type of which varies down the tract. There are glands and mucus produced by goblet cells in parts, as well as smooth muscle, elastin or cartilage. Most of the epithelium (from the nose to the bronchi) is covered in pseudostratified columnar ciliated epithelial cells, commonly called respiratory epithelium. The cilia beat in one direction, moving mucus towards the throat where it is swallowed. Moving down the bronchioles, the cells get more cuboidal in shape but are still ciliated.

In modified form, cilia trigger the discharge of stinging devices in jellyfish and give rise to the light-sensitive rods of the mammalian retina and the odour-detecting units of olfactory neurons.

42. Which fact about photosynthesis is **incorrect**?

1 Water, CO_2, chlorophyll and sunlight are mainly needed
2 It takes place in the grana, in the chloroplasts, in the palisade cells and in the mesophyll in a leaf
3 Some plants photosynthesise at 5 ºC and others at 70 ºC
4 The two biochemical phases are glycolysis and the Krebbs cycle
5 Products of photosynthesis are oxygen, glucose, sucrose and starch

Answer: 4 (Encyclopaedia Britannica)

During photosynthesis in green plants, light energy is captured and used to convert water, carbon dioxide, and minerals into oxygen and energy-rich organic compounds. In chemical terms, photosynthesis is a light-energized oxidation–reduction process. (Oxidation refers to the removal of electrons from a molecule; reduction refers to the gain of electrons by a molecule.) In plant photosynthesis, the energy of light is used to drive the oxidation of water (H_2O), producing oxygen gas (O_2), hydrogen ions (H^+), and electrons. Most of the removed electrons and hydrogen ions ultimately are transferred to carbon dioxide (CO_2), which is reduced to organic products. Other electrons and hydrogen ions are used to reduce nitrate and sulfate to amino and sulfhydryl groups in amino acids, which are the building blocks of proteins. In most green cells, carbohydrates—especially starch and the sugar sucrose—are the major direct organic products of photosynthesis. The overall reaction in which carbohydrates—represented by the general formula (CH_2O)—are formed during plant photosynthesis can be indicated by the following equation:

$$CO_2 + 2H_2O \xrightarrow[\text{green plants}]{\text{light}} (CH_2O) + O_2 + H_2O.$$

43. Which one is not a function of the kidney?

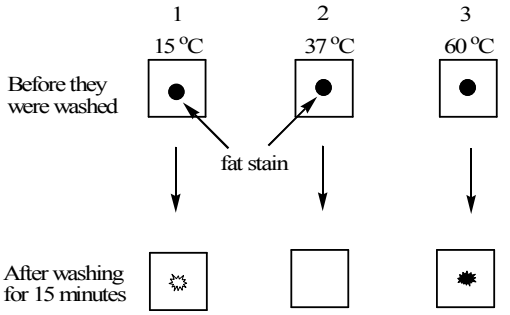
1 Osmoregulation
2 Regulates the pH of blood
3 Filtration of metabolic waste products from the blood
4 Regulates the salt content of blood
5 Regulates the glucose level in the blood

Answer: 5 (Encyclopaedia Britannica)

Kidneys have evolved in multicellular animals as a highly sophisticated channel for waste disposal, and they function to regulate the levels of water, salts, and organic materials in the bodies of higher animals. Materials eliminated via the kidney include nitrogenous waste products (ammonia, uric acid, urea, creatine, creatinine, and amino acids), excess

quantities of salts and water that may be taken into the body, and various other organic materials produced by life-sustaining chemical reactions. Functionally, the kidney is a microfilter that initially removes dissolved as well as some suspended materials from the circulatory system, along with large quantities of water. These substances are differentially reabsorbed into the blood by various kidney structures during urine formation to a degree that varies considerably throughout the animal kingdom. For example, animals that absorb large quantities of water into their bodies (such as freshwater fishes) excrete copious quantities of water in their urine. The reverse is true of many desert animals, who must conserve water and therefore produce a thick, semisolid urine. The kidney, in its various stages of evolution, functions at the expense of considerable metabolic energy and cannot be considered to be a passive system.

44. The figure below shows details of an experiment in which three similar table cloths (1, 2 and 3) with identical fat stains were washed in the same washing machine with the same enzyme-containing washing powder at three different temperatures.



What can be concluded after studying the results?

1 Enzymes are substrate specific
2 Enzymes are sensitive to temperature
3 Not enough washing powder was used
4 Cloths were not washed long enough
5 pH ahs no influence on this enzyme

Answer: 2 (Encyclopaedia Britannica)

All washing conditions were kept identical, with temperature being the only variable. At 15 ºC, the fat stain was only partially removed, at 37 ºC it was completely removed whilst at 60 ºC it was not removed at all. This shows that the enzyme employed has an optimum temperature of 37 ºC.

Enzymes catalyze all aspects of cell metabolism. This includes the digestion of food, in which large nutrient molecules (such as proteins, carbohydrates, and fats) are broken down into smaller molecules; the conservation and transformation of chemical energy; and the construction of cellular macromolecules from smaller precursors.

Many inherited human diseases, such as albinism, result from a deficiency of a particular enzyme. Enzymes also have valuable industrial and medical applications. The fermenting of wine, leavening of bread, curdling of cheese, and brewing of beer have been practiced from earliest times, but not until the 19th century were these reactions understood to be the result of the catalytic activity of enzymes. Since then, enzymes have assumed an increasing importance in industrial processes that involve organic chemical reactions. The uses of enzymes in medicine include killing disease-causing microorganisms, promoting wound healing, and diagnosing certain diseases. Enzyme activity can be affected by other molecules. Inhibitors are molecules that decrease enzyme activity; activators are molecules that increase activity. Many drugs and poisons are enzyme inhibitors. Activity is also affected by temperature, chemical environment (e.g. pH), and the concentration of substrate. Some enzymes are used commercially, for example, in the synthesis of antibiotics. In addition, some household products use enzymes to speed up biochemical reactions (e.g., enzymes in biological washing powders break down protein or fat stains on clothes; enzymes in meat tenderizers break down proteins, making the meat easier to chew).

45. Which one does not have sensory receptors?

1 Retina in the eye
2 Olfactory cells in the nose
3 Corpuscles of Langerhans in the skin
4 Taste buds
5 Organ of Corti in the cochlea of the ear

Answer: 3 (Encyclopaedia Britannica)

Organisms have a variety of sensory structures that respond to different stimuli, such as light, pressure, or chemicals, all of which are forms of energy. Once excited, these sensory receptors convert the energy of the stimulus into a behavioral response of the organism. In general, sense cells, or receptors, located superficially in an organism receive signals from outside the organism and are parts of the exteroceptive system. Receptors located inside the body receive signals from changes taking place inside the body and belong to the interoceptive system. On activation, sensory cells cause reactions appropriate to their location; they are said to respond with their local sign. Photoreceptors are sensitive to light changes. They contain photopigments for absorption of light. The variety of photopigments in different cells determines the number of colours that can be distinguished. It is interesting to note that in insects, among other animals, colour sensitivity is extended into the ultraviolet range, though it is short in the red range. Cells especially sensitive to infrared radiation are found in the remarkable pit organs of vipers, which enable the snake to

locate warm-blooded prey from a distance even when it freezes into immobility.

In the skin of warm-blooded animals, nerve endings, with or without accessory structures, are present that react especially to warming or to cooling. Well-known organs of chemical reception are those of smell and of taste. Except in cases in which there is great specificity to one substance, as, for example, the sex attractant in insects, the spectrum of chemoreceptive cells is broad. The sense of taste was long thought to be mediated by narrow, separate fibres for acid, bitter, sweet, and sour sensations; this viewpoint is now being replaced by one in which the spectra are considerably wider. Frogs have been shown to have taste cells that react specifically to distilled water. Chemoreceptors are also present as interoceptors, a well-known example being the carotid body in certain vertebrates; this organ monitors oxygen pressure in the carotid artery, which supplies the brain with blood. Mechanoreceptors are the most widespread type of sense receptor and the most varied with regard to localization, sensitivity, and type of nerve-impulse firing. There are numerous subdivisions of the mechanoreceptive sense, such as touch, pain, sound, gravity, and muscle tone. Examples in humans include the naked nerve endings in the cornea of the eye; the Pacinian corpuscles in the skin, with their multilayered sheath-like covers; and the hair cells in the inner ear. Impulse formation may continue for as long as stimulus lasts, thus giving a continuous (tonic) type of discharge, or be limited and proportional to the rate of change of the stimulus, thus producing an abrupt (phasic) discharge. A remarkable type of mechanoreceptor occurs in the elastic organs of crustacean legs; movement-sensitive cells fire for the time a joint moves in one direction, and others fire for the opposite movement.

In addition to melanocytes, human epidermis contains another system of dendritic cells called Langerhans cells (after their discoverer, the German physician Paul Langerhans, in 1868) which do not manufacture pigment. Their distribution extends farther toward the skin surface than that of the pigment cells. Their function remained obscure until it was realized that they are a vital part of the immunologic mechanism. Langerhans cells can be looked upon as “sentinel” cells of the immune system. By virtue of their situation, they are among the first cells to come into contact with foreign particulate substances encountering the skin. Their function is aided by the large surface area created by the dendritic processes of the cell. By means of specialized receptors on the cell membrane, the Langerhans cell recognizes invading as opposed to host molecules. By conveying this information to the lymphoid system, the body is able to mount a defensive immunologic response to the foreign material.

46. Which hormone is responsible for the development of the placenta during pregnancy in mammals?

1 Oestrogen
2 Adrenalin
3 Insulin
4 Progesterone
5 Follicle Stimulating Hormone (FSH)

Answer: 1 (Encyclopaedia Britannica)

Estrogen is any of a group of hormones that primarily influence the female reproductive tract in its development, maturation, and function. There are three major hormones—estradiol, estrone, and estriol—among the estrogens, estradiol being the predominant one. The major sources of estrogens are the ovaries and the placenta (the temporary organ that serves to nourish the fetus and remove its wastes); additional small amounts are secreted by the adrenal glands and by the male testes. It is believed that the egg follicle (the saclike structure that holds the immature egg) and interstitial cells (certain cells in the framework of connective tissue) in the ovary are the actual production sites of estrogens in the female. Estrogen levels in the bloodstream seem to be highest during the egg-releasing period (ovulation) and after menstruation, when tissue called the corpus luteum replaces the empty egg follicle. Estrogens affect the ovaries, vagina, fallopian tubes, uterus, and mammary glands. In the ovaries, estrogens help to stimulate the growth of the egg follicle; they also stimulate the pituitary gland in the brain to release hormones that assist in follicular development. Once the egg is released, it travels through the fallopian tubes on its way to the uterus; in the fallopian tubes estrogens are responsible for developing a thick muscular wall and for the contractions that transport the egg and sperm cells. The young female uterus, if deprived of estrogens, does not develop into its adult form; the adult uterus that does not receive estrogens begins to show tissue degeneration. Estrogens essentially build and maintain the endometrium—a mucous membrane that lines the uterus; they increase the endometrium's size and weight, cell number, cell types, blood flow, protein content, and enzyme activity. Estrogens also stimulate the muscles in the uterus to develop and contract; contractions are important in helping the wall to slough off dead tissue during menstruation and during the delivery of a child and of the placenta. The cervix, the tip of the uterus, which projects into the vagina, secretes mucus that enhances sperm transport; estrogens are thought to regulate the flow and thickness of the mucous secretions. The growth of the vagina to its adult size, the thickening of the vaginal wall, and the increase in vaginal acidity that reduces bacterial infections are also correlated to estrogen activities. In the breasts the actions of estrogens are complexly interrelated with those of other hormones, and their total significance is not easily defined; they are, however, responsible for growth of the breasts during adolescence, pigmentation of the nipples, and the eventual cessation of the flow of milk. Estrogens also influence the structural

differences between the male and female bodies. Usually the female bones are smaller and shorter, the pelvis is broader, and the shoulders are narrower. The female body is more curved and contoured because of fatty tissue that covers the muscles, breasts, buttocks, hips, and thighs. The body hair is finer and less pronounced, and the scalp hair is usually more permanent. The voice box is smaller and the vocal cords shorter, giving a higher-pitched voice in females than in males. In addition, estrogens suppress the activity of sebaceous (oil-producing) glands and thereby reduce the likelihood of acne in the female.

Progesterone is the hormone secreted by the female reproductive system that functions mainly to regulate the condition of the inner lining (endometrium) of the uterus. Progesterone is produced by the ovaries, placenta, and adrenal glands; in the ovaries the site of production is the corpus luteum tissue, which begins to form prior to an egg's release and continues to grow into the empty follicular space once the egg has left the follicle (a capsule of tissue around the egg). The released egg, if it is fertilized by the male sperm cell, becomes implanted in the uterus, and a placenta forms. The placenta then produces progesterone during the period of pregnancy. If the egg is not fertilized, progesterone is secreted by the ovaries until a few days before menstruation, at which time the level of progesterone drops sufficiently to stop the growth of the uterine wall and to cause it to start to break down, and menstruation ensues. Progesterone prepares the wall of the uterus so that the lining is able to accept a fertilized egg and so that the egg can be implanted and develop. It also inhibits muscular contractions of the uterus that would probably cause the wall to reject the adhering egg.

The *follicle stimulating hormone (FSH)* is one of two gonadotropic hormones (i.e., hormones concerned with the regulation of the activity of the gonads, or sex glands) produced by the pituitary gland. FSH, a glycoprotein operating in conjunction with luteinizing hormone (LH), stimulates development of the graafian follicle, a small, egg-containing vesicle in the ovary of the female mammal; in the male, it promotes the development of the tubules of the testes and the differentiation of sperm. Though in the male the presence of FSH is necessary for the maturation of spermatozoa, additional FSH may not be required for months because testosterone can maintain this activity. In the female, however, there is a rhythmic, or cyclical, increase and decrease of FSH, which is essential for monthly ovulation.

Adrenaline (also called epinephrine) is a hormone secreted by the medulla of the adrenal glands which are either of two small triangular endocrine glands that are located above each kidney. Adrenaline stimulates the breakdown of glycogen to glucose in the liver, which results in the raising of the level of blood sugar. Both hormones increase the level of circulating free fatty acids. The extra

amounts of glucose and fatty acids can be used by the body as fuel in times of stress or danger where increased alertness or exertion is required. Epinephrine is sometimes called the emergency hormone because it is released during stress and its stimulatory effects fortify and prepare an animal for either "fight or flight."

Insulin is a hormone that regulates the level of sugar (glucose) in the blood and is produced by the beta cells of the islets of Langerhans in the pancreas. Insulin is secreted when the level of blood glucose rises—as after a meal. When the level of blood glucose falls, secretion of insulin stops, and the liver releases glucose into the blood. Insulin is a simple protein in which two polypeptide chains of amino acids are joined by disulfide linkages. Insulin helps transfer glucose into cells so that they can oxidize the glucose to produce energy for the body. In adipose (fat) tissue, insulin facilitates the storage of glucose and its conversion to fatty acids. In muscle it promotes the uptake of amino acids for making proteins. In the liver it helps convert glucose into glycogen and it decreases gluconeogenesis (the formation of glucose from noncarbohydrate sources). Inadequate production of insulin is responsible for the condition called diabetes mellitus.

47. The part of the brain that is used in the answering of this question.

1 Cerebrum
2 Cerebellum
3 Hypothalamus
4 Medulla oblongata
5 Pons Varolii

Answer: 1 (Encyclopaedia Britannica)

The human brain weighs about 1,500 grams (3 pounds) and constitutes about 2 percent of total body weight. It consists of three major divisions: (1) the massive paired hemispheres of the cerebrum, (2) the brainstem, consisting of the thalamus, hypothalamus, epithalamus, subthalamus, midbrain, pons, and medulla oblongata, and (3) the cerebellum. The cerebrum, derived from the telencephalon, is the largest, uppermost portion of the brain. It is involved with sensory integration, control of voluntary movement, and higher intellectual functions, such as speech and abstract thought.

The *cerebellum* ("little brain") overlies the posterior aspect of the pons and medulla oblongata and fills the greater part of the posterior fossa of the skull. This distinctive part of the brain is derived from the rhombic lips, thickenings along the margins of the embryonic hindbrain. It consists of two paired lateral lobes, or hemispheres, and a midline portion known as the vermis. The cerebellar cortex appears very different from the cerebral cortex in that it consists of small leaflike laminae called folia. The cerebellum functions as a kind of computer, providing a quick and clear response to sensory signals. It plays no role in sensory perception, but it exerts profound influences upon equilibrium, muscle tone, and the coordination of

voluntary motor function. Because the input and output pathways both cross, a lesion of a lateral part of the cerebellum will have an ipsilateral effect on coordination.

The *hypothalamus* lies below the thalamus in the walls and floor of the third ventricle. It is divided into medial and lateral groups by a curved bundle of axons called the fornix, which originate in the hippocampal formation and project to the mammillary body. The hypothalamus controls major endocrine functions by secreting hormones (i.e., oxytocin and vasopressin) that induce smooth muscle contractions of the reproductive, digestive, and excretory systems; other neurosecretory neurons convey hormone-releasing factors (e.g., growth hormone, corticosteroids, thyrotropic hormone, and gonadotropic hormone) via a vascular portal system to the adenohypophysis, a portion of the pituitary gland. Specific regions of the hypothalamus are also involved with the control of sympathetic and parasympathetic activities, temperature regulation, food intake, the reproductive cycle, and emotional expression and behaviour.

The *pons* (metencephalon) consists of two parts: the tegmentum, a phylogenetically older part that contains the reticular formation, and the pontine nuclei, a larger part composed of masses of neurons that lie among large bundles of longitudinal and transverse nerve fibres. The pons relays sensory information between the cerebellum and cerebrum, aids in relaying other messages in the brain, controls arousal, and regulates respiration (see respiratory centres).

The *medulla oblongata* (myelencephalon), the most caudal segment of the brainstem, appears as a conical expansion of the spinal cord. The roof plate of both the pons and the medulla is formed by the cerebellum and a membrane containing a cellular layer called the choroid plexus, located in the fourth ventricle. Cerebrospinal fluid entering the fourth ventricle from the cerebral aqueduct passes into the cisterna magna, a subarachnoid space surrounding the medulla and the cerebellum, via openings in the lateral recesses in the midline of the ventricle. The medulla contains nuclei associated with the hypoglossal, accessory, vagus, and glossopharyngeal cranial nerves. In addition, it contains portions of the vestibular nuclear complex, parts of the trigeminal nuclear complex involved with pain and thermal sense, and solitary nuclei related to the vagus, glossopharyngeal, and facial nerves that subserve the sense of taste. Summarily, the medulla oblongata oblongata controls autonomic functions, and relays nerve signals between the brain and spinal cord. It is also responsible for controlling several major points and autonomic functions of the body: respiration (via dorsal respiratory group and ventral respiratory group), blood pressure, heart rate, swallowing, vomiting, defecation.

48. Which of the following animals were used in the first experiments to do pregnancy tests in humans?

1 White rats
2 Pigs
3 Spur-toed frog
4 Field mice
5 Dogs

Answer: 3 (Encyclopaedia Britannica)

Biological tests for pregnancy depend upon the production by the placenta (the temporary organ that develops in the womb for the nourishing of the embryo and the elimination of its wastes) of chorionic gonadotropin, an ovary-stimulating hormone. In practice, the tests have an accuracy of about 95 percent, although false-negative tests may run as high as 20 percent in a series of cases. False-negative reports are frequently obtained during late pregnancy when the secretion of chorionic gonadotropin normally decreases. The possibility not only of false-negative but also of false-positive tests makes the tests, at best, probable rather than absolute evidence of the presence or absence of pregnancy. Chorionic gonadotropin in a woman's blood or urine indicates only that she is harbouring living placental tissue. It does not tell anything about the condition of the foetus. In fact, the greatest production of chorionic gonadotropin occurs in certain placental abnormalities and disorders that can develop in the absence of a foetus. Tests using immature mice (the Aschheim-Zondek test) and immature rats have been found to be extremely accurate. Tests using rabbits (the Friedman test) have been largely replaced by the more rapid and less expensive frog and toad tests. The use of the female South African claw-toed tree toad, *Xenopus laevis*, is based on the discovery that this animal will ovulate and extrude visible eggs within a few hours after it has received an injection of a few millilitres of urine from a pregnant woman. The male common frog, *Rana pipiens*, will extrude spermatozoa when treated in the same way. Both of these tests are considered somewhat unsatisfactory because false-positive reactions are not uncommon.

49. Under which conditions will plants have a low transpiration rate?

1 High temperatures
2 High humidity
3 Strong winds
4 Lots of ground water available
5 More light

Answer: 2 (Encyclopaedia Britannica)

Transpiration is the plant's loss of water, mainly through the stomates of leaves. Stomates consist of two guard cells that form a small pore on the surfaces of leaves. The guard cells control the opening and closing of the stomates in response to various environmental stimuli. Darkness, internal water deficit, and extremes of temperature tend to close stomates and decrease transpiration; illumination, ample water supply, and optimum temperature open stomates and increase transpiration.

The exact significance of transpiration is disputed; its roles in providing the energy to transport water in the plant and in aiding in heat dissipation in direct sunlight (by cooling through evaporation of water) have been challenged. Stomatal openings are necessary to admit carbon dioxide to the leaf interior and to allow oxygen to escape during photosynthesis, hence transpiration has been considered by some authorities to be merely an unavoidable phenomenon that accompanies the real functions of the stomates.

50. Which disease is not waterborne?

1 Cholera
2 Malaria
3 Scurvy
4 Yellow fever
5 Diarrhoea

Answer 3: (Encyclopaedia Britannica)

Cholera is an intestinal disease that is the archetype of waterborne illnesses. It spreads by the faecal–oral route: infection spreads through a population when faeces containing the bacterium contaminate water that is then ingested by individuals. Transmission of the disease can also occur with food that has been irrigated, washed, or cooked with contaminated water. Foods that have the greatest potential to transmit the disease include shellfish and seafood, especially if eaten raw; fruits and vegetables grown in soil that has been either fertilized with human excrement (night soil) or irrigated with raw sewage; and foods packed in contaminated ice. *Vibrio cholerae* is a member of the family Vibrionaceae, which includes three medically important genera of water-dwelling bacteria. It is a short, gram-negative, rod-shaped bacterium that appears curved when isolated. There are about 140 types of *V. cholerae*, based on the classification of a protein called the O antigen in the bacterium's cell wall. The only strains of *V. cholerae* known to cause cholera—strains O1 and O139—have the ability to produce a type of toxin called an enterotoxin. Not all *V. cholerae* O1 produce the toxin.

Scurvy (also called vitamin C deficiency) is one of the oldest-known nutritional disorders of humankind, caused by a dietary lack of vitamin C (ascorbic acid), a nutrient found in many fresh fruits and vegetables, particularly the citrus fruits. Vitamin C is important in the formation of collagen (an element of normal tissues), and any deficiency of the vitamin interferes with normal tissue synthesis, a problem that underlies the clinical manifestations of the disorder. Scurvy is characterized by swollen and bleeding gums with loosened teeth, soreness and stiffness of the joints and lower extremities, bleeding under the skin and in deep tissues, slow wound healing, and anemia.

Yellow fever is an acute infectious disease, one of the great epidemic diseases of the tropical world, though it sometimes has occurred in temperate zones as well. The disease, caused by a flavivirus, infects

humans, all species of monkeys, and certain other small mammals. The virus is transmitted from animals to humans and among humans by several species of mosquitoes. Yellow fever appears with a sudden onset of fever, chills, headache, backache, nausea, and vomiting. The skin and eyes may appear yellow—a condition known as jaundice and a sign that gives rise to the disease's popular name. There is no specific treatment for those with yellow fever beyond good nursing and supportive care. However, yellow fever is an outstanding example of a completely preventable disease. People can be rendered immune to the virus through vaccination, and outbreaks can be contained by eliminating or controlling mosquito populations. Thanks to such measures, the great yellow fever epidemics of the late 19th and early 20th centuries are no more, though the disease is still present in tropical Africa and South America, where access to vaccine is sometimes lacking and the virus is held in vast natural reservoir by forest monkeys.

Diarrhoea is abnormally swift passage of waste material through the large intestine, with consequent discharge of loose faeces from the anus. Diarrhoea may be accompanied by cramping. The disorder has a wide range of causes. It may, for example, result from bacterial or viral infection; from dysentery, either amoebic or bacillary; from impaired absorption of nutrients; from eating coarse or highly seasoned foods or drinking large quantities of alcoholic beverages; from poisons such as arsenic or mercury bichloride; or from drugs administered to reduce high blood pressure. Excessive amounts of thyroid hormones, parathyroid hormone deficiencies, irritable bowel syndrome, and uremia (an excess of nitrogenous wastes in the blood) all may cause diarrhea. Most cases of diarrhea are not serious and do not require treatment; dehydration can be prevented by drinking plenty of clear liquids. Diarrhea caused by an infection can often be treated with antibiotics.

Malaria is an intermittent and remittent fever caused by a protozoan parasite that invades the red blood cells. The parasite is transmitted by mosquitoes in many tropical and subtropical regions. The parasite belongs to the genus *Plasmodium* (phylum Sporozoa) and is transmitted by female mosquitoes of the genus *Anopheles*. ORIGIN: mid 18th cent.: from Italian, from mal'aria, contracted form of mala aria ‘bad air.’ The term originally denoted the unwholesome atmosphere caused by the exhalations of marshes, to which the disease was formerly attributed.