

## Life Science Essential Questions and Answers

### **What is the basic unit of all living things?**

The cell is the basic unit of all living things and is the smallest unit capable of performing life functions. Cells come in many shapes and sizes. These differences in form help to support the function of the cells. All cells have a cell membrane, cytoplasm and heredity material.

### **What is the Cell Theory and how was it developed?**

The cell theory was developed through the work of several scientists and is made up of three parts. First, all living things are made of one or more cells. Second, the cell is the basic unit of organization in an organism. Third, all cells come from cells. Robert Hooke was the first to discover cells with the improvement of the microscope in 1665. In the 1830's, Matthias Schleiden concluded all plants were made of cells followed by Theodor Schwann concluding that all animals were made of cells. This was followed by the observations and conclusions of Rudolf Virchow that all cells came from cells that already existed

### **Do both plant and animal cells have mitochondria? Explain.**

Yes, plants need energy to function too! Both plant and animal cells contain mitochondria to break down sugars for energy to help them perform their basic functions.

### **How does the movement of materials into and out of the cell affect the body's ability to maintain homeostasis?**

Just like the body, cells take in food, oxygen, water and other substances. Through processes like osmosis, diffusion and active transport the cell can make changes to keep the right amount of food, water and substances in their cells. This regulation of substances in cells affects tissue, organs, organ systems and ultimately the organism and its ability to maintain the proper conditions on the inside. For example, when cells are not receiving enough water (using the process of osmosis), the brain receives a signal for thirst. Through drinking water the cells receive water and ultimately the body as a whole is hydrated.

### **How does the circulatory system work with digestive, respiratory and muscular systems?**

The organ systems of the body constantly work with each other to maintain homeostasis and the overall health of the body. The muscular system on a larger scale moves our bodies but on a cellular level needs food, water and other substances to provide the energy that is needed for this movement. The muscle cells receive these nutrients and get rid of waste through the circulatory system. Through the digestive and respiratory systems, the circulatory system brings nutrients and oxygen to the cells of the body, such as the muscular system. Through working with the digestive and respiratory systems, the circulatory system gets rid of waste and carbon dioxide picked up from the cells, such as the cells in the muscular system.

### **Why is a body made up of many cells instead of just several large cells?**

As a cell grows its volume increases faster than its surface area. If a cell gets to large, its surface area is not large enough to take in enough nutrients and get rid of enough waste to keep the cell alive.

### **Why can a single cell chicken egg be so large?**

A chicken egg does not have to take in nutrients. The white and yolk provide the food for the developing chick.

### **Choose one organelle we have studied and describe the role of this cell organelle to something in your house.**

Example: A cell membrane is similar to the walls of a house with special openings to let certain things in but keep other things out.

Example: The endoplasmic reticulum is like the hallways in a house because other items need to be moved from one place to another in the house.

Example: A chromosome is like an encyclopedia because lots of information is organized and used as needed.

Answers will vary. If the student can logically explain their analogy go with it.

### **Using two different organ systems explain how the two systems work together to carry out one task.**

The respiratory system and the digestive system work together to get oxygen and food to the cells so that energy can be produced and the cell can carry out its task.

Answers vary – as long as the student can justify the relationship go with it.

**How does the cell membrane, cytoplasm, and mitochondria work together to help provide the cell with energy?** Materials the cell needs to make energy enter the cell through the cell membrane. The materials are transported through the cytoplasm to the mitochondria where they are burned to create energy.

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**Why does a plant need both chloroplasts and mitochondria?** Plants need both cells because they have different functions, and the plants need both functions to live. Chloroplasts make food for the plant (photosynthesis) while the mitochondria burn that food (cellular respiration) for energy. Without the chloroplasts, the plant cells would have no food. Without mitochondria, the plant cells would have no energy.

**What major organs systems help support the needs of the mitochondria?** The respiratory and circulatory systems provide the mitochondria with oxygen. The digestive and circulatory system supply the mitochondria with food. The circulatory and excretory system help the cell rid the body of waste.

**What major body system does the cell membrane work most directly with, and how does this system support the cells needs?** The cell membrane works with the circulatory system. The circulatory system delivers nutrients, water, and oxygen to the cell and transport waste away from the cell. All of these materials pass in and out of the cell through the cell membrane into the capillaries of the circulatory system.

**How does each of the following key organelles contribute to the cell's life functions: nucleus, cytoplasm, cell membrane, chloroplast, mitochondria?**

All materials the cell needs enter through the cell membrane and into the cytoplasm. The cytoplasm, made up of fluid and the organelles, is where most of the cells metabolism takes place. The mitochondria produce energy. This energy comes, either directly (from the same organism) or indirectly (from an organism that was consumed) from the food produced by chloroplasts found in autotrophs. All of the cellular activity is controlled by the nucleus, which contains the genetic material in the cell.

**Choose an organ system and compare it to a cell organelle.**

The nucleus is similar to the brain because it controlled the activities of the cell like the brain controls the activities of the body. The cytoplasm is like blood. Materials are carried to the body through the blood stream just as materials for the cells organelles are carried through the cytoplasm.

The cell membrane is similar to skin because it protects the internal parts of a cell just as the skin contains the body's organs and protects the body.

The mitochondria are similar to the intestines. The intestines are where most of the nutrients from food are released to the body while the mitochondrion is where energy is released to the cell.

The stomach and vacuole are similar in that they both hold food and water for the cell/body.

A cell wall is similar to an exoskeleton because it give shape and support like our body's endoskeleton.

**Why are organisms classified?**

Organisms are classified to make it easier to study, compare and communicate information about those organisms. With millions of different species of living things on earth, it could be very easy get confused or lose track of an organism. Classification gives scientists from around the world, speaking different languages, a common way to communicate about living things. Classification also provides a framework for understanding the evolutionary relationships between different organisms.

**Explain how Aristotle's and Linnaeus' systems of classification are similar and how they are different.**

Aristotle was the first to classify organisms by looking at external features and how the organisms moved. Aristotle's system did not provide a step-by-step method of identifying each organism, and very different organism might be placed in the same groups based on how they move – such as whales and fish. Hundreds of years later, Linnaeus took the different classification systems that by his time had become very complicated and for which there was no universal standard of naming or classifying, and simplified it.

Organisms were classified using basic physical features and assigned a two part name that was specific to that one type of organism only. Aristotle's system was very simple and many organisms could fit into one category. Linnaeus' system meant that each organism fit into its own classification place and could be identified and shown to be different from every other organism.

**What is the relationship between the type of reproduction and the genetic diversity of the resulting offspring, and what are some examples of organisms that use each type of reproduction?**

Asexual reproduction involves only one parent donating genes to the next generation. As a result, all offspring are an exact copy of the parent organism and there is lower genetic diversity in the population. In sexual reproduction, two parents donate genes to the offspring, resulting in offspring that have their own unique combination of genes and a population with a higher genetic diversity. Bacteria and fungi often reproduce asexually, while animals and plants most often reproduce sexually.

**In what way are fungi more like animals than plants?**

Fungi are more like animals than plants because both animals and fungi are heterotrophs and therefore must take in food from their environment. Plants are different because as autotrophs they can make their own food.

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### **Explain how a dichotomous key can be used to identify a type of frog**

A dichotomous key is a series of pairs statements used to identify an organism such as a frog. A dichotomous key uses the paired statements to identify physical features found on the frog and through step-wise process eliminate frogs that do not share the same features.

### **How do scientists use classification today?**

Classification is the process of putting things into orderly groups based on similar characteristics. Scientists use a seven-level system known as taxonomy to classify living things based on shared characteristics. The more shared characteristics organisms have the more closely related the organisms may be.

### **Trace the history of the current method used to classify organisms.**

Classification can trace its beginnings over 2,000 years ago to the Greek philosopher and scientist Aristotle. Aristotle did not view organisms as related by descent, but organized them according to several criteria: red blood/ no red blood, way of life, actions, body parts, size and appearance. Drawbacks occur in using this system, for example, when trying to classify organisms that swim. Penguins, fish and whales may not be closely related even though they share a way of life. In the late 1600's *species* was established as the basic unit for classification. Modern classification is based on a system developed by Carolus Linneaus in the mid-1700s. This system is based on similarities in structure and arranged into categories using a two word name of *genus* and *species*. Today DNA provides new insights into the relationships among different organisms.

### **What are the characteristics of the six major kingdoms?**

The first two kingdoms are Archaeobacteria and Eubacteria. They are both unicellular, prokaryotic, can be heterotrophs or autotrophs, and most reproduce asexually. The main differences are where they are found. Archaeobacteria are some of the oldest living organisms found on earth and can live in extreme environments such as thermal springs and in the high salinity of oceans. Examples of Archaeobacteria are methanogens, halophiles, thermophiles and cyanobacteria. Eubacteria are found almost everywhere on earth including human intestines. Some Eubacteria can convert milk into yogurt or cause diseases like pneumonia. The kingdom Protista contains organisms are mostly unicellular and with some multicellular members, eukaryotic, heterotrophic or autotrophic, and most reproduce asexually. There are three types of Protists, fungus-like, plant-like and animal-like. The fourth kingdom, Fungi, can be unicellular but most are multicellular, are eukaryotic, are heterotrophic and reproduce both sexually and asexually. Fungi can live almost anywhere but prefer warm and damp environments. Examples of fungi are mushrooms, bread molds and yeast. The fifth kingdom, Plantae, is multicellular, eukaryotic, and autotrophic and can reproduce asexually and sexually. They are mostly terrestrial. Examples of plants are mosses, ferns, conifers and flowering plants. The sixth kingdom, Animalia, is eukaryotic, multicellular, and heterotrophic, most reproduce sexually and live on land or water. Examples of animals are sponges, jellyfish, worms, arthropods, fish, amphibians, reptiles, birds and mammals.

### **Compare and contrast Archaeobacteria and Eubacteria. (Insert any two kingdoms to continue this type of EQ)**

They are both unicellular and prokaryotic, but Archaeobacteria are found in extreme environments like deep oceans and hot springs whereas Eubacteria are found almost anywhere on the planet.

### **How does the Kingdom Protista compare to the Fungi, Plant and Animal kingdoms?**

Protists are both unicellular and multicellular eukaryotes that contain three types of protists. Protists such as slime molds share characteristics with fungi. Plant-like protists such as algae are autotrophs and share characteristics with plants. Animal-like protists, such as protozoans consume other organisms to live.

### **Which kingdoms are autotrophs, heterotrophs or both?**

Plantae is the only kingdom that is autotrophic only. Kingdom Fungi and kingdom Animalia are heterotrophic only. Kingdom Archaeobacteria, kingdom Eubacteria and kingdom Protist contain both autotrophic and heterotrophic organisms.

### **How is a dichotomous key used to identify an organism?**

A dichotomous key is a set of paired descriptive statements with only two possible responses to each statement. A person trying to identify an organism chooses the statement that describes the organism and is either directed to another pair of statements or to the identity of the organism.

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**What are the seven levels of classification from broadest to most specific? What does each of the seven levels contain? [How is each kingdom broken down into more specific groups?]**

The seven levels of classification from broadest to most specific are kingdom, phylum, class, order, family, genus and species. Kingdoms contain similar phyla. Phyla contain similar classes. Classes contain similar orders. Orders contain similar families. Families contain similar genera. Genera contain similar species and species contain organisms that have the same characteristics and can interbreed.

**With animal populations continuously eating, growing, and reproducing, why do ecosystems not run out of energy?**

The source of energy for most ecosystems is the sun. Plants use the energy from the sun to produce their own food, and the plants are then eaten by consumers. The consumers take the energy from the plants and use it to live or pass it on to animals that prey on them. As long as the sun keeps sending energy to the earth, ecosystems will not run out of energy.

**Explain the phrase “You are what you eat” as it relates to matter being transferred in food chains.**

When a person has chicken for dinner, they are taking in the matter that made up the chicken and making some of that matter part of their own body. Because the chicken ate plants, the person is also taking in that plant matter through the chicken and making some of it part of their own body. Matter is transferred from the chicken’s food to the chicken and from the chicken to the person.

**How do ecosystems recycle nutrients and matter?**

When an organism dies, decomposers such as fungi and bacteria break down the organism and return the nutrients and matter from that organism to the soil, where it becomes available to plants to absorb and return to the food chain.

**Describe each of the following roles in an ecosystem, and give an example of an organism that fills that role: producer, consumer, decomposer.**

A producer is an organism that is able to make its own food for energy. All plants, such as grass or an apple tree, are producers that make their own food using energy from the sun.

A consumer is an organism that eats another organism for energy. All animals are consumers, such as birds, frogs, and fish.

A decomposer is an organism that breaks down dead organisms to get energy. Some types of fungi and bacteria are decomposers.

**What are the three types of consumers that can be found in a food web and how do they differ? Give an example of each type of consumer.**

The three types of consumers are herbivores, carnivores and omnivores. Herbivores eat only plants. An example of a herbivore is a zebra. A carnivore eats only other animals. An example of a carnivore is a lion. An omnivore eats both plants and animals. An example of an omnivore is a raccoon.

**What path does energy from the sun follow in order to be used by humans?**

Humans may eat plants which have used the sun’s energy to create energy rich compounds or humans may eat animals that have eaten plants (cow eats grass, human eats cow (hamburger)).

**How are food chains and food webs related?**

Food webs are made up of numerous overlapping food chains, where organisms are part of more than one food chain. Food chains show one path from the sun’s energy to an organism, while food webs show that the diversity of plants and animals allows for flexibility in an organism meeting its food needs.

**Explain the relationship between producers and consumers.**

Producers are organisms that can make their own food from sunlight or chemicals. Consumers cannot make their own food and are therefore dependant on producers that they eat to get energy. Producers allow the transfer of the sun’s energy to the rest of the food chain/web.

**Explain why there are more producers than consumers in an ecosystem, and why there are more herbivores than carnivores.**

Producers are the only organisms that can make their own food. When a consumer eats a producer, up to 90% of the energy is lost as waste or heat. So an ecosystem can never support as many consumers as producers because there would not be enough energy. This process is the same with carnivores and herbivores. Carnivores eat herbivores, and up to 90% of the energy from the herbivore is lost to the carnivore. As a result, any ecosystem will need many more herbivores to support just a few carnivores.

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### **Define the energy roles of the following: herbivore, omnivore, carnivore, and decomposer.**

Herbivores only consume plants. Omnivores eat both plants and animals. Carnivores eat only other animals. Decomposers consume the waste and dead bodies of other consumers and producers.

### **Describe one way two different species interact with each other.**

Some animals eat plants for food. Wolves catch and eat rabbits. Clown fish live in and around a sea anemone and they help each other. Bacteria live in animal intestines and get food and help the host access some nutrients while getting food for itself. Ticks feed on a dog's blood. Fleas feed on cat's blood. Remoras feed on shark leftovers.

### **What are examples of relationships between two organisms that are beneficial for at least one of the organisms, and what are some examples of these relationships?**

Mutualism is a relationship where both organisms benefit, such as some species of ants that live in certain species of tree and fight off herbivores that try to feed on the tree. The ants get shelter and the tree is protected from being eaten.

Commensalism is a relationship where one organism benefits and the other is not harmed, such as epiphyte plants that live on the limbs of trees to gain access to sunlight

### **What are examples of relationships between two organisms that are harmful for at least one of the organisms, and what are some examples of these relationships?**

In a predation, the prey is killed and eaten by the predator, such as when a water snake eats a frog.

In competition, organisms compete for food, shelter, or mates and the organism that loses the competition may be less likely to survive and reproduce. A large, strong deer with big antlers may fight off other males who then do not get to mate

In parasitism, the parasite uses the host for resources and harms the host in the process, such as when a leech or tick sucks the blood of a dog.

### **Explain how two different species of organisms can exist together and help each other using a specific example.**

Organisms such as the sea anemone and clown fish live together and help each other. The clown fish catches its own food and the sea anemone can eat the leftovers. The clown fish is not bothered by the sea anemone's stinging cells and therefore has a safe place to live because most other predator fish won't bother the sea anemone.

**What are the abiotic factors in all ecosystems?** Abiotic factors are air (O<sub>2</sub> and CO<sub>2</sub>), water, soil, temperature, sunlight.

**What are the biotic factors of an ecosystem?** Biotic factors are factors that are alive in an ecosystem or have been alive.

**Explain how a desert and grassland are similar and how they are different. [Insert other biomes to vary.]** A desert is an ecosystem that has little rain and extremes in temperature – often it is very hot. Plants and animals are scarce and those present (such as cactus, insects, and reptiles) are especially adapted to conserve water in the hot, dry climate. In the grassland biome there may also be extreme temperatures and seasonal drought. However, more rainfall supports grasses as the dominant plant species and some shrubs and trees. There is a greater diversity of animals in the grassland than in the desert, including large mammals that graze on the grass.

**How is a \_\_\_\_\_ adapted to life in the \_\_\_\_\_ biome?** Can be used with a variety of organism/biome combinations: Cactus/desert – no leaves to conserve water, snake/temperate biome – hibernates to avoid cold winter, Arctic Fox/Tundra – white fur in winter to hide from prey, etc.

**List 5 biotic factors in a desert (or other biome).** Cactus, ants, scorpions, kangaroo rat, birds, etc

**Compare and contrast the abiotic and biotic factors of the taiga forest to those of the temperate forest.** The taiga forest and temperate forest both have 4 distinct seasons. However, the taiga has a longer, colder winter and more of the precipitation in the taiga falls as snow. In the taiga, the dominant plants are coniferous trees, while in the temperate forest the trees are deciduous. **(tropical rainforest vs. temperate or taiga, tundra vs. desert also make good compare/contrast examples.**

**What is the relationship between an organism being endangered and going extinct?** An organism that is endangered is at risk for going extinct. If the organism cannot adapt to the changes in its ecosystem that are threatening it or in the case of human created changes if actions are not taken to protect the endangered organism, all individuals of that species may die, making it extinct.

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### **What is the scientific method?**

The procedures used to solve problems and answer questions that can include stating the problem, gathering information, forming a hypothesis, testing the hypothesis with an experiment, analyzing data and drawing conclusions.

### **Why is the scientific method important?**

It is a consistent, organized way to solve scientific problems. This organization allows a scientist to clearly state their purpose, record the steps they took so they can repeat their results and allows scientists to study each other's work.

### **Why is it important to follow the correct procedures and use equipment appropriately in a lab setting?**

It's important to follow the correct procedures in a lab to ensure that the lab is completed correctly and that results are valid. It also reduces the waste of lab materials and reduces safety risks. Equipment should be used appropriately to reduce the risk of accidents, keep it in good working-order and to provide correct and appropriate measurements.

### **What is accuracy?**

Accuracy refers to how close a measured value is to an accepted value.

### **What is precision?**

Precision refers to how closely repeated measurements or observations are to each other.

### **Compare and contrast herbivores, carnivores and omnivores.**

Unlike herbivores, which eat only plants, carnivores eat only meat. Like herbivores and carnivores, omnivores eat both plants and animals.

### **What is the source of energy in food webs?** The sun.

### **Explain the roles of producers, consumers and decomposers and how their energy is transferred in a food web. Give examples of each.**

The sun is the source of energy in a food web. Producers, such as plants and algae, make their own food using the sun's energy. This energy is transferred when it is eaten by a consumer. Consumers, like rabbits and foxes, must obtain their energy by eating other organisms. Decomposers consume the waste or dead bodies of producers and consumers. They are important because they return nutrients to their environment for producers to use.

### **Compare the energy needs of producers and consumers to the energy needs of autotrophs and heterotrophs.**

Autotrophs and producers both make their own food, such as plants. Heterotrophs and consumers, such as mice and hawks, both have to get their energy through consuming other organisms.

### **What is the source of energy for food webs and how do the organisms in a food web use this energy?**

The sun is the primary source of energy in a food web. The sun's energy is used by producers to make food or store energy. This food is eaten by primary consumers, so the energy is transferred to the consumer. Primary consumers transfer their energy when eaten by secondary consumers.

### **What is predation?**

Predation is a type of relationship between two organisms, when one organism is eaten (the prey) by another organism (the predator) for food. Death of the prey is the result.

### **What is competition?**

Competition is the type of relationship when two organisms compete for the same resources, such as food, water and living space. This can occur within the same species or between different species.

### **Describe abiotic factors found in biomes?**

Abiotic means non-living. So abiotic factors found in a biome would be anything not living found in those ecosystems, such as water, land, weather, rocks, sunlight, and temperature.

**Describe the abiotic and biotic factors found in the \_\_\_\_\_.** (Fill in with a biome of your choice) Answers will vary.

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**Compare and contrast the tundra and the desert.** The tundra and desert are similar in that they have very dry climates and receive similar amounts of rainfall annually. They also have organisms that are well adapted to the extreme climates. The main difference is temperature. The tundra is always cold to extremely cold while the desert gets extremely hot. The organisms found in these biomes are adapted to these harsh conditions.

### **How do genetic traits affect an organism's survival?**

The genetic traits of an organism (genotype) determine the physical and behavioral characteristics of that organism (phenotype). If the traits an organism receives are useful in their environment – such as helping them access resources or avoid predation – the organism will survive and likely pass on those traits to their own offspring. If those traits are not useful in the environment the organism is in, the organism may not survive and those traits may not be passed on.

### **How are Darwin's finches an example of evolution by natural selection?**

Darwin's finches show that depending on the demands of the environment certain traits may or may not be useful. Traits are beneficial if the trait helps the organism survive. When a number of finches started a population in the Galapagos islands, finches with beak's that were best able to access the different food sources on each island were more likely to survive and pass on those useful genes. Over time, each island developed a population of finches with beaks adapted to the food available on that island.

### **How does the fossil record provide evidence for evolution?**

The preserved remains of organisms, when dated and compared to other similar fossil remains and living organisms, allow scientists to produce a timeline of change in different species of organism and show evolutionary relationships between species. A series of fossils might show a series of changes between an ancient, extinct species and a different, but related modern species.

### **How does selective breeding produce plants and animals with desired traits?**

By controlling which organisms are allowed to breed and choosing only those organisms with desirable traits to breed, the potential genes passed on to offspring can be controlled. Plants or animals with desirable traits are allowed to breed; those without desirable traits are not allowed to breed. This ensures that any offspring produced have or are likely to have the desired traits of the parents.

### **Why are the traits of sexually produced offspring not exactly like their parents?**

Sexual reproduction means that some of the traits of each parent are combined in the offspring. Each offspring only gets  $\frac{1}{2}$  of each parent's traits, therefore the offspring never look exactly like either parent.

### **Why does sexual reproduction produce more genetic diversity than asexual diversity?**

Asexual reproduction produces offspring that are identical to their parent. The genetic material is an exact copy passed from parent to offspring, resulting in no new diversity. In sexual reproduction, the offspring receives  $\frac{1}{2}$  of its genes from each parent, producing a new combination and increasing diversity.

### **How has Gregor Mendel contributed to the study of modern genetics?**

Through the study of pea plants, beginning in 1856, Mendel was the first to trace *one* trait through several generations. Before Mendel, scientists studied many traits at one time. Luckily, he chose a plant that made it easy to study and cross breed for one trait. He was also the first to use mathematics and probability to explain heredity of traits, but was forgotten for a long time. He was re-discovered independently by three different plant scientists around 1900, which had separately discovered his writings and reached the same conclusions as Mendel.

### **What is the difference between a dominant and recessive allele?**

Alleles are the different forms of a trait that make up a gene pair. One form is usually dominant, or a trait that covers or "dominates" the other trait. It is the one that shows up physically. The other trait is usually recessive, or is the trait that is covered over by the dominant trait and seems to disappear.

### **Explain the role of genotypes in inheriting a specific phenotype.**

Each sexually reproducing organism receives one gene from each parent for a particular trait, or their genotype. In most cases, one of these genes is dominant over the other. The dominant allele is the one that shows physically in the organism's phenotype, or the way the organism looks and behaves. Either one of these alleles can be passed on to the next generation's genotype, thus allowing for the possibility of recessive traits to show up in following generations' phenotypes.

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### **How can we predict the probability of a certain trait showing up in an organism?**

First, we'd have to know the genotype of the parents. Then, we could use a Punnett square. The Punnett square allows us to predict the probability of one specific trait appearing in the phenotype. A Punnett Square is a tool that allows us to see the different ways the parents' alleles could combine.

### **Compare and contrast the outcome of meiosis and mitosis.**

Meiosis and mitosis are alike because they both produce new cells. Meiosis and mitosis are different because meiosis produces four new sex cells with half the number of chromosomes as the parent cell and mitosis produces two new cells with the same number of chromosomes as the parent cell.

### **Explain the difference between sexual and asexual reproduction, using specific examples.**

Sexual reproduction occurs when two organisms of the same species each contribute half the genetic material to produce a new organism with a new unique combination of genes, different from the parents. For example, a female cat and male cat each contribute half the genetic material to produce a litter of kittens, each genetically slightly different from the parents. In asexual reproduction, a new organism is produced that will have heredity material identical to the heredity material of the parent organism. For example, hydras reproduce asexually through budding. When the bud on the adult is big enough, it detaches and becomes a new hydra with the exact genetic material as the hydra it detached from.

### **What is selective breeding and how can it be beneficial?**

Selective breeding is when two organisms with desired traits are bred to produce offspring with those desired traits. One example is purebred dogs, such as poodles, pugs, golden retrievers, etc. There is an economic market for these types of dogs. Another benefit is the selective breeding of crops to be more resistant to disease so there is less of a chance for a shortage of food in places like the U.S.

### **How does sexual reproduction contribute more to a population's genetic diversity than asexual reproduction?**

Because sexual reproduction is the combination of the genetic material from two different organisms creating a new unique combination of genetic material through their offspring, the amount of genetic diversity will increase at a far greater rate in successive generations than in asexual reproduction which passes on the exact same combination of genes in following generations. The greater the genetic diversity, the more healthy the population will be. They will more likely be a population to survive disease or adapt to changes in their environment.

### **Tracing evidence through the fossil record, explain how the fossil record provides evidence for the long history of evolution?**

The fossil record found in sedimentary rock shows a change in organisms over a large period of time. It provides evidence to support the theory of evolution, showing the relationship between organisms and the changes that occurred to them over time.

### **How have physical characteristics of organisms changed over time?**

Physical characteristics of organisms have changed over time through natural selection. Natural selection means that organisms with traits best suited to their environment will survive which can lead to gradual physical changes in a species. Two prominent examples of this type of change are Darwin's finches found in the Galapagos Islands and the Peppered moths of Manchester, England. Darwin observed 13 species of finch on the Galapagos Islands that were similar, except for differences in eating habits, beak size and body shape. They were also similar to one species of finch he had observed on the South American coast. He reasoned that the finches on the Galapagos Islands originated from South America. Those finches with beak shapes that allowed them to eat available food sources survived and were able to pass on their traits to successive generations. Eventually they became separate species, each adapted to their type of food source.

There were two types of peppered moth in Manchester, England. One was a light "peppered" color and the other was a dark color. Before the Industrial Revolution, the trees in the surrounding area were light colored and made the perfect camouflage to hide the peppered colored moths from predators. The dark colored moths were easily seen and eaten, making this population predominantly peppered colored. During the Industrial Revolution, the trees bark became covered in soot. The peppered colored moths no longer had the advantage. They were easily seen by predators and now the darker phenotype of moth was easily hidden and had the trait that better suited them to their environment. After a certain period of time, the population's phenotype changed to predominantly dark colored moths.