

Common Student Ideas about Plants and Animals

Common Student Idea(s)	Scientific Explanation
<p>1. You can tell that something is alive because it moves. Plants aren't alive because they don't move.</p> <p>You can tell that something is alive because it has a mouth, a nose, and eyes [<i>or other specific body parts</i>].</p> <p>[<i>Children don't begin to understand that death is the cessation of life processes until the ages of 9 or 10.</i>]</p>	<p>No single criterion can be used to classify something as living or nonliving. Some characteristics used to identify living things are difficult to observe. Living things are made up of one or more cells and carry out basic life processes, such as acquiring or making food, growing, respiring, reproducing, reacting to stimuli, moving, and eliminating waste. But not all living things exhibit all of these characteristics at all times.</p>
<p>2. All living things are either plants or animals.</p>	<p>In the past, scientists classified living things into two kingdoms: Plants or Animals. Today, scientists recognize three domains at a higher level of organization than kingdoms: Bacteria, Archea, and Eukarya. Bacteria and Archea are mostly single-celled organisms, or <i>prokaryotes</i>, with no membrane-bound nuclei or cell organelles. Eukarya includes both single-celled and multicellular organisms (<i>eukaryotes</i>) with membrane-bound nuclei and organelles. Among the Eukarya, most of the multicellular organisms fall into the categories (kingdoms) of Plants, Animals, and Fungi. Although fungi were once classified as plants, they are now distinguished from both plants and animals. Unlike plants, they can't make their own food, and unlike animals, they don't ingest (eat) their food. Fungi absorb food from the environment by secreting powerful enzymes that break down the food into smaller pieces.</p>
<p>3. An environment is something we have to take care of.</p> <p>Plants and animals need a home, a place to live.</p>	<p>An environment, or an ecosystem, is a place where living things can get the matter and energy they need to live and grow. An environment includes both living and nonliving things. The matter living things need includes oxygen, water, food, carbon dioxide, and mineral nutrients. Plants need light energy and food energy, and animals need food energy.</p>
<p>4. Animals are things like dogs, cats, horses, and cows [<i>terrestrial mammals</i>] that have four legs and fur and live on land. Humans, insects, birds, and fish aren't the same as animals.</p>	<p>Scientific classification is based on cellular details, anatomical details (internal and external), and embryology rather than on general appearance or behavior. Animals have body parts and structures that allow them to obtain food from the environment. Their cells don't have cell walls. The animal kingdom includes sponges, worms, and mollusks, as well as fish,</p>

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	birds, and humans.
<p>5. Plants are flowers. Trees, grass, vegetables, and cactuses aren't plants.</p> <p>Plants are things that farmers and gardeners plant in the ground and take care of. Weeds, like dandelions, aren't plants.</p>	<p>Plants are multicellular organisms that are generally able to make their own food through photosynthesis. Plants have cell walls. Examples of plants include ferns, grass, trees, flowers, cactuses, moss, bushes, vegetables, phytoplankton, seaweeds, and weeds. Bacteria and fungi (such as molds and mushrooms) aren't plants because they don't have chlorophyll or produce their own food through the process of photosynthesis.</p>
<p>6. Animals only need food and water to live and grow, and plants only need water. We can tell what they need by looking at what they take into their bodies.</p> <p><i>[When students consider what living things need to live and grow, they tend to identify only those things they can see entering their bodies, such as food and water. They don't consider things they can't see, such as air or sunlight.]</i></p>	<p>Living things need both visible and invisible substances to help them live and grow. Although air isn't visible, it provides matter (molecules) that's essential for living things, such as oxygen and carbon dioxide. Plants need both oxygen and carbon dioxide, which they take in through microscopic pores or holes called <i>stomata</i>. Animals need oxygen molecules to live and grow, and they take these molecules into their bodies in a variety of ways, including through noses and mouths (in mammals) and through the skin (in worms).</p> <p>Plants need sunlight to produce food through the process of photosynthesis. This process takes place in cells that contain the green pigment chlorophyll. As with air, we can't directly observe plants taking sunlight into their bodies, but it's absorbed via the chlorophyll pigment.</p>
<p>7. Living things need a home because they need a place to live, stand, and sleep.</p>	<p>Living things need an environment where they can get the matter and energy they need to live and grow, not just a place to live, stand, or sleep.</p>
<p>8. Animals need food to live, but plants don't.</p> <p>The plants people take care of need food, but plants in the forest don't need food.</p>	<p>All organisms, whether plant or animal, need food to provide both matter and energy to support basic life processes, such as acquiring or making food, growing, respiring, reproducing, reacting to stimuli, moving, and eliminating waste).</p>
<p>9. Living things need food to help them be healthy, live, and grow.</p> <p><i>[Students don't consider specific functions of food in organisms.]</i></p>	<p>Living things need <i>matter</i> from food to build new cells and add mass (grow). Food supplies the <i>energy</i> organisms need for internal life processes, such as chemical reactions in their cells, the transportation of matter, reproduction, and the ability to maintain a stable internal environment (homeostasis).</p>
<p>10. Food is anything useful that an organism takes into its body, including water and minerals.</p>	<p>Water and minerals aren't considered food because they don't provide energy that living things can use. Scientists define <i>food</i> as "matter (essential building</p>

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	<p>materials) that contains stored energy living things can use to live and grow. Both matter and usable energy must be present for a substance to be considered food.</p> <p>Water and carbon dioxide provide <i>matter</i> that producers use to make food molecules (glucose) during photosynthesis. But by themselves, they don't provide energy that living things can use to live and grow.</p> <p>Mineral nutrients from the soil (such as nitrogen and phosphorous) also don't provide energy for living things. The products labeled "plant food" in stores are actually just mineral nutrients that provide about 3% of the matter a plant needs. Minerals are used to change the simple glucose molecules made during photosynthesis into more complicated molecules needed for plant health (e.g., proteins). Like vitamins, mineral nutrients are important for health, but they don't provide energy for living things.</p>
<p>11. Animals hunt for other animals to get their food. For example, a lion can catch and eat a deer.</p> <p><i>[Students don't think about animals eating plants.]</i></p>	<p>Some animals (carnivores) eat only other animals, but many animals (herbivores) eat only plants. <i>Omnivores</i> are animals that consume both plants and animals. The animals that carnivores eat may also be carnivores, but they may also be herbivores or omnivores.</p>
<p>12. Some animals, like worms, eat dirt for food.</p>	<p>Although worms burrow in the dirt and ingest it, their source of food energy comes from consuming organic matter in the dirt. This organic matter includes dead grass and leaves, vegetables or fruits that have fallen from trees (or have been placed in compost bins), and microscopic organisms, such as algae, fungi, and bacteria. Neither the dirt itself nor minerals in the dirt provide energy that worms can use, so after they consume the organic matter in the dirt, they excrete the dirt as worm casts.</p>
<p>13. Plants get their food from soil or from plant food added to the soil.</p> <p>Like humans, plants have many food sources.</p> <p>Water and air <i>[or carbon dioxide]</i> are food for plants.</p>	<p>The everyday reference to fertilizers as "plant food" promotes the inaccurate idea that plants get food from soil or from plant food added to the soil.</p> <p>Plants, however, use energy from the Sun and matter from the air (carbon dioxide) and the soil (water) to make their own food.</p> <p>Water and carbon dioxide by themselves aren't food because they don't provide energy that living things can use to support life processes. The matter and nutrients plants take from the soil (such as nitrogen and phosphorus) are also not considered food</p>

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	<p>because they don't provide usable energy and can't be used to make food (glucose) during photosynthesis.</p> <p>Why, then, do these soil nutrients help plants grow better in gardens? The answer is simple. Plants use these nutrients to build materials they need. For example, plants use nitrogen to build protein molecules that can then be used to make new body parts or regulate life processes.</p>
14. Sunlight is food for plants.	<p>Sunlight is a form of energy that doesn't provide any of the matter organisms need to grow (get bigger). So sunlight by itself is not food for plants. However, sunlight is critical in the food-making process of photosynthesis! Light energy from the Sun is transformed during photosynthesis into food energy (chemical energy) that is stored in glucose molecules. To make these glucose molecules, carbon dioxide and water molecules must react in the presence of sunlight. So sunlight alone isn't food, nor is it sufficient to make food; rather it provides the energy for photosynthesis to occur. Similarly, water and carbon dioxide are needed for plants to make food, but neither constitutes food.</p>
15. Plants can't breathe. Only animals with noses can breathe.	<p>Like animals, plants need air to live. Plants and animals have a variety of ways they take in gases from the environment. Leafy, green plants take in gases through pores or holes on the underside of their leaves called <i>stomata</i>. Plants can also take in oxygen from the soil through their roots. On the other hand, many animals have body structures like noses, mouths, and lungs that enable them to breathe. Other animals, such as worms, are able to take in gases through their skin.</p>
16. Plants make food for us and for other animals to eat.	<p>Plants don't make food for the sole purpose of providing food for animals! They also need the food they make to keep themselves alive and healthy. Some of the food (sugars) they make is used immediately for energy. In a process called <i>cellular respiration</i>, food molecules react chemically with oxygen, the food molecules are rearranged, and energy is released to support the plant's life processes. Carbon dioxide and water are also released the environment, and the plants use some of the released energy to convert sugars into new structures (e.g., new cells, cell walls, proteins, hormones, enzymes) that enable the plants to grow (get bigger). Building new cells is also important for repairing injured parts.</p>

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17. Animals take in food, digest it, and then get rid of it in pee or poop.	A common student misconception is that animals take in food, break it down, and then excrete it. While all of this is true, it misses the key purpose of digestion, which is breaking down food matter into smaller molecules that can be transported more easily to each and every living cell in the organism. In each cell, a process called <i>cellular respiration</i> takes place, causing a chemical reaction between the food molecules and oxygen that releases the stored energy in the food molecules. Organisms then use this energy to live.
18. Animals breathe in oxygen and turn it into carbon dioxide that they breathe out.	Animals breathe in oxygen, which travels to each cell in their bodies. In each cell, a chemical reaction (cellular respiration) occurs between the oxygen and food molecules that releases energy stored in the food molecules. Cells need this energy to function, and the organism needs it to move, think, breathe, and so on. During this reaction, oxygen and food molecules rearrange to form carbon dioxide and water, which the animal exhales into the environment. So although it's correct that animals breathe in oxygen and exhale carbon dioxide, it isn't correct to say that oxygen immediately turns into carbon dioxide that organisms exhale.
19. Plants don't need oxygen. They only breathe in carbon dioxide.	It's a common misconception that plants need only carbon dioxide. In fact, plants need <i>both</i> carbon dioxide and oxygen. They need carbon dioxide for the process of photosynthesis, but they also need oxygen to survive for the same reason animals do. Oxygen travels to each cell in a plant, where it reacts with food molecules (sugars) to release stored energy. As a by-product of this reaction (cellular respiration), carbon dioxide and water are released into the environment. So plants need carbon dioxide to make food (photosynthesis), and they need oxygen to release energy from the food they make (cellular respiration).
20. Animals don't need plants.	Carnivores—animals that only eat other animals—don't directly need plants; however, they do need them indirectly to harness the energy from sunlight and use it to transform water and carbon dioxide into energy-supplying food. Without this food energy, herbivores (plant-eating animals) would die. If this happened, the carnivores would lose their food source and die too. So ultimately, all animals depend on plants for their survival.
21. Plants don't need animals.	Plants are more self-sufficient than animals because they can make their own energy-providing food as

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	<p>long as they have a supply of sunlight, carbon dioxide, and water. But do plants depend on animals for a source of carbon dioxide? Older students might think that without animals to exhale carbon dioxide, the atmosphere would run out of carbon dioxide, and plants would die. However, remember that plants, like animals, use oxygen to release energy from food in the process of cellular respiration. During this process, they release carbon dioxide into the air. So plants produce both oxygen (during photosynthesis) and carbon dioxide (during cellular respiration). In fact, plants existed on Earth for a long time without the presence of animals. At that time, there were much higher levels of carbon dioxide in the atmosphere, and only small amounts of free oxygen. Plants significantly changed the atmosphere by increasing atmospheric oxygen levels, allowing animal cells to eventually evolve.</p> <p>While plants are largely self-sufficient, they do benefit from having animals in their environment. For example, animals and microscopic decomposers help ensure that matter is recycled in the plants' environment. When animals eat plants and other animals, they produce waste matter (carbon dioxide, water, and excrement) that plants can use. When animals die, bacteria and fungi decompose their bodies, which produces waste matter (carbon dioxide, water, and mineral nutrients) that plants can reuse.</p>