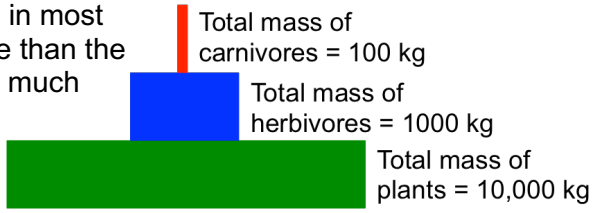
Name _____ Teacher _____ Date _____

1.1: Assessing Ecosystems Unit Pretest

This pretest is designed to help students to express a wide range of ideas, even if they are incorrect. Ideally, students will come to recognize that they have many different ideas about animal growth, as well as unanswered questions.

*Level 4 responses are in **bold blue italics** below. Remember Level 4 is the eventual learning goal; we do not expect most, possibly any, students to produce these responses at this point in the unit. We also have suggestions based on our research about likely Level 2 and Level 3 responses. This worksheet has "assessing" in the title because we do NOT recommend giving your students a grade based on the scientific accuracy of their responses at this point in the unit. It is designed to be used as a tool for formative assessment.*

1. This graph shows a pattern that biologists have observed in most ecosystems on Earth. The total mass of plants is much more than the total mass of herbivores, and the total mass of herbivores is much more than the total mass of carnivores.



Why do you think that this is the case?

Level 4 responses may indicate that mass is lost through cellular respiration with each level leaving less mass to be consumed by the next.

Level 3 responses may suggest that the mass is lost because the animals die or use the food for energy, or that the food they eat is turned into energy and "burned up" (note: it is common for level 3 students to suggest that matter can be turned into energy) Level 3 responses may also invoke the "10% rule:" mass at each trophic level is about 10% of the mass at the level below. This states the pattern, but does not explain it.

Level 2 responses might focus on describing a food chain (e.g., the carnivores eat the herbivores, and the herbivores eat the plants) without providing an explanation for why mass is lost. They may add that there has to be more plants to support the herbivores, and that there are fewer carnivores because they are at the top of the food chain.

2. Here is a simple food chain with one plant, one animal, and some decomposers:

Grass	is eaten by →	**Rabbit**	dies and is decomposed by →	**Decomposing bacteria**

Answer true or false to the following questions:

True	***False***	The **molecules** in the rabbit came from the grass without changing.
True	False	The **atoms** in the rabbit came from the grass without changing.
True	False	The **energy** in the rabbit came from the grass without changing.
True	***False***	The bacteria recycle **molecules** from the dead rabbit back to the grass.
True	False	The bacteria recycle **atoms** from the dead rabbit back to the grass
True	***False***	The bacteria recycle **energy** from the dead rabbit back to the grass

Name _____ Teacher _____ Date _____

Explain your answers: How do **molecules** move through the ecosystem that this food chain is part of?

Level 4 responses may suggest that plants, animals, and decomposers all take in molecules from their environment or other organisms and rearrange their atoms into different molecules; the atoms do not change.

Level 3 responses might suggest that molecules move through an ecosystem when animals eat each other.

Level 2 responses might suggest that molecules are recycled because when things die the atoms go back to the grass/soil, and that everything is always recycled.

Explain your answers: How do **atoms** move through the ecosystem that this food chain is part of?

Level 4 responses might suggest that atoms cycle in the ecosystem and are rearranged into new molecules during photosynthesis, digestion, decomposition, and cellular respiration (most of which happens in the process of organisms eating other organisms).

Level 3 responses might suggest that atoms move through an ecosystem when animals eat each other and through photosynthesis.

Level 2 responses might suggest that atoms are recycled because when things die the atoms go back to the grass/soil, and everything is always recycled.

Explain your answers: How does **energy** move through the ecosystem that this food chain is part of?

Level 4 responses may suggest that plants take light energy from the sun and transform it to chemical energy in plant molecules, which goes through food chains and into soil carbon. During cellular respiration in plants, animals, and decomposers, the chemical energy in their cells is transformed to heat and motion energy. Once energy leaves the food chain as heat it cannot be reused again by the plants or animals

Level 3 responses might suggest that energy is transferred when animals eat plants and when animals eat other animals.

Level 2 responses might suggest that when something grows it has energy, or that when things die the energy goes back to the grass/soil.

3. In a forest ecosystem, how would you expect the amount of carbon dioxide in the air to change in the **winter**.

The amount of carbon dioxide in the forest air (choose one):

a. Would increase

b. Would decrease

c. Would stay about the same

Explain your answer. What would cause the amount of CO_2 in the forest air to change during the winter?

Level 4 responses may suggest that during the winter the rate of photosynthesis decreases, and cellular respiration either stays the same or decreases slightly. Since there are fewer carbon atoms entering plants compared to in the summer (and since atoms last forever), the overall amount of carbon dioxide in the atmosphere increases.

Level 3 responses might suggest that because there are fewer leaves on the trees in winter that this causes CO_2 to increase or stay about the same. They might also suggest that because plants and animals are less 'active' or die in the winter that this releases less CO_2 because they are less active, dead, or hibernating.

Level 2 responses might suggest that because of the cold weather in the winter the CO_2 in the forest increases, stays the same, or decreases. They might also suggest that there is less sunlight and less heat in the winter so this is the cause of the change. They will most likely suggest that CO_2 levels decrease in winter.

4. In a forest ecosystem, how would you expect the amount of carbon dioxide in the air to change in the **summer**.

The amount of carbon dioxide in the forest air (choose one):

a. Would increase

b. Would decrease

c. Would stay about the same

Explain your answer. What would cause the amount of CO2 in the forest air to change during the summer?

Level 4 responses may suggest that during the summer, the rate of photosynthesis increases more than the rate of cellular respiration. Since more carbon atoms are entering plants, the overall amount of carbon dioxide in the atmosphere decreases.

Level 3 responses might suggest that photosynthesis is involved but may not be able to explain how or why this causes a decrease in the CO_2 levels in the surrounding forest air.

Level 2 responses might suggest that it the warmer weather in the summer causes the air to decrease, increase, or stay the same. They also might suggest that the amount of heat from the sunlight causes the increase/decrease/no change. They will most likely suggest that CO_2 levels increase in the summer.

5. Think about what might happen to carbon atoms and to energy in a forest. Decide whether each of the following pathways is possible or not:

Carbon atoms could leave the forest after they have been used by plants or animals.	**Possible**	Impossible
After carbon atoms have been used by plants or animals they could be recycled and used again by plants or animals.	**Possible**	Impossible
Energy could leave the forest after it has been used by plants or animals.	**Possible**	Impossible
After energy has been used by plants or animals it could be recycled and used again by plants or animals.	Possible	**Impossible**

Explain your thinking. How are the possible pathways for carbon atoms and for energy alike and different?

Level 4 responses might suggest that carbon atoms last forever, so they could leave the forest are be recycled. Energy also lasts forever, but plants cannot reuse the heat energy that leaves the ecosystem, so energy cannot re-enter the food chain.

Level 3 responses might suggest that both energy and carbon atoms can be reused again in the ecosystem. They might also suggest that carbon atoms cannot leave an ecosystem, but that energy can. Level 3 responses might also suggest that energy and carbon are used differently because one is matter and one is energy, but cannot explain why.

Level 2 responses might suggest that once carbon atoms leave the forest they are gone forever, or that once energy leaves the forest it disappears. They might also suggest that everything can always be recycled and reused because of the cycle of life. They might also suggest that carbon and energy are recycled or disappear when things in the ecosystem die.

6. A remote island in Lake Superior is uninhabited by humans. The primary mammal populations are white-tailed deer and wolves. The island is left undisturbed for many years. Circle the best choice to complete the statement about what will happen to the average populations of the animals over time.

On average, the populations of deer and wolves will fluctuate, but:

a. there will be more deer than wolves.

b. there will more wolves than deer

c. the populations of each would be about equal.

d. sometimes there will be more deer and sometimes there will be more wolves.

e. None of the above.

Please explain your answer to what happens to the populations of deer and wolves.

Level 4 responses may indicate that there will be more deer than wolves because as organic materials are eaten in a food chain, most of the food is used for cellular respiration (to release energy for the organism). One wolf will always need several deer (lots of organic carbon and chemical energy) in order to stay alive, and most of the organic carbon that makes up deer bodies will be respired by the wolf.

Level 3 responses might suggest that because wolves are at the top of the food chain they need a larger deer population to maintain their own population, but may not be able to explain that this is a result of mass from the deer bodies being released into the air as CO_2 during the wolf's cellular respiration. They might also suggest that all animal populations fluctuate because when the wolves eat too many deer, there will be less deer than wolves, but then as the deer populations increase there will be more deer again.

Level 2 responses might suggest that there will be more wolves than deer because wolves are at the top of the food chain/trophic level and have no predators; that the populations will be about equal because they don't change; or that there will be less deer because the wolves eat the deer; or that the deer will thrive because there are lots of plants on the island.