Ecological Relationships
What symbiotic relationships are seen in ecosystems?

Why?
All living organisms need each other in some way to survive. This can include the interactions between predators and their prey, the close associations between and among living things (symbiosis), or the competitive relationships between and among species. All of these relationships may be equally advantageous to the parties involved, or they may be more beneficial to one organism over the other.

Model 1 – Predator–Prey Relationships

Relationship between Snowshoe Hares and Lynx

1. Refer to the graph in Model 1.
   a. What does the y axis on the left represent?
   b. What does the y axis on the right represent?

2. What was the approximate population of snowshoe hares in 1865?

3. What was the approximate population of lynx in 1865?
4. When the number of snowshoe hares is high, what happens to the number of lynx? Use actual data from the graph to support your observation.

5. What happens to the population of lynx as the number of snowshoe hares decreases? Use actual data from the graph to support your observation.

6. Propose an explanation for the apparent cause and effect relationship between the populations of lynx and hares.

**Model 2 – Symbiosis**

<table>
<thead>
<tr>
<th>Organism 1</th>
<th>Organism 2</th>
<th>Description of the relationship</th>
<th>Symbiotic Relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dog</td>
<td>Flea</td>
<td>The flea feeds on blood from the dog. There is no benefit to the dog and the itching and bites may lead to infection.</td>
<td></td>
</tr>
<tr>
<td>Fungus</td>
<td>Algae</td>
<td>The photosynthetic algae provide food for the fungus, which in turn provides a suitable living environment for the algae.</td>
<td></td>
</tr>
<tr>
<td>Termite</td>
<td>Cellulose-digesting bacteria</td>
<td>The bacteria in the gut of the termite breakdown and feed on some of the cellulose taken in by the termite. The termite would be unable to digest cellulose without these bacteria and they gain an additional source of nutrition from the surplus digested cellulose.</td>
<td></td>
</tr>
<tr>
<td>Shark</td>
<td>Remora</td>
<td>The Remora fish swim alongside the shark and take scraps of food that the shark drops during feeding. The shark does not eat the Remora and appears unaffected by its presence.</td>
<td></td>
</tr>
<tr>
<td>Cattle</td>
<td>Cattle egret</td>
<td>The cattle egret follows herds of cattle and eats the insects that the cattle stir up as they move through the grassland. The cattle appear to be unaffected by the egrets.</td>
<td></td>
</tr>
<tr>
<td>Human</td>
<td>Tapeworm</td>
<td>The tapeworm lives in the small intestines where it feeds and grows, robbing the human of essential nutrients.</td>
<td></td>
</tr>
</tbody>
</table>
7. Refer to the information given in Model 2.
   a. In the dog and flea relationship, is there a benefit for one of the organisms or for both?

   b. Is either the dog or the flea harmed by this relationship?

   c. Which other relationship in Model 2 is similar to that between the dog and flea?

8. Refer to the fungus and algae relationship in Model 2.
   a. Is there a benefit for one of the organisms or for both?

   b. Is either the fungus or the algae harmed by this relationship?

   c. Which other relationship in Model 2 is similar to that between the fungus and the algae?

9. Refer to the shark and remora relationship in Model 2.
   a. In the shark and remora relationship, is there a benefit for one of the organisms or for both?

   b. Is either the shark or the remora harmed by this relationship?

   c. Which other relationship in Model 2 is similar to that between the shark and the remora?

Read This!

Symbiotic relationships are identified by how they affect the organisms involved. The three types of symbiotic relationships are listed below.

- **Mutualism:** Both organisms benefit from the relationship.
- **Parasitism:** One organism benefits and the other is harmed.
- **Commensalism:** One organism benefits and there is no effect on the other.

10. Using the information from the Read This! Box, label each of the relationships in Model 2 as mutualism, parasitism or commensalism.
Ecological Pyramids
How does energy flow through an ecosystem?

Why?

Every organism in an ecosystem is either eating or being eaten. When cows eat grass, they obtain some of the energy that the grass transferred from the sunlight it absorbed. If cows could carry out photosynthesis, would they have access to more energy than they get as herbivores? Which organisms in an ecosystem require the most energy to sustain life?

Model 3 – Pyramid of Energy

11. A unit used to measure energy is the kcal (kilocalorie).
   a. What is the source of all energy in the pyramid in Model 3?
   b. How much energy does this source provide to a square meter of the Earth per year? (Be sure your answer includes units.)

12. Label the pyramid levels in Model 3 with the following: producers, primary consumers, secondary consumers, and tertiary consumers.

13. The arrows in Model 3 represent the energy available to the next level of the pyramid.
   a. What percentage of the source energy from Question 1a is absorbed by the oak leaves in Model 3?
   b. By what process do the oak leaves harness this energy?
14. Describe how the consumers in one level of the pyramid obtain energy from the organisms at the previous level of the pyramid.

15. Refer to Model 3.
   a. How much energy per year do the caterpillars in Model 3 obtain from eating the leaves in a square meter of the oak tree?
   
   b. What percentage of the energy that was originally absorbed by the oak leaves is passed on to the caterpillars?
   
   c. What percentage of the energy absorbed by the oak leaves is not passed on to the caterpillars?
   
   d. List at least three possible uses and/or products of the energy absorbed by the oak leaves that did not contribute to the production of biomass.

16. What percentage of the caterpillars’ original energy is available to the hawk?

17. What percentage of the oak leaves’ original energy is available to the hawk?

18. Propose an explanation for why populations of top carnivores, such as hawks, are always smaller than the populations of herbivores, such as caterpillars.

**Read This!**

Each level in the pyramid in Model 3 is a **trophic level**. The word “trophic” refers to feeding or nutrition. Model 3 shows one example of one organism that would be included in each level, but each level in an ecosystem includes many species of organisms *(think about food webs)*.

19. List at least three other species that might be found in the trophic level with the oak trees.

20. List at least three other species that might be found in the trophic level with the blue jays.