OBJECTIVE
Students will gain a better understanding of ecosystems by identifying and comparing the biotic and abiotic factors present in the rainforest and arctic tundra biomes. Students will then use these observations to answer conclusion questions that allow them to explore the interconnectedness between abiotic and biotic factors.

LEVEL
Middle School Life Science

NATIONAL STANDARDS
UCP.1, UCP.2, C.4, C.5

CONNECTIONS TO AP
AP Biology:

   AP Environmental:
   V. Global Changes and Their Consequences A. First-order Effects 3. Biota: habitat destruction, loss of biodiversity, introduced exotics

TIME FRAME
30 minutes

MATERIALS
(For a class of 28 working in pairs)
   1 box of crayons (48 count)     28 copies of each biome sketch
TEACHER NOTES

*Clouds and Cockatoos and Cacti, Oh My!* is an excellent introduction to the following concepts: biomes, ecosystems, biotic/abiotic factors, producers/consumers, and photosynthesis. Before beginning this activity you may want to give a brief lecture over these topics.

Any type of writing utensil can be used such as overhead markers, map pencils, highlighters, or pens. The important thing is that each student has access to three colors. A different color will be used to identify each the following: plants, animals, and abiotic factors. If you are limited on supplies, have students share.

During the data collection part of this exercise, walk around and encourage students to work with their partners to determine the biotic and abiotic factors present in each ecosystem. Conclusion questions should be answered individually.
### Data Table 1: Biotic and Abiotic Factors Found in the Rainforest Biome Sketch

<table>
<thead>
<tr>
<th>Animals</th>
<th>Amphibians</th>
<th>Birds</th>
<th>Insects</th>
<th>Reptiles</th>
<th>Fish</th>
<th>Mammals</th>
<th>Plants</th>
<th>Abiotic Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Poison Dart frog</td>
<td>Toucan</td>
<td>Moth</td>
<td>Anaconda</td>
<td>Angelfish</td>
<td>Bengal tiger</td>
<td>Moss</td>
<td>Rocks</td>
</tr>
<tr>
<td></td>
<td>Green Tree frog</td>
<td>Parrot</td>
<td>Butterfly</td>
<td>Boa Constictor</td>
<td>Catfish</td>
<td>Spider monkey</td>
<td>Fern</td>
<td>Water</td>
</tr>
<tr>
<td></td>
<td>Toad</td>
<td></td>
<td>Dragon fly</td>
<td></td>
<td>Neon Tetras</td>
<td></td>
<td>Angiosperm</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Beetle</td>
<td></td>
<td>Betta</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Data Table 2: Biotic and Abiotic Factors Found in the Arctic Tundra Biome Sketch

<table>
<thead>
<tr>
<th>Animals</th>
<th>Amphibians</th>
<th>Birds</th>
<th>Insects</th>
<th>Reptiles</th>
<th>Fish</th>
<th>Mammals</th>
<th>Plants</th>
<th>Abiotic Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Penguin</td>
<td>Snow owl</td>
<td>Trout</td>
<td>Polar bear</td>
<td>Salmon</td>
<td>Arctic fox</td>
<td>Moss</td>
<td>Rocks</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Salmon</td>
<td>Harp seal</td>
<td>Cod</td>
<td>Arctic hare</td>
<td>Angiosperm</td>
<td>Water</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cod</td>
<td>Arctic fox</td>
<td></td>
<td></td>
<td></td>
<td>Soil</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Clouds</td>
</tr>
</tbody>
</table>
1. **What is an ecosystem? What is a biome? Provide three examples of biomes.**
   - An ecosystem is defined as the combined biotic and abiotic factors present in a particular area. A biome is a region of the world made up of many similar ecosystems. Biomes have similar plants, animals, and other life forms. Examples of biomes include: desert, rainforest, tundra, and grassland.

2. **Compare and contrast the terms biotic and abiotic. Provide three examples of each.**
   - Biotic and abiotic factors are both found in ecosystem and therefore in biomes. Biotic factors are those that are living, or were once living, such as plants, animals, and microorganisms. Abiotic factors, on the other hand, are non-living and include rocks, soil, and water.

3. **Using the table below, list the abiotic factors present in each biome. Some of these factors were visible in the sketch and others were not. Of the ones not seen, which can you assume are present (use the table found on pg.1)? Even though you cannot see them, explain how you know they are present.**

<table>
<thead>
<tr>
<th>Abiotic Factors in Each Ecosystem</th>
<th>Found in Sketch</th>
<th>Not in Sketch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainforest</td>
<td>rocks</td>
<td>sun</td>
</tr>
<tr>
<td></td>
<td>water</td>
<td>clouds</td>
</tr>
<tr>
<td></td>
<td>soil</td>
<td>nutrients</td>
</tr>
<tr>
<td></td>
<td></td>
<td>air (oxygen, carbon dioxide)</td>
</tr>
<tr>
<td>Arctic tundra</td>
<td>rocks</td>
<td>nutrients</td>
</tr>
<tr>
<td></td>
<td>water</td>
<td>air (oxygen, carbon dioxide)</td>
</tr>
<tr>
<td></td>
<td>soil</td>
<td></td>
</tr>
<tr>
<td></td>
<td>clouds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>sun</td>
<td></td>
</tr>
</tbody>
</table>

   - Although not all of the abiotic factors can be seen in the sketch, they are present because without them, the plants, animals, and other biotic factors could not survive.

4. **Abiotic factors such as yearly precipitation, amount of sunlight, and temperature determine the type and amount of biodiversity found in an ecosystem. What did you observe about the number of species found in the rainforest compared to the arctic tundra? To what do you attribute this difference?**
   - There were far fewer species of animals and types of plants found in the arctic tundra than in the rainforest. In the arctic tundra the yearly precipitation, sun intensity, and temperatures are all very low compared to the rainforest.
5. Due to the low temperatures in the arctic tundra, certain types of animals have a hard time surviving. Which categories of animals (from the Data Table 2) were completely absent in the arctic tundra? What would you hypothesize is the reason?
   - There were no reptiles or amphibians in the arctic tundra. I believe this is because they are cold-blooded and thus need external heat to sustain their body temperatures. With such low temperatures, they have a hard time staying warm.

6. Compare and contrast the terms producer and consumer. Give three examples of each.
   - Producers and consumers are both biotic factors and are both found in ecosystems. Producers use energy from the sun to create edible sugars whereas consumers eat the sugars made by producers in order to survive. Mosses, gymnosperms, and angiosperms are all types of plants and are therefore producers. Monkeys, snakes, and humans are all consumers.

7. Plants are producers, and thus must utilize the abiotic factors present to help consumers sustain life. Which abiotic factors do plants use for this process and what do they produce? What is this process called?
   - Plants use carbon dioxide from the air, water from the soil, and sunlight. They produce edible sugars and oxygen. This occurs through the process of photosynthesis.

8. Abiotic factors, such as precipitation and temperature, tend to change slowly over time allowing the biotic factors to adapt to the new environmental pressures. Evolution occurs over generations, and therefore extreme and sudden changes in temperature or precipitation can dramatically affect biodiversity. Knowing this, what do you think would happen to the biodiversity in the deserts of Africa during times of extreme drought?
   - Answers will vary but students should understand that drastic changes in abiotic factors over a short period of time can result in the extinction of certain species in that ecosystem, and thus a decrease in the biodiversity. Cacti and succulents found in the desert can store water and therefore live a long time without rain. However, they will eventually use up all of their stored water and many will die during times of drought.

9. In the above example, the balance in the ecosystem was disturbed naturally for a period of time. However, sometimes ecosystems are disturbed in a less natural way. Scientists are discovering that human activity such as the burning of fossil fuels, pollution, and deforestation are all having an impact on ecosystems.
   a. How could deforestation affect the biodiversity in forests around the globe?
      - Answers will vary. Animals need plants and trees for food and for habitat. Deforestation results in a disturbance of the forest ecosystem and causes many animals to die or relocate.
   b. Why should we be concerned about how our actions affect the planet around us?
      - Answers will vary.
   c. It is believed that the increase in carbon dioxide from the burning of fossil fuels has tended to increase temperatures on our planet (referred to as Global Warming). What kind of effect can this have on ecosystems?
      - Temperatures remain relatively consistent from year to year. If plants and animals are unable to adapt quickly enough to drastic changes in temperature, they will die off. This disturbs ecosystems.
Clouds and Cockatoos and Cacti, Oh My!
Investigating Abiotic and Biotic Factors

Have you ever seen a fox dart down the street late at night, or a squirrel scurry across the fence? How often does it rain where you live? Does it snow? Depending on the part of the country in which you live, the biotic (living), and abiotic (nonliving), factors can vary drastically.

Ecosystems are defined by the combined biotic and abiotic factors present in an area as well as the interactions that occur between them. Biomes are regions of the world made up of many similar ecosystems and therefore have similar plants, animals, and other life forms (examples include the desert, rainforest, tundra, and grassland). The variation of species found in an ecosystem is referred to as biodiversity. To better understand the terms biotic and abiotic, carefully study the table below.

<table>
<thead>
<tr>
<th>Abiotic and Biotic Factors found in an Ecosystem</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Abiotic Factors</strong></td>
</tr>
<tr>
<td>Sun</td>
</tr>
<tr>
<td>Rocks</td>
</tr>
<tr>
<td>Clouds (precipitation)</td>
</tr>
<tr>
<td>Soil</td>
</tr>
<tr>
<td>Nutrients</td>
</tr>
<tr>
<td>Air (oxygen, carbon dioxide)</td>
</tr>
<tr>
<td>pH, Temperature, Humidity</td>
</tr>
</tbody>
</table>

In order for biotic factors to survive, abiotic factors must be present. Plants, also known as producers, take in nutrients from the soil to transform water, carbon dioxide (from the air), and sunlight into edible sugars and breathable oxygen. This process is called photosynthesis. Animals, also known as consumers, then eat these sugars and breathe the oxygen. Rocks and other topographical structures provide protection and habitat for consumers. Without soil, water, sunlight, and precipitation, which are all abiotic factors, life could not exist.

**PURPOSE**
In this activity you will study a sketch of an ecosystem found in: (1) the rainforest biome and (2) the arctic tundra biome. Using a crayon you will circle all biotic (living) and abiotic (non-living) factors. In the conclusion section of this exercise you will explore the interconnectedness of the two and the effects of human activity on ecosystems around the world.

**MATERIALS**
- 3 different colored crayons
- 2 copies of each biome sketch
PROCEDURE

1. With your partner, obtain all supplies from your teacher: three different colored crayons and two copies of each sketch (rainforest and arctic tundra).

2. Using one of the crayons circle all of the animals found in sketch #1 (the rainforest ecosystem). List the names of each animal under the appropriate column heading in Data Table 1. For example, the Bengal Tiger should be listed under ‘Mammal.’ Work with your partner on this exercise, but do not copy answers.

3. Using a different colored crayon circle the names of each category of plant found in sketch #1 (mosses, ferns, gymnosperms, angiosperms) and list them under the appropriate column heading.

4. Using the third color of crayon circle all of the abiotic factors found in sketch #1. List the abiotic factors under the appropriate column heading in Data Table 1.

5. Repeat steps 2–4 for sketch #2 (the arctic tundra). All information for sketch #2 should be recorded in Data Table 2.

6. Return the crayons to your teacher, go back to your desk, and work independently on the conclusion questions.
Tundra

Precipitation: 6-10 inches/year
Sunlight: low intensity
Average Temperatures: -30º C (winter) and 3-12º C (summer)

Tropical Rainforest
Precipitation: 50-260 inches/year
Sunlight: high intensity (canopy)
low intensity (beneath the canopy)
Average Temperatures: 20-34°C (year round)
Tropical Rainforest

- Precipitation: 50-260 inches/year
- Sunlight: high intensity (canopy), low intensity (beneath the canopy)
- Average Temperatures: 20-34°C (year round)

- Lemur
- Bengal Tiger
- Angelfish
- Neon Tetra
- Betta
- Catfish
- Anaconda
- Spider
- Monkey
- Parrot
- Butterfly
- Dragonfly
- Beetle
- Fern
- Moss
- Gymnosperm
- Poison Dart Frog
- Beetle
- Toucan

Tundra

- Precipitation: 6-10 inches/year
- Sunlight: low intensity
- Average Temperatures: -30°C (winter) and 3-12°C (summer)

- Willow Tree (angiosperm)
- Harp Seal
- Snow Owl
- Penguins
- Arctic Hare
- Arctic Fox
- Polar Bear
- Cod
- Salmon
- Trout
DATA AND OBSERVATIONS

The Rainforest Biome (Sketch #1):

| Data Table 1: Biotic and Abiotic Factors Found in the Rainforest Biome Sketch |
|----------------------------------|------|------|------|------|------|------------------|
| Amphibians | Birds | Insects | Reptiles | Fish | Mammals | Plants |
| Animals    |      |        |          |      |         | Abiotic Factors |

The Arctic Tundra Biome (Sketch #2):

| Data Table 2: Biotic and Abiotic Factors Found in the Arctic Tundra Biome Sketch |
|----------------------------------|------|------|------|------|------|------------------|
| Amphibians | Birds | Insects | Reptiles | Fish | Mammals | Plants |
| Animals    |      |        |          |      |         | Abiotic Factors |
CONCLUSION QUESTIONS

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<td>Arctic tundra</td>
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