Environmental Education Teaching Games:
How Climate Change Affects Species

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Top of the Mountain:
Climate change affects high latitudes and high altitudes most severely. In the Rocky Mountains, as the climate at lower elevations warms and dries, species will be forced to move their range up slope to stay in the "sweet spot" of conditions that they prefer. For example, as the climate warms, low elevation ponderosa pines may find it too hot to survive in the foothills, and gradually shift their range upslope as temperature and moisture gradients change. Other plants, such as sagebrush, may favor the new conditions in the foothills and move in to take over the area formerly occupied by the pines.

As life zones gradually shift upwards, the tundra habitat at the top of the peaks has nowhere to go to escape the changing conditions, and may gradually vanish as it is replaced by plants and animals moving up from below. If tundra becomes increasingly scarce, its plants and animals will vanish from all but the very tallest peaks.

Goal: Learners personally experience how climate change forces mountain life zones to gradually shift up slope, with some habitats and species ultimately being replaced.

Materials: A stick or sharp object to draw on the ground
Indoors: Masking tape to delineate a mountain on the floor

Explain the concept of life zones, and how each plant and animal community thrives at an elevation that provides the exact mix of temperature and moisture conditions that best suit it. Using a stick, draw a long, wide triangle in the dirt, about 10 feet high. This is our mountain (you can give it a name, if you like). Select about 5 "volunteers" to represent a species that lives in the hot, dry

conditions at the bottom of the mountain (e.g. prairie dogs) and place them in a line parallel to the base of the triangle. If you have a picture of a prairie dog, ask this group to hold it up. Select another 3-4 "volunteers" and ask them to represent an animal of low elevation forests (such as an Abert's squirrel; again, give the group a picture if you have one). Arrange them parallel to the prairie dogs, but "higher up" the mountain. 2-3 more students can become an animal of high elevation forests (a porcupine, or a pine martin). Finally, at the summit, choose 1-2 "volunteers" to be pikas, which live in rock slides and meadows above timberline.

Once everyone is located on the mountain, suggest that climate change makes the lower elevations hotter and drier. The Abert's squirrel layer can't survive where it is, so it moves "upward," displacing the porcupines. "But that's OK, because the prairie dogs can move into the squirrels' former territory. And hey, the porcupines can move up the mountain to higher elevations." But it will become clear that to do so, they have to push the pikas farther up . . . and they have nowhere to go. They get pushed off the mountain and have no home, ultimately dying out.

If you want to avoid the depressing end of the pikas, you can suggest that they may continue to survive in reduced numbers in reduced habitats on the very tallest mountains; and some day in the distant future when the climate changes again, they will be able to move downwards to occupy their former habitats as conditions become cooler and moister.

Variation: A similar effect will happen with latitude: species at lower latitudes will be pushed north. Instead of a "mountain", you could use a rough diagram of North America.

Migration Hopscotch:
Some plants and animals take their seasonal cues from temperatures. Others use changes in day length to assess the change of seasons. As climate change and earlier warming affect some seasonal events, it may cause species that measure time by day length to lag behind temperature-related seasonal developments. For example, warm temperatures may cause insects to hatch out too early in spring, before the flowers they pollinate have received the necessary day length cues to bloom. Results: insects starve and flowers go unpollinated.

Migration offers another example of synchronous timing in nature. In spring, migrants time their arrival in anticipation of food and habitat conditions. But if migrants use day length to measure the seasons in a warming climate, they may arrive after food sources have passed their peak, or some necessary conditions have already vanished for the season.

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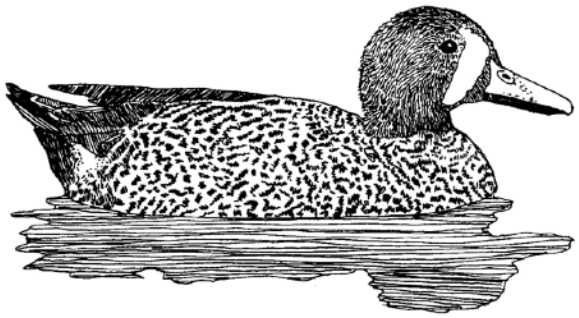
Goal: Learners personally experience how climate change can desynchronize migration – and by extension, other synchronous natural events.

Materials: A stick or sharp object to draw on the ground
Indoors: large rings or hula-hoops to simulate ponds



When birds migrate they must stop to rest and refuel at refuges along the way. For waterfowl, these refuges are ponds, lakes and potholes between wintering and breeding grounds. To simulate the importance of these refuges, line a group of participants up single file and tell them they are ducks in Mexico. With a stick, draw a series of circles each about 1 – 2 feet in diameter, about 3 – 4 feet apart, in a rough zigzag in front of the first person in the line. Each circle represents a lake or pond along the course of their migration, which ends in Canada. Each person must jump from pond to pond, like hopscotch, without missing a single step to complete the migration alive.

Line them back up in Canada for the return migration, but ask them to imagine that, due to climate change, summers have become hotter and drier in Colorado. By the time day length causes the birds to return to Mexico, the hotter temperatures have caused many of the lakes they depend on during migration to dry up for the season. Scuff out several of the circles with your foot – these ponds have dried up earlier than in previous years. Now ask the ducks to return to Mexico using fewer existing lakes.

With the chain of refuges broken, they will find the return trip much harder to complete! Some may no longer be able to make it.

Is there anything humans can do to help the ducks? We can create new wildlife refuges, for example by turning old gravel mines into ponds (scuff a new pond in that was made by people). We can also make some tough choices about irrigation water, such as using water to fill a pond for ducks late in the year. (scuff a dry pond back in as people divert water to it). However, that water won't be available for other purposes such as growing crops or green lawns on golf courses – and that's a tough choice.

People can do positive things for the environment as well as negative – and that's an important lesson, too.

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