A
GIANT SCREEN
FILM

FEATURING:
TORAH BRIGHT,
JEREMY JONES,
& SAMMY CARLSON

MOUNTAIN ADVENTURE

OUT OF BOUNDS

EDUCATORS GUIDE

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INTRODUCTION

Welcome to the *Mountain Adventure: Out of Bounds* Guide for Educators

On the following pages, you will find five open-ended inquiry activities for grades three through eight, all directly related to *Mountain Adventure: Out of Bounds* and exploring concepts in greater depth that the film introduces.

Here are a few important things to keep in mind as you read on:

1. Each activity is centered on a hands-on science question for grades 3-5 and includes background information regarding the science content. We want to encourage students to think independently and solve problems like scientists and engineers.
2. Each activity includes a research question for grades 6-8 addressing the issue of human impact on our environment that is central in the film. We encourage students to apply what they learned in the film to protect the Earth's resources.
3. All activities are addressed directly to the students so that you can easily photocopy and distribute the pages to your class. Our activities are designed for students to work in teams. The amount of supplies you will need depends on the number of students.
4. We know there's a big difference between a third grader and an eighth grader. The hands-on activities are generally designed for grades 3-5 and the research questions for grades 6-8 but please feel free to adapt for the individual needs of your students.
5. Each activity includes a selection of online resources to provide background information for you and spark the curiosity of older students.
6. All activities are linked to the Next Generation Science Standards. Please see page 17 to make those connections.

Written by: Jennifer Jovanovic

Special thanks to:
Dennis Bateman
and Wendy Brenneman
at Carnegie Science Center
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Designed by Matthew Palanca

FROM THE FILMMAKERS

An Overview of *Mountain Adventure: Out of Bounds*

Mountains tower above the plains and dominate the skyline. Critical to life - they fill our rivers, sway the weather, and provide sanctuary to incredibly diverse wildlife. They are as beautiful as they are dangerous - and for a brave few, they are the source of incredible adventure.

Follow Olympian Torah Bright as she journeys through the world's longest chain of mountain ranges extending from Antarctica all the way to Alaska. Along the journey, Torah will ride with backcountry legend Jeremy Jones and freeskiing superstar Sammy Carlson. Together, they will encounter penguins, polar bears, and other wildlife, and meet with scientists and environmentalists to uncover a deeper understanding of our mountain ecosystems.

From glaciated valleys to icy tundras, *Mountain Adventure: Out of Bounds* is a giant screen film that will venture through the mountain's most awe-inspiring vistas. Come discover the crucial role mountains play in our every day lives and for the world, while witnessing the most spectacular snowboard action ever brought to the giant screen!

ACTIVITY 1

How does the water cycle impact mountain habitats and what danger do microplastics cause?

Grades 3–5

Materials

You will need, for each team of students:

- round clear plastic container, about 4" tall and 6" diameter
- small mixing bowl
- 1/3 cup salt
- 1 cup water
- food coloring
- spoon
- small glass cup/ramekin, about 2" tall x 3" diameter
- stretchy plastic wrap
- masking tape
- rock about 2" x 1"
- sunny day

Illustration #1

What to Do

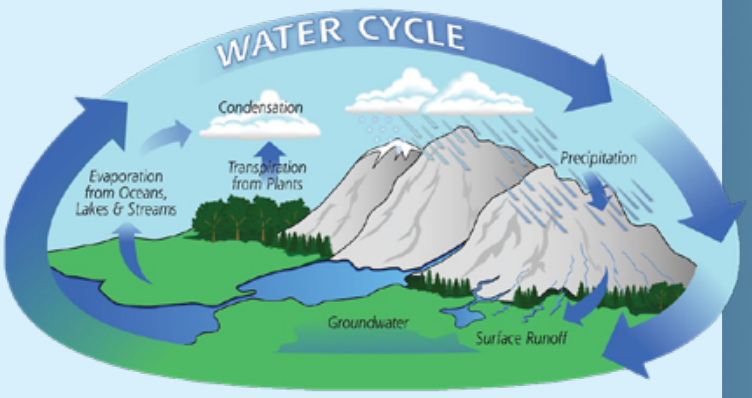
1. Place the container in a sunny spot.
2. Stir the salt, water and food coloring together in the small bowl. Pour the solution into the plastic container so that it's about 1" deep, as shown in illustration #1.
3. Carefully center the glass cup in the middle of the container, making sure that no salt water gets into the cup. (If the water level is too high, pour some out.)

Illustration #2

4. Loosely cover the top of the container with plastic wrap, placing the rock in the center, directly above the glass cup so that the plastic wrap sinks down as shown in illustration #2.
5. Tape around the edge of the plastic wrap to make sure the container is sealed.
6. Leave the container in the sun for several hours, checking on it every 30 minutes.
7. As time passes, what do you notice on the plastic wrap and in the glass cup? Draw a diagram comparing your model to Earth's water cycle.

About the Water Cycle

Where did you see evaporation, condensation and precipitation in your model?
"Precipitation is a vital component of how water moves through Earth's water cycle, connecting the ocean, land, and atmosphere. Knowing where, (how much, and the character of the falling rain, snow, sleet or hail) allows scientists to better understand precipitation's impact on streams, rivers, surface runoff and groundwater. Frequent and detailed measurements help scientists make models of, and determine changes in, Earth's water cycle. The water cycle describes how water evaporates from the surface of the earth, rises into the atmosphere, cools and condenses into rain or snow in clouds, and falls again to the surface as precipitation." — Excerpt from "Precipitation Education," Goddard Space Flight Center, NASA
https://pmm.nasa.gov/education/water-cycle



A Challenging Pollutant in the Water Cycle – Microplastics

"Microplastics are small plastic pieces less than five millimeters long which can be harmful to our ocean and aquatic life." – Excerpt from "What are Microplastics?" U.S. National Oceanic and Atmospheric Administration (NOAA)
https://oceanservice.noaa.gov/facts/microplastics.html

How does your model present a theory for how microplastics travel all the way to the Arctic?
"We found a lot of microplastics, like record concentrations, and the question arose: From where does the microplastic originate?" This is the question posed by marine biologist Gunnar Gerdts and he goes on to say, "there were only two likely suspects: it's from the water or from the air." – Excerpt from "Microplastic in the Atmosphere is Making its Way to the Pristine Arctic," *Los Angeles Times*, Aug 15, 2019
https://www.latimes.com/environment/story/2019-08-14/microplastic-is-significant-source-of-air-pollution

White and Wonderful? Microplastics Prevail in Snow from the Alps to the Arctic
https://advances.sciencemag.org/content/5/8/eaax1157

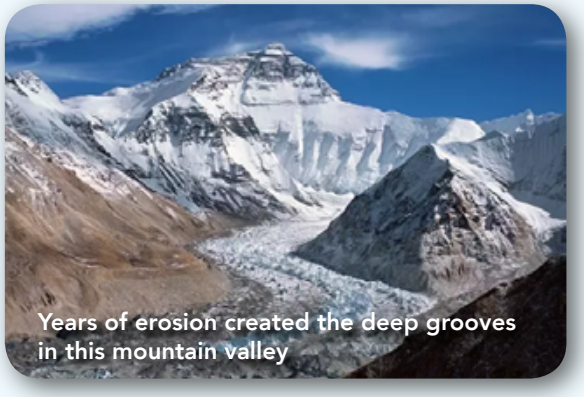
It's Not Just the Oceans: Microplastic Pollution is All Around Us
https://www.cnn.com/2018/04/22/health/microplastics-land-and-air-pollution-intl/index.html

Grades 6–8

Research Question

What can we do to protect our ecosystem from problems associated with soil erosion?

Here are some different ideas for researching how soil erosion affects our world and what you can do about it in your own backyard, plus some hands-on activities to understand how it happens.



Years of erosion created the deep grooves in this mountain valley

The Impact of Climate Change on Soil Erosion
https://www.agclimate.net/2015/04/04/the-impact-of-climate-change-on-soil-erosion/

9 Inexpensive Ways You Can Prevent Erosion
https://home.howstuffworks.com/green-living/inexpensive-prevent-erosion.htm

Soil Erosion and Degradation
https://www.worldwildlife.org/threats/soil-erosion-and-degradation

Erosion's Effect on Different Landforms
(hands-on activities)
https://www.youtube.com/watch?v=ZNJe6hrdL3M

How Erosion Builds Mountains
http://rgn.hr/~bruntom/nids_bruntom/PDF%20Strukturna%20geomorfologija/Pinter%20&%20Brandon.pdf

ACTIVITY 2

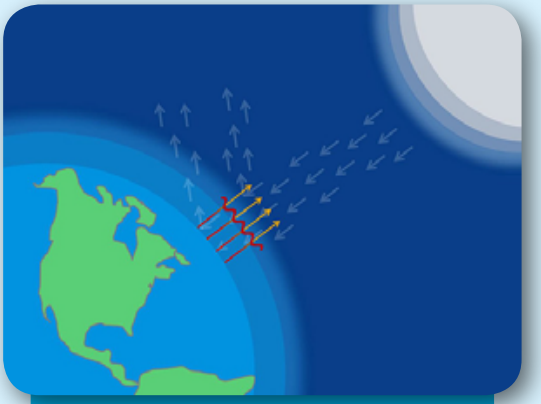
How does the "Greenhouse Effect" work?

Grades 3–5

Materials

You will need:

- one two-liter bottle with the top cut off for each team of students, and one "control" bottle for the class
- thermometer
- soil
- plastic wrap
- masking tape
- small plants
- other items selected by students to observe
- lamp
- stop watch



Earth's atmosphere traps some of the Sun's heat, preventing it from escaping back into space at night

What to Do

1. Put a layer of soil in the bottom of the bottles - the students' and the control.
2. Add the plants and any other small objects you would like to observe, making sure you put the same plants and objects in each, for an equal comparison.
3. Tape a thermometer inside each bottle, so that you can read it from the outside.
4. Tightly cover the top of one bottle with plastic wrap.
5. Place bottles under the lamp. Record the changes in temperature in each bottle every 60 seconds for five minutes. Note any changes to the plants or other items you chose. What do you observe?
6. Scientists are concerned about how human activity contributes to the Greenhouse Effect. How would you design a third bottle to represent that impact?

About the Greenhouse Effect

Which part of your model represents greenhouse gases?

"The greenhouse effect is a process that occurs when gases in Earth's atmosphere trap the Sun's heat. This process makes Earth much warmer than it would be without an atmosphere. The greenhouse effect is one of the things that makes Earth a comfortable place to live. … Human activities are changing Earth's natural greenhouse effect. Burning fossil fuels like coal and oil puts more carbon dioxide into our atmosphere. NASA has observed increases in the amount of carbon dioxide and some other greenhouse gases in our atmosphere. Too much of these greenhouse gases can cause Earth's atmosphere to trap more and more heat. This causes Earth to warm up." — Excerpt from "Climate Kids," NASA's Jet Propulsion Lab
https://climatekids.nasa.gov/greenhouse-effect/

Grades 6–8

Research Question

What scientific research is being done regarding human impact on the environment?

These sites have a wide variety of activities and videos to choose from, all on different subjects related to human impact on the environment. You can also find out how to volunteer or join a Citizen Science research project.

Human Impacts on the Environment
https://www.nationalgeographic.org/topics/resource-library-human-impacts-environment/?q=&page=1&per_page=25

Human Impacts and Resilience
https://serc.si.edu/research/research-topics/ecosystems-ecology/human-impacts-resilience

Environmental Data
https://serc.si.edu/environmental-data

Maps Show Humans' Impact on the Planet
https://www.nationalgeographic.com/news/2016/08/human-footprint-map-ecological-impact/

ACTIVITY 3

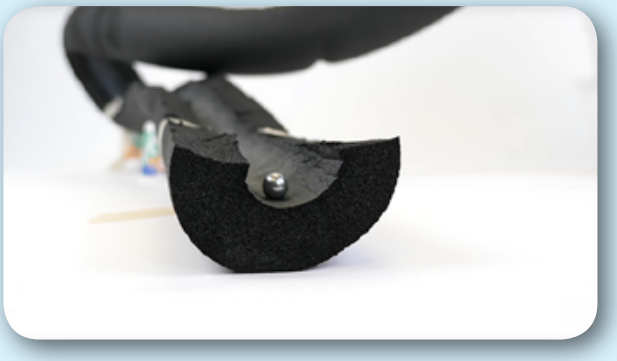
How is energy transferred from one form to another when an athlete skis or snowboards down a mountain?

Grades 3–5

Materials

You will need, for each team of students:

- *Mountain Adventure: Out of Bounds* video clip of Torah Bright snowboarding down the mountain (available to view at this link: **https://youtu.be/WHvMmGaNZOg**)
- pool noodles cut in half lengthwise
- masking tape
- chairs, school desks, books
- permanent marker
- marbles
- sand paper
- small cups
- stop watch
- measuring tape



What to Do

1. Watch the video clip from *Mountain Adventure*. Identify the points in the video where potential energy, kinetic energy and thermal energy can be observed.
2. Working in teams, use the pool noodle to create a ski jump for a marble to land in a cup. Attach the pool noodle to chairs, desks and/or books to stabilize it.
3. Try different ski run configurations to meet different challenges. Time the run and find out which ski run is the fastest. Measure the distance from the bottom of the run to the cup. Which ski run results in the longest jump for the marble?
4. How can you use sandpaper, masking tape or other materials to slow the marble down without stopping it?
5. Compare your ski run with other teams' runs for a classroom Winter Olympics.

About Transfer of Energy

Label the parts of your ski run where potential energy, kinetic energy and thermal energy can be observed.

"Energy is the ability to do work. Energy comes in different forms: Heat (thermal), Light (radiant), Motion (kinetic), Electrical, Chemical, Nuclear and Gravitational. There are two types of energy: Stored (potential) energy and Working (kinetic) energy." — Excerpt from "Energy Kids," U.S. Energy Information Administration
https://www.eia.gov/kids/energy.php?page=about_home-basics

Energy Transformation for Downhill Skiing
https://www.physicsclassroom.com/mmedia/energy/se.cfm

Grades 6–8

Research Question

What causes avalanches and how can they be controlled? How do they affect skiers?

In "Mountain Adventure: Out of Bounds" they discuss how dangerous a "cornice" – snow overhanging the edge of a mountaintop – can be. These sites will help you figure out why and also include hands-on avalanche simulations so you can see it for yourself.

The Science of Avalanches
https://sciencing.com/the-science-of-avalanches-13710358.html

The Science of Snow
https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5408133.pdf

Avalanche!
https://nrich.maths.org/7454

Why Skis Slide
http://www.mechanicsofsport.com/skiing/basic_mechanics/why.html

ACTIVITY 4

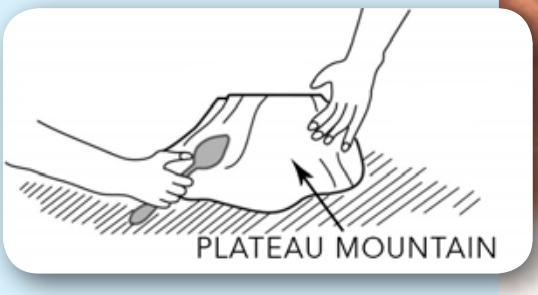
Grades 3–5

What kinds of mountains are featured in the film? Where are they?

Materials

You will need, for each team of students:

- two cups playdough
- photos of the 5 types of mountains pictured on the next page
- ruler
- 18" piece of fishing line or plain dental floss
- large piece of paper to create map
- newspaper
- pencil
- colored markers

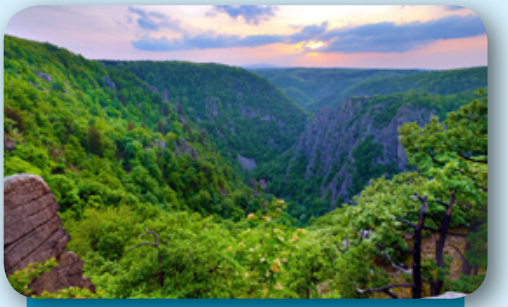


What to Do

1. Review the photos on the next page and draw a line from each mountain to the way it was formed.
2. Choose one of the five mountains for your topographic map. Find a map online with your mountain's height and the country and environment where it is located.
3. On the large piece of paper, indicate N, S, E and W directions on your map. Draw the ecosystem surrounding your mountain including vegetation and animals.
4. On the newspaper, shape the playdough into a fold, dome, fault-block, plateau or volcanic mountain. Check with others to be sure they can tell which of the 5 kinds of mountains you have made, and adjust your model if needed.
5. Measure the height of your mountain with the ruler, putting a mark at each inch. Compare the number of feet of the real mountain's height to the number of inches of your model and indicate on your map that xx inches = xx feet.
6. Hold the fishing line tightly with one end wrapped in each hand and carefully slice the top inch off the mountain.
7. Place that layer on your map and trace around it. Remove the layer.
8. Slice another one-inch layer off the top of your mountain. Center that layer over the first layer you drew on your map. Trace this new larger layer.
9. Repeat steps 5, 6, and 7 until you have sliced each layer of the mountain.
10. Take a tour of all of the students' topographical maps, so that they can present their findings.

FOLD MOUNTAINS:
Rocky Mountains, Colorado

DOME MOUNTAINS:
Half Dome, California



FAULT-BLOCK MOUNTAINS:
Harz Mountains, Germany

PLATEAU MOUNTAINS:
Columbia Plateau, Washington

VOLCANIC MOUNTAINS:
Mt. Ranier, Washington

Match the mountain with the explanation of how it was formed.

Formed from blocks of rock when the Earth's crust breaks apart

Formed by the folding of the layers of the Earth's crust

Formed by an explosion of hot magma bulding up under the surface of the Earth

Formed by erosion when water and wind wear away at the surface of the Earth

Formed by an explosion of hot magma, covered by the Earth's crust and cooling into a rounded shape

About the Five Different Mountain Formations

- Dome Mountains are formed similarly to volcanoes, except that instead of resulting in an eruption, the Earth's crust covers the magma (called lava when it erupts into the air) and it cools into a dome shape. An example of a dome-shaped mountain is Half Dome in the Sierra Nevada range in California.
- Fault-Block Mountains, like most of the Sierra Nevada range in California, are formed from blocks of rock when the Earth's crust breaks apart.
- Fold Mountains, like the Rockies in Colorado, are formed by the folding of the layers of the Earth's crust.
- Volcanic Mountains, like Mt. Ranier in Washington, are formed by an explosion of hot magma bulding up under the surface of the Earth.
- Plateau Mountains, like the Piedmont Plateau in the Eastern United States, are formed by erosion when water and wind wear away at the surface of the Earth.

For more information, visit:

"Types of Mountains," Universe Today
https://www.universetoday.com/29771/types-of-mountains/

"How Topographic Maps are Made," Illinois Institute of Technology
https://web.iit.edu/sites/web/files/departments/academic-affairs/academic-resource-center/pdfs/topograph.pdf

Grades 6–8

Research Question

How do changes in mountain environments impact food webs, drive competition among organisms or create limitations?

That's a big question! We suggest you browse the websites below and others you find on your own to narrow this down to a particular area of research – mountain environments, food webs, competition among organisms, or something related that sparks your interest.

How are Food Chains and Food Webs Alike and Different?
https://sciencing.com/food-food-webs-alike-different-6192951.html

Climate Impacts on Ecosystems
https://archive.epa.gov/epa/climate-impacts/climate-impacts-ecosystems.html

These Animals Thrive in Extreme Mountain Conditions
https://www.nationalgeographic.com/animals/2019/03/extreme-animals-that-live-in-mountains/

ACTIVITY 5

Penguins, whales and people – How do we all stay warm?

Grades 6–8 Activity Leaders
Grades 3–5 Participants

This group of activities is designed for an Animal Adaptations Science Fair with four hands-on stations in which older students teach younger students. The activities can also be used for regular classroom time.

Blubber

You will need: shortening, ice water, large bowl, large plastic bag, small plastic bag, stop watch, towels

1. Fill the large bowl with ice water.
2. Cover the inside of the large plastic bag with shortening.
3. Wrap one hand in the small plastic bag and stick it inside the large plastic bag so that your hand is covered by the shortening, like a layer of fat.
4. Stick both hands in the ice water and set the stop watch. What happens?

Reflection and Absorption

You will need: black paper, white paper, 2 rubber bands, 2 plastic containers, 2 ice cubes, sunshine

1. Wrap black paper around the outside of one of the plastic containers and white around the other. Secure each paper with a rubber band.
2. Put an ice cube in each container.
3. Set both containers in the sun. What do you notice?

Insulation

You will need: sock, plastic bag

1. Remove your shoes, put a plastic bag over one of your socks, and then a second sock on top of the bag.
2. Leave the other sock as it is. Do your feet feel different?

Air

You will need: large plastic cup with the bottom cut out of it, 2 resealable plastic bags, 2 ice cubes, cookie sheet

1. Put each ice cube in a resealable plastic bag.
2. Position one ice cube (in the resealable bag) with the bag hanging over the side of the cup so that the ice cube is suspended inside, surrounded by air. Place the cup on the cookie sheet, making sure the ice cube doesn't touch the cookie sheet.
3. Place one ice cube (in resealable bag) directly on the cookie sheet. Observe the changes in the two ice cubes.

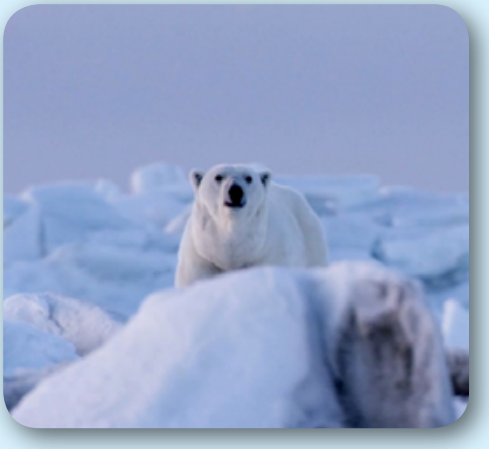
About Staying Warm

In the activities above, which method animals use to stay warm surprised you? Why?

"When it is cold outside, you put on more clothes. Your winter coat does not keep out the cold, but rather keeps in the heat. … Birds and mammals also rely on insulation to prevent heat loss. The most effective insulation traps air, since air is one of the best insulators. Wool tends to be warm because its fibers are curled, effectively trapping air and keeping you (and sheep) warm. Birds fluff up their feathers when they want to stay warm, since fluffing introduces air.

For mammals without hair, insulation is accomplished by blubber, a thick layer of fat tissue which helps to insulate an animal's body because fat does not transfer heat as well as muscle and skin. This blubber may be two feet thick in some whales!" — Excerpt from "Chilling Out, Warming Up," American Chemical Society
https://www.acs.org/content/acs/en/education/resources/highschool/chemmatters/past-issues/archive-2013-2014/animal-survival-in-extreme-temperatures.html

See more examples at: "How do birds stay warm in the winter?"
https://www.fws.gov/midwest/news/WinterWarmth.html



This baby sea lion's blubber keeps her warm as she naps on the ice

Grades 6–8

Research Question

How do changes in a mountain environment impact the organisms that live there and the ecosystem as a whole? Can these changes also impact humans?

What questions come to mind when you read the quote below? Dig up the scientific studies that are the basis for this information.

"Mountain ecosystems in the western U.S. and the Northern Rockies in particular are highly sensitive to climate change. In fact, the higher elevations of the Northern Rockies have experienced three times the global average temperature increase over the past century. These same ecosystems provide up to 85% of the water humans depend on as well as a host of other ecosystem services such as snow-based recreation, timber, unique flora and fauna, and critical habitat for rare and endangered species such as bull trout and grizzly bear." — Excerpt from: "Climate Change in Mountain Ecosystems," US Geological Survey
https://www.usgs.gov/centers/norock/science/climate-change-mountain-ecosystems-ccme?qt-science_center_objects=0#qt-science_center_objects

Introduction to Mountain Ecosystems
https://www.nps.gov/noca/learn/nature/bio-diversity1.htm

Mountain Habitat
https://kids.nationalgeographic.com/explore/nature/habitats/mountain/

Next Generation Science & Geography Standards and Related Activities for *Mountain Adventure: Out of Bounds*

Activity 1: How does the water cycle impact mountain habitats and what danger do microplastics cause?

- **4-ESS 2-1. *Earth's Systems.*** Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.
- **MS-LS2-5. *Ecosystems.*** Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
- **Geography Element III-7. *Physical Systems.*** The physical processes that shape the patterns of Earth's surface.

Activity 2: How does the "Greenhouse Effect" work?

- **MS-ESS2-2. *Earth's Systems.*** Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
- **5-ESS3-1. *Earth & Human Activity.*** Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

Activity 3: How is energy transferred from one form to another when an athlete skis or snowboards down a mountain?

- **4-PS3-3. *Energy.*** Ask questions and predict outcomes about the changes in energy that occur when objects collide.
- **MS-PS3-5. *Energy.*** Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

Activity 4: What kinds of mountains are featured in the film? Where are they?

- **4-ESS2-2. *Earth's Systems.*** Analyze and interpret data from maps to describe patterns of Earth's features.
- **5-LS2-1. *Earth & Human Activity.*** Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
- **Geography Element I-1. *The World in Spatial Terms.*** How to use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective.

Activity 5: Penguins, whales and people – How do we all stay warm?

- **4-LS1-2. *Structure, Function, and Information Processing.*** Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

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