

Exploring the KU Natural History Museum

Weather across Space and Time

Target Audience: Middle school and above

Differentiated Instruction Summary

Strategy	Levels	Content/Process/Product	Grouping(s)*
Cubing	Learning modalities <ul style="list-style-type: none">• Level 1 – visual/spatial• Level 2 – body/kinesthetic• Level 2 – verbal/linguistic	Process Product	Small groups Peer partners Homogeneous Heterogeneous

* Varied grouping options can be used for this activity, depending on student needs and chaperone ability.

Objective: Investigate weather/climate variables over time and geographic locations, and its impact on adaptation.

Pre-assessment/Prior Knowledge: Prior to their visit, students should be familiar with the distinction between weather and climate, and weather/climate related variables such as sunlight, precipitation, wind, temperature, etc.

Activity Description: A cubing activity that explores weather through the framework of natural history—variation across time and space. This includes local weather conditions, differences in weather related variables across geographical contexts both current and historical, and their connection to organismal adaptations.

Materials Needed:

- Student
 - Cubes (three levels, see attached)
 - Paper and pencils (alternatively you could use flipchart paper and markers, whiteboards and dry erase markers)
 - Optional (cell phones or other recording device for visual or kinesthetic levels)

Note: Format to record/present findings determined by individual teacher. Provide clear instructions about expectations for documenting participation, particularly for verbal/spatial and body/kinesthetic levels (e.g. stage direction, audio/video recording).

- Teacher
 - Content Outline
 - Cube labels
 - Cube template

Content: Weather Present and Past

Numerous factors influence weather conditions across different geographic regions such as temperature, sunlight, wind, and precipitation. The distinction between weather and climate is one of time; weather typically refers to current conditions and short periods of time, and climate takes a longer view of weather patterns. Adaptations observed in organisms reflect these current and historical weather/climate variables.

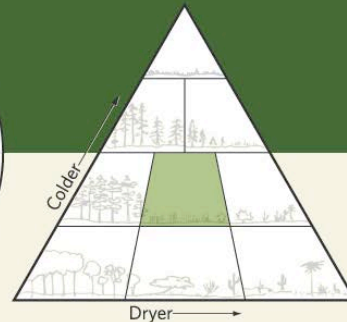
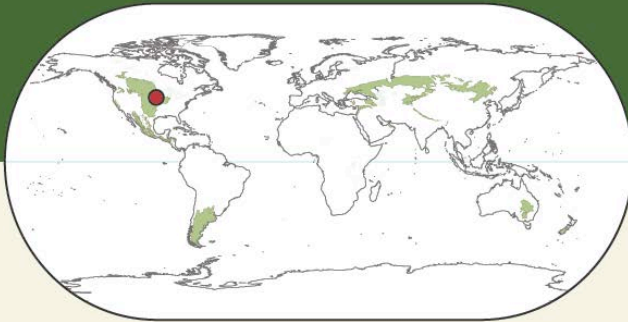
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Content: Museum Exhibits with Weather/Climate Depicted


Museum Floor	Example exhibits
Fourth Floor (Panorama)	See example zone summary, and copies of zone labels in the section below
Third Floor Fossil Galleries and <i>Bugtown</i>	Dinosaur (with <i>Triceratops</i>); Kansas dinosaurs; Late Devonian fish, <i>Dimetrodon</i> , Permian amphibians; Turtles/Tortoises; several ice age mammal exhibits; giant squid & ammonite
Fifth Floor <i>Explore Evolution</i>	Finches, ants
Sixth Floor Plants and Animals of the Great Plains; Darwin and tree evolution exhibit	Numerous dioramas of plants and animals

Content: Panorama Zone Example Summary (Short-Grass Prairie)

THE GREAT PLAINS was once the largest grassland on Earth. Plant life in this region is adapted to an environment with irregular rainfall, high winds and frequent fires. As a result, plants need little water and have extensive root systems that prevent soil erosion. Trees and large shrubs have difficulty overcoming the extremes, leaving little cover above ground for animals. This forces the animals to use other methods to hide from predators, such as burrowing.



 80°F summer (27°C)
0°F winter (-18°C)


 12–40 in. per year (30–100 cm)

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Content: Panorama Zones Weather/Climate (from left to right or north to south)

Arctic Coast Panels


THE ARCTIC COAST is along the ice-covered Arctic Ocean, beyond the tundra. Winters bring constant darkness, cold temperatures and clear skies. Summers bring continuous daylight but foggy conditions, rain and snowstorms prevail. Despite the endless cold, this area contains the world's largest remaining untouched ecosystems and is home to marine mammals and other aquatic species.



50°F summer (10°C)
-30°F winter (-34°C)

4-100 in. per year (10-254 cm)

Arctic Coast




Furry Torpedo
The seal's body shape—a round middle, tapered at each end—is well adapted for aquatic life. The seal's keen eyesight and hearing enable it to pinpoint prey in the vast ocean. Harp seals only come ashore to mate, and they are known to swim thousands of miles between breeding seasons. Although well suited to life in the oceans, seals are slow on land and become easy prey for polar bears and humans.


SPECIES SPOTLIGHT

Tiny Organism, Huge Impact
Tiny organisms called plankton are the foundation for all living species in the Arctic. There are two main types of plankton: phytoplankton and zooplankton. Phytoplankton are plant-like and depend on photosynthesis for energy. Zooplankton are animal-like and eat plankton and other material for energy.

When Arctic Ocean temperatures rise, plankton species found in warmer waters move into an area, changing the diversity of plankton. These non-native, or invasive, species compete with existing species for sunlight and nutrients. Animals that rely on the dwindling native populations are at risk and either die or change to a less nutrient-rich diet. This in turn can affect many other Arctic species.




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4-100 in. per year (10-254 cm)


Arctic Coast



Warm and Fuzzy
Polar bears have thick, oily, water-repellent fur and insulating fat that keeps them warm in and out of the Arctic water. Although their skin is actually black, each hair is a hollow transparent tube reflecting all light, making the fur appear white. Their paws have rough hairy soles that provide traction and insulation, and they have sharp claws for digging shelters and catching prey. White front paws with slightly webbed toes make them excellent swimmers.

FEATURE SPOTLIGHT

Chill Out
Floating masses of frozen salt water known as sea ice dominate the Arctic region. Wind and ocean currents keep some of this ice in constant motion. Another type of ice is called fast ice, which is ice that is fastened to the shore. Arctic fox, caribou, seals, polar bears and other animals forage for food, breed and rest on the ice throughout the Arctic.



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Arctic Tundra Panel

THE ARCTIC TUNDRA is one of the coldest and harshest environments on Earth. A small number of animals and plants have adapted to survive there. Because the ecosystem's food web is limited, damage to any element of this fragile system can have a rapid and dramatic, chain reaction. The permafrost, a thick layer of permanently frozen soil underlying the entire region, is showing evidence of deterioration from climate change.

45°F summer (7°C)
-30°F winter (-34°C)

6-10 in per year (15-25 cm)

Arctic Tundra

Vitamin C
The chauliophora is a common fruit-bearing plant found primarily in cold, mountain climates with moist environments and plenty of sunlight. Its vibrant colored berries are prized as a delicacy. But the plant has to become widely cultivated. Rich in vitamin C, the berries are prized to help animals and people.

Hairy Beast
Muskeeters are a furry species, some resembling wolf-dogs and raccoons. In the early 20th century before they were given protection by the Canadian government, muskeeters were almost hunted to extinction for their fur. The animal's distinctive change coat is made of 40 to 100 long guard hairs that protect the animal from cold temperatures, wind and precipitation. During the winter, a second layer of thick insulating undercoat called guard hair or "fleece" grows. This fur is eight times warmer than sheep's wool.

SPECIES SPOTLIGHT

Light Leach
Light leach are small, rarely seen fish that stay on mountain lakes in the tundra environment. Many populations of light leach in a single stream have different genetic profiles. The fish are unable to move where they like because the terrain is so steep, limiting genetic exchange that could help the fish better adapt to their environment. Light leach are thought to be among other populations directly because the fish have been found in the same stream in the same area.

Boreal Forest Panels

THE BOREAL FOREST is the world's largest ecological region, covering approximately 14.5% of the Earth's land surface. Winters last more than five months, they are short and average temperatures are just below freezing. Drought for six months helps animals in this region stay warm and some hibernate during the coldest parts of the year. Plants in the forest have adapted to use resources quickly when they are available.

22°F summer (4°C)
-14°F winter (-10°C)

10-20 in per year (25-50 cm)

Boreal Forest

The Dominators
Larches, in comparison, have an adapt for cold, dry environments with short growing seasons. They dominate the boreal forest. By retaining leaves year-round, larches don't have to produce an entire set of leaves each spring and can use sunlight to produce food or photosynthesize, whenever conditions are favorable. Conifer leaves are small and this helps them keep cool that helps retain moisture and nutrients. The vertical shape of the tree also sheds snow, which prevents branches from breaking.

Fancy Feet
As an animal walks on top of thick frozen ground and breaking it from stepping on soft ground in winter. Deer select a raised edge grows around the outside of each hoof, enabling it to grip the walking stick for a sharp edge to cut through snow or thin frost. During quiet and still mornings, these sharp air trapped between hooves also make excellent padding for cushioning some snow and larch.

SPECIES SPOTLIGHT

Foot Foot
The snowshoe hare is an important food source for many predators in the boreal forest. It has a white winter coat and a brown summer coat. The hare's population fluctuates in a regular cycle that is linked to the population of its predator, the Canada lynx. The hare's white winter coat helps it blend in with the snowy ground while the brown coat helps it blend in with the forest floor during the summer months.

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22°F summer (4°C)
-14°F winter (-10°C)

10-20 in per year (25-50 cm)

Boreal Forest

Yea Time
Larches make up an abundant, live-growing part of a deciduous forest. They are known for their yellow and red autumn foliage. The plant contains a compound known as methyl salicylate, similar to aspirin, which helps the plant repel insects and pathogens. Today, wintergreen oil derived from the plant is used in many products.

Yin Cushion
The North American porcupine can live in forests, forest prairie or even in open land. Porcupines are present in forest prairie for about 100,000 years, which are usually modified forests. The quills are hollow with a soft base and tip that is barbed. Once introduced to the western U.S., the barbs caught and work their way deeper into the body. Porcupines are adapted to make status mostly dormant. Certain porcupine habitat they inhabit about or three feet tall.

SPECIES SPOTLIGHT

Wintering Snacks
Larches are known for their yellow and red autumn foliage. The plant contains a compound known as methyl salicylate, similar to aspirin, which helps the plant repel insects and pathogens. Today, wintergreen oil derived from the plant is used in many products.

Rocky Mountains Panel

THE ROCKY MOUNTAINS region encompasses a wide range of habitats and ecosystems. The region's diverse topography, including high mountain peaks, deep valleys, and extensive river networks, creates a complex and varied landscape. The region's diverse topography, including high mountain peaks, deep valleys, and extensive river networks, creates a complex and varied landscape.

54°F summer (12°C)
-14°F winter (-10°C)

15-40 in per year (38-100 cm)

Rocky Mountains

Reclaiming Land
The Rocky Mountains are a major mountain range in western North America. The range is home to a wide variety of plants and animals, including many species that are found nowhere else. The range's diverse topography, including high mountain peaks, deep valleys, and extensive river networks, creates a complex and varied landscape.

Rock Buggers
The North American porcupine can live in forests, forest prairie or even in open land. Porcupines are present in forest prairie for about 100,000 years, which are usually modified forests. The quills are hollow with a soft base and tip that is barbed. Once introduced to the western U.S., the barbs caught and work their way deeper into the body. Porcupines are adapted to make status mostly dormant. Certain porcupine habitat they inhabit about or three feet tall.

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Prairie Panel

THE GREAT PLAINS was once the largest grassland on Earth. Plant life in this region is adapted to an environment with long, cold, high winds and frequent frost. As a result, plants need little water and have extensive root systems that prevent soil erosion. Trees and large shrubs have difficulty surviving the extremes, leaving little cover above ground for animals. This forces the animals to use other methods to hide from predators, such as burrowing.

80°F summer (27°C)
0°F winter (15°C)

14-16 in per year (36-41 cm)

Prairie

Deep Drinkers
Prairie grasses grow from a root or tap root below the soil surface, which prevents their winter growth leaves from grazing, fire and the elements. Up to two-thirds of their total living material, or biomass, is below ground in the form of extensive roots. Some prairie plant roots grow 15 ft (4.6 m) or more down to access moisture deep underground during regular dry periods. The roots absorb carbon dioxide as the grass grows, making these grasses with low carbon levels.

Burrowing Underfoot
With their elaborate burrow systems, prairie dogs play a vital role in their ecosystems. They support ecosystems and other species of animals. Prairie dog burrows, or tunnels, provide shelter for other animals and help aerate the soil. Prairie dogs are an important food source for numerous predators. Unfortunately, many prairie dogs have been killed by poachers and they struggle for resources in an attempt to rebuild the animals.

Short-Grass Prairie Panel

THE SHORT-GRASS PRAIRIE is dominated by short blue grama and buffalograss. These grasses have adapted to the dry conditions and resistant soil of the mountains that prevent other grasses and trees from growing. The Rocky Mountains force the air to be more arid than other prairie ecosystems. As air is forced up over the western slope of the Rockies, it cools and water vapor condenses to form rain. This leaves less moisture for the land on the eastern side.

80°F summer (27°C)
0°F winter (15°C)

13-24 in per year (33-61 cm)

Short-Grass Prairie

Team Player
Coyotes are highly adaptive animals that once were widely distributed across the prairie. They are fast and hunt in packs of four to seven animals. They communicate with each other through howling, barking, and growling. Coyotes will take advantage of the herds' vulnerability and wait nearby to chase down any group of animals. The short-horned bighorn sheep is a prey of the coyote and will stay a large number of miles throughout its range during its lifetime.

Tim Foundation
Blue grama grass is a dominant grass in the short-grass prairie in many areas, including Kansas. It grows in areas that have the least soil and the greatest soil alkalinity and salinity. The short-grass prairie is a very dry area and the grasses have adapted to these conditions. If the prairie is disturbed, it can take 10 years or more to rebuild and the grass may never return to its density.

Eastern Deciduous Forest Panel

DECIDUOUS forests are found in temperate regions worldwide. Deciduous, or broad-leaf, trees lose their leaves each winter or dry season. They have high summer demands because their growth cycle is to survive the falling leaves provide an abundance, with sparse of nutrients. The leaves then rapidly reach spring just at the growing season begins. Great fluctuations in temperature and precipitation are the driving force behind plant and animal adaptations in this ecological region.

70°F summer (21°C)
25°F winter (4°C)

30-60 in per year (76-152 cm)

Eastern Deciduous Forest

Changing Leaves
Perhaps the most noticeable adaptation for deciduous plants comes each fall, when their leaves change color and fall off to prevent ice from the winter. Leaves are the food factories of plants. They use sunlight to take water and carbon dioxide into regions and glucose, a kind of simple sugar to make plant tissue. In the autumn, the chlorophyll in leaves that produces green color has been broken by the more abundant green chlorophyll.

Play Dead
Capable of adapting to a wide variety of forest habitats, the common opossum is found in rural and urban environments. It is capable of playing dead, an ancient, inconspicuous defense that by feigning death and appearing to be dead, its eyes and mouth remain open, and it emits a foul-smelling liquid from its anal. Opossums can remain in this state for up to four hours, "playing possum."

A Girdling Tree
Can be seen around the eastern deciduous forest and common. The tree grows rapidly. It will not tolerate poor soil and is a very common tree. The quality of water is mostly good. But in some areas, the tree is not as common as in other areas. It is a very hardy tree and can survive in many places. It is a very common tree and can be seen in many places.

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Sonoran Desert Panel

THE SONORAN DESERT is the most biologically diverse and hottest of the four major North American deserts. The latter three are the Great Basin, Mojave, and Coloradoan. A tropical, or semi-tropical, rainfall pattern of winter storms from the Pacific and frequent summer droughts provide additional moisture that increases the diversity of vegetation and animal life in this desert.

80°F summer (26°C)
32°F winter (0°C)

3-12 in per year (76-304 mm)

Sonoran Desert

Water Towers

The Sonoran desert is also unique in the world of semi-arid regions for its water towers. These cacti reach heights of 30-40 ft (9-12 m) in addition to a dense network of roots that extends to a depth of 100-200 ft (30-60 m) in the soil. When it rains, the roots can soak up enough water to keep the plant alive for up to a year of drought. The water towers are estimated to be 100-200 years old.

Species Eating and Drinking

Many mammals find an easy meal in seeds, berries, cactus and eggs. However, several animals, on top of the threat of food being scarce in one year and then the next, choose to be in their fall. They can drink enough water in one day to keep their body weight for 200% and more in their bladder. Their ability to store food and water and their metabolism can allow them to stay hidden and inactive for several weeks at a time.

SPECIES SPOTLIGHT

Dig and Disperse

Kangaroo rats build tight, complex tunnels with an entrance to the surface. They are specialists at finding and storing seeds. They often live in groups and dig and store food for the winter. They can store food for up to a year. They are also known for their ability to store water in their bladder. They are also known for their ability to store food and water in their bladder. They are also known for their ability to store food and water in their bladder.

Tropical Rainforest Panel

TROPICAL RAINFORESTS are located near the equator and cover around 7% of the Earth's land surface. Rain is frequent and abundant. However, the leafy tops, or canopy, block most of the sunlight and water from reaching the ground. Biomes on the forest floor are diverse, and nearly half of all known plant and animal species live in rainforests. The same before you depicts rainforests found in Central and South America.

93°F summer (34°C)
68°F winter (20°C)

50-260 in per year (1270-6604 mm)

Tropical Rainforest

Howling to be Heard

The howl you hear all of the birds, including can be heard through the dense forest canopy up to three miles away. The howl and howling call that makes sound through the forest. The howl you hear all of the birds, including can be heard through the dense forest canopy up to three miles away. The howl and howling call that makes sound through the forest.

Species Hanging Out

The common marmoset has spent most of its time in being using its long claws and prehensile, or grasping, tail to cling to branches. Marmosets have poor vision but a keen sense of smell that they use to sniff out their favorite foods—ants and termites. They use their powerful prehensile tail and strong claws to grip onto and swing onto and to up the branch with their long, curved, sickle-shaped tail. Marmosets do not have teeth and depend on a membrane gland to break down their food.

SPECIES SPOTLIGHT

Killer Grip

The strangler figs are an important food source for many rainforest animals. Fig trees produce fruits around the base of a tree. Strangler figs can climb, hang and branch out. The trunk and branches spread through tree canopies. The roots spread to connect between branches of other trees, sending roots down to the ground and then they can climb the light. The tree then grows up into the canopy and eventually kills the host tree to live on its own.

LIVE HOST

DEAD HOST

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Materials: Cube Labels

Museum Cubing Level 1 (Visual)

<p>DRAW a picture that shows the light & wind conditions you observe over a 10 minute period outside the museum</p>	<p>GRAPH <u>two</u> weather related variables as you move from the Arctic to the rainforest (4th floor Panorama)</p>	<p>CREATE a diagram to show <u>three</u> factors that explain temperature differences between the Arctic, desert & rainforest (4th floor Panorama)</p>
<p>SKETCH an organism on exhibit that has an adaptation that provides protection from extreme climate conditions (e.g. lots of sun, extreme cold)</p>	<p>PLOT how precipitation changes through the seasons the prairie</p>	<p>DRAW a scene from an exhibit, <u>and</u> then what you might expect to see happen over time if the climate were to change</p>

Museum Cubing Level 2 (Physical)

<p>MOVE yourself to show the light & wind conditions you observe over a 10 minute period outside the museum</p>	<p>MODEL <u>three</u> factors that explain temperature differences between the Arctic, desert & rainforest (4th floor Panorama)</p>	<p>MODIFY a piece of paper (e.g. spare cube) to show how precipitation changes through the seasons in the prairie</p>
<p>FIND an example of a plant <u>and</u> animal on exhibit with adaptations that provide protection from extreme climate conditions (e.g. lots of sun, extreme cold)</p>	<p>MIME a story about climate changes that are linked to an extinction event highlighted in a exhibit</p>	<p>FIND <u>five</u> fossil exhibits that depict historical climate conditions, <u>and</u> then WALK between all of them in order of lowest to highest overall temperature (3rd floor)</p>

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Museum Cubing Level 3 (Verbal)

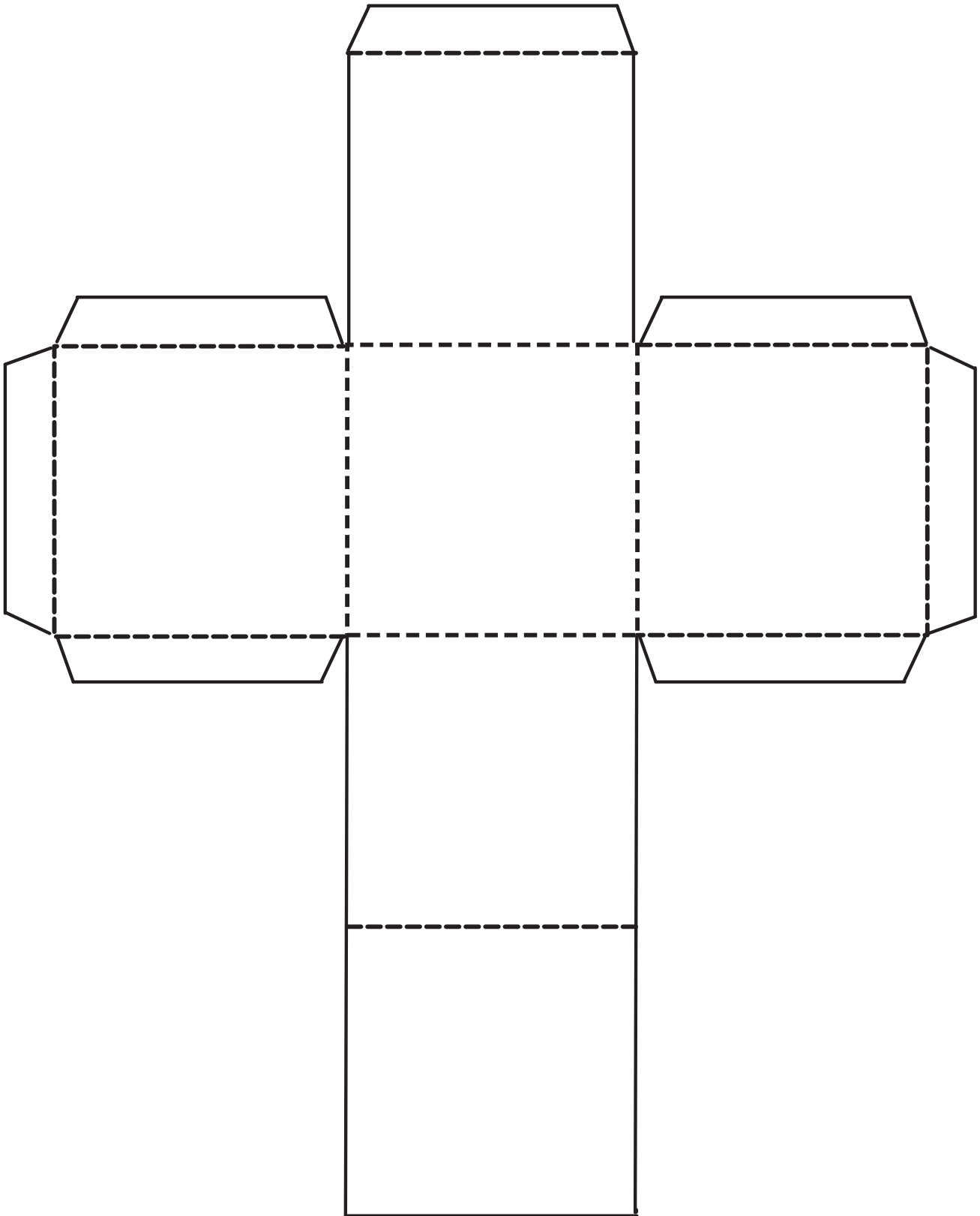
<p>DESCRIBE an adaptation that provides protection from climate conditions in an organism on exhibit (e.g. lots of sun, extreme cold)</p>	<p>TELL a story that recounts your observations of the light & wind conditions for a 10 minute period outside the museum</p>	<p>SING a song about the climate depicted or described in <u>two</u> exhibits from different time periods, <u>and</u> how the climate is the same or different (3rd floor)</p>
<p>RECORD & COMPARE <u>three</u> factors that explain temperature differences between the Arctic, desert & rainforest (4th floor Panorama)</p>	<p>WRITE a poem that describes how precipitation changes through the seasons in the prairie</p>	<p>Create a CHART that contrasts <u>three</u> weather variables that change as you move from the rainforest to the Arctic (4th floor)</p>

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Materials: Cube Template

Cube Pattern

Cut on solid lines - Fold on dashed lines



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Rubric: Weather Present and Past

Item	Needs further support	Meets Expectations	Exceeds Expectations
Weather outside	Addresses basic information on weather conditions	Provides detailed description of conditions	Provides detailed description of conditions
Weather variables	Addresses most variables outlined in exhibit panels	Addresses all variables outlined in exhibit panels	Incorporates factors beyond those outlined in exhibit panels
Temperature in Zones	Addresses most variables outlined in exhibit panels	Addresses all variables outlined in exhibit panels	Incorporates factors beyond those outlined in exhibit panels
Prairie precipitation	Addresses most but not all forms of precipitation	Includes a description of all forms of precipitation	Provides a rich description of all forms of precipitation, and make links to factors that influence change
Extreme/Weather change	Provides a basic description of weather/climate conditions before and after event/change	Provide good descriptions of conditions before and after event/change	Provides strong comparative descriptions before and after event/change
Adaptation	Provides a brief statement about an organism and its adaptation	Provides a description of an adaptive feature found in an organism on display, and notes connection to severe weather condition	Provides a full description of adaptive feature found in an organism on display, and makes clear link to severe weather condition