WINTER ADAPTATIONS CHALLENGE

Challenge Goal: To learn more about how animals have adaptations to live in cold environments, and to test how fast heat is lost in large and small objects.

Materials:
- two containers of the same type, one small & one large
  - tin cans, mugs, glass jars, etc.
- a thermometer
- hot water - CAUTION: ASK AN ADULT FOR HELP WHEN USING HOT WATER

Instructions:
1. Make a hypothesis: In a cold environment, which would lose heat and grow cold faster, a small object or a large object? Record this on your data page.
2. Place a thermometer in the small container and fill the container with hot water.
3. On your data table, record the starting temperature of the hot water.
4. Wait 1 minute and record the temperature. Repeat for 8 minutes.
5. You should now have 9 temperature recordings for your small container on the data table.
6. Repeat steps 2 - 5 for the large container.
7. Which container lost heat and grew cold faster, small or large?

ABOVE & BEYOND

Graph your results! Use the blank graph to plot the heat loss data from your data table.
ADAPTATIONS: SIZE, SHAPE & HEAT

What is adaptation? The process of physical or behavioral change that helps an animal survive in its environment. Let’s explore how animals have adapted to live in cold environments!

BERGMANN’S RULE

Birds and mammals are larger in colder environments than warmer.

The Earth is warmest at the equator, so as you move away from the equator, animals at higher latitudes will be larger.

FOR EXAMPLE

A kit fox has short, brown fur and large ears. An adult fox weighs 4 to 6 lbs on average. They live in the deserts of southwest North America.

An arctic fox has long fur that changes from brown to white in the winter, and short ears. An adult fox weighs 6.5 to 17 lbs on average! They live in the arctic tundra of North America.
ADAPTATIONS: SIZE, SHAPE & HEAT

ALLEN’S RULE
The "stubbiness" of an animal's shape increases in colder environments.

FOR EXAMPLE
A black-tailed jackrabbit has short brown fur, long legs, and very long ears. They live in the hot deserts of North America.

A snowshoe hare has long fur that changes from brown to white in the winter, and fairly short ears. They live in upper montane and boreal forests.

Why would larger, "stumpy" animals hold onto heat so much better than smaller, long animals? This has to do with the surface area to volume ratio.

Small objects have a large surface area compared to their volume. Animals that are smaller, or have long ears and limbs, have a larger surface area so it is easier for them to lose heat.

The opposite is true for large, stumpy animals that survive so well in the arctic! Because of their large size, they have a greater volume that holds onto heat well. By having stumpy limbs, their surface area is smaller so they don't lose heat as quickly!
Use the table below to record the water temperature at 30 second intervals for both the large and small containers. Which one loses heat the fastest?

**HYPOTHESIS:** ________________________________

______

<table>
<thead>
<tr>
<th>TIME</th>
<th>SMALL CONTAINER TEMPERATURE</th>
<th>LARGE CONTAINER TEMPERATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>START</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 MIN</td>
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<td>2 MIN</td>
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<td>3 MIN</td>
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<td>4 MIN</td>
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<td>7 MIN</td>
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</tr>
<tr>
<td>8 MIN</td>
<td></td>
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</tr>
</tbody>
</table>
Graphing Sheet

Use the chart below to plot your information from your data sheet and graph your results. Make sure to include the units for temperature on the y axis.

Change in Temperature over Time

TIME (MINUTES)

TEMPERATURE