

ECOS Inquiry Template

1. CONTRIBUTOR'S NAME: **Hannah Elliott**
2. NAME OF INQUIRY: **Winter Animal Adaptations: What Body Shape Stays Warmest?**
3. GOALS AND OBJECTIVES:
 - a. Inquiry Questions: **What body shape loses heat faster, flat or round?**
 - b. Ecological Theme(s): **Winter Animal Adaptations**
 - c. General Goal: **Understand that different animals have different adaptations to their environments.**
 - d. Specific Objectives: **Understand why birds in cold climates are round, and how some birds are able to stay in Montana for the winter.**
 - e. Grade Level: **K-3**
 - f. Duration/Time Required:
 - Prep time **at most 1 hour**
 - Implementing Exercise During Class **30-45 minutes**
 - Assessment **10 minutes**

4. ECOLOGICAL AND SCIENCE CONTEXT:

- a. Background (for Teachers):

All wintering animals have adaptations for dealing with cold, including insulation in the form of hollow fur or feathers and/or lots of fat. Body surface area is an adaptation that can have a large effect on heat loss or gain. Birds such as

- **Bergmann's Rule states that northern species of a particular genus or similar class of birds or mammals tend to be larger in size, although this is not always true. Larger body size means a higher body mass-to-surface area ratio. It's easier to retain heat. Polar bears are larger than tropical bears. White-tailed deer in Michigan dress out at higher weights than their counterparts in Texas or Florida. (Cook 2001 <http://www.dsisd.k12.mi.us/mff/Environment/WinterAnimals.htm>)**

Types of heat loss:

- **conduction - heat escapes from your body when you sit on a cold rock.**
- **convection - cooler air currents remove heat from the surface of your skin.**
- **[evaporation](#) - evaporative cooling occurs when water (often from perspiration) leaves the skin surface as a gas, lowering the body temperature by taking the heat of evaporation from the body. (Wikipedia)**

- b. Background (to present to Students):

First have students think about animals they see in Montana in the winter and animals they have heard about or seen in hot climates (deserts or tropical). Are there differences in overall shape, if so, what?

Ask students what they think would cool faster, a slice of pizza or the same pizza rolled up into a ball?

5. MOTIVATION AND INCENTIVE FOR LEARNING:

**This lesson answers simple questions young students may ask.
Playing with water and thermometers is always fun!**

6. VOCABULARY:

Heat Loss: Lowering of temperature of an object as a result of a difference in temperature between the object and its environment (e.g. cool air).

Body Shape: Three dimensional shape of an animal (e.g. spherical: pidgeon, torpedo: penguins and owls, slender: mockingbirds and hummingbirds)

Surface Area: summation of the areas of the exposed sides of an object (Wikipedia) i.e. area of the outside surface of an object

7. SAFETY INFORMATION:

Many thermometers are made of glass, which breaks easily when dropped and must be disposed of carefully if it is broken. Thermometers also sometimes contain mercury, a carcinogen, although most are made without mercury. Plastic and digital thermometers are widely available today, but use care if using glass.

It is fairly likely that the water will spill when students do this inquiry, so be prepared to wipe up or have students wipe up.

8. MATERIALS LIST (including any handouts or transparency masters):

Thermometers, Pie Tins, 1-Liter Soda Bottles with top half cut off, water: enough of each of these for each group of 2-3 students (about 10 of each item).

Pictures of birds and other animals for extension.

9. METHODS/PROCEDURE FOR STUDENTS:

a. Pre-investigation work: **Discussion, using background questions**

Ask students to predict whether the water in the pie pan or the pop bottle will cool faster

b. Investigation work: **1. Put 2 cups warm tap water into a pie pan, and 2**

cups into pop bottle with top half cut off.

2. Take temperature of each: should be same.

1) What evidence (data, samples) do students collect? Students take temperature of water in each container twice, once when water is poured, again 20 minutes later.

2) How do students present the evidence (data)?

K-1: Teacher collects temperatures and creates a graph on board.

2-3: Student write temperatures on board and whole class can average and graph data.

3) What conclusions are drawn from the evidence students collect?

The pie pan will most likely cool the fastest.

Larger surface area to body mass ratio leads to faster heat loss (and less surface area for a given body mass will retain heat longer).

4) Include examples of data sheets.

Time (min)	Temperature of Water in Pie Pan (°C)	Temperature of Water in Pop Bottle (°C)
0	60	60
20	20	35

10. ASSESSMENT: Discuss what was discovered in inquiry

K-1: Students participate in discussion

2-3: Students assist in creating graph on board, groups each write a prediction and results.

11. EXTENSION IDEAS:

Have students go to <http://www.learner.org/jnorth/tm/AdaptationsLesson.html> and <http://www.learner.org/jnorth/tm/crane/jr/JnKidsOverview.html> to look at whooping crane and other animal adaptations.

This lesson goes with the Winter Ecology Unit which includes “Hopscotch Migration,” “Winter Tracks,” and “Ice and Snow Caps.”

12. SCALABILITY

Lesson initially created for K-3

Ideas for 4-8: Have students add a few more body shape types using their own ideas for models.

Have students invent types of insulation for their models (fur, feathers, air).

Have students record the temperature many times, or use a thermometer hooked to computer with software that records continuously and graph data.

13. REFERENCES:

Bryner, J. (2005). Why does ice float? *Instructor*, 115(4), 42-43.

Cook, William. (2001). Winter Animal Adaptations. *Michigan Forests Forever Teacher's Guide Website*. Michigan State University Extension.
<http://www.dsisd.k12.mi.us/mff/Environment/WinterAnimals.htm>

Wikipedia Online Encyclopedia: Area. http://en.wikipedia.org/wiki/Surface_area

14. LIST OF EXPERTS AND CONSULTANTS

Cornell Lab of Ornithology. 2005. *The Birds of North America Online*.
<http://bna.birds.cornell.edu/BNA/>

Cornell Lab of Ornithology. 2002. *Educators Guide to Bird Study*.
<http://www.birds.cornell.edu/schoolyard/>

Alison Perkins, ECOS PhD Fellow

Avian Science Center at the University of Montana.
<http://avianscience.dbs.umt.edu/>

Wikipedia Online Encyclopedia: *Thermoregulation*.
<http://en.wikipedia.org/wiki/Thermoregulation>

15. EVALUATION/REFLECTION BY FELLOWS AND TEACHERS OF HOW IT WENT:
I have not tried this lesson with a real class yet! (updates on how it works soon to come)