

## ECOS Inquiry Template

1. **Contributor's Name:** Alison Perkins

2. **Name of Inquiry:** Egg-streme shapes

3. **Goals and Objectives:**

**a. Inquiry Questions:** Are all eggs shaped the same? Does an egg's shape affect how it rolls? Why would egg shape matter?

**b. Ecological Theme(s):** Egg shape can be an adaptation in birds. Different nest sites have different ecological consequences, and certain egg shapes may have evolved in response to those consequences.

**c. General Goal:** To build on young students' understanding of rolling objects by introducing them to how these processes affect things in nature. This activity also reminds students that birds hatch from eggs.

**d. Specific Objectives:**

*Academic:* adaptations of bird eggs to different nesting habitats

*Experimental:* research into shapes and how shapes can be adaptations, and to explore and describe the motion of rolling spheres versus eggs.

*Procedural/technical:* learning to make observations about rolling objects

*Social:* work as part of a team to collaborate on observations

*Communication:* oral presentation of their ideas about egg shapes and the effect on movement

**e. Grade Level:** 1-2

**f. Duration/Time Required:** 60 minutes total

→ Preparation requires downloading the prepared Powerpoint presentation (or making transparencies from the sheets provided at the end of this inquiry), preparing non-sticky clay dough (e.g., Play-doh), labeling sheets of paper, and gathering materials to make ramps (e.g., wood blocks and boards such as durable cardboard found in the Balance and Motion FOSS Kit). [Note: the Powerpoint presentation includes some animated text requiring a mouse click before some text will display.]

→ Implementing exercise during class – introduction (10 minutes), optional pre-investigation (20 minutes), student research (20 minutes), wrap up (10 minutes)

→ Assessment – in class on Day 1

4. **Ecological and Science Context:**

Birds nest in a variety of places, and they have a variety of nest types. Some birds nest on the ground (ducks), others nest in trees (American Robins), and still others nest on very shallow ledges on cliffs (murrets and other seabirds). These different nest sites have different ecological consequences, such as exposure to high temperatures and long drops out of the nest. Nesting on cliffs reduces the chances that predators will take eggs, but eggs on narrow ledges could easily roll off. Some bird species build nests to protect their eggs (ducks and robins), but cliff-nesting seabirds, such as Thick-billed Murrets, have little material available to make a nest.

As a result, the shape of eggs of many birds nesting in these precarious environments became elongated and pointed as a result of natural selection (see the Powerpoint presentation). This shape prevents the egg from rolling in a straight line; it rolls in an arc instead. Eggs that are jostled when the parents leave the nest site won't roll straight off the ledge; the curving roll increases the likelihood that the egg will remain on the ledge and not fall to its demise.

A sphere is theoretically the most economical shape for an egg because a sphere has the lowest surface-area-to-volume ratio. A low surface-area-to-volume ratio means the strongest eggshell and the largest volume for the amount of material invested in the eggshell. In addition, round eggs conserve heat more than ovate eggs.

### **5. Motivation and Incentive for Learning:**

Students get to relate what they are learning about physical sciences (specifically Balance and Motion) to the natural world. Plus, they get to create their own egg and predict how it will roll. They also get to learn about a cool new group of birds they probably have never thought about before.

### **6. Vocabulary:**

**ledge** – A shelf on a cliff or rock wall.

**cliff** – A high or steep face of rock.

**seabird** – A bird that spends a great deal of time out on the open ocean or along coastal waters.

**murre** (mûr) – Any of the closely related black and white seabirds in the genus *Uria* that nest along the coastlines. In North America, a murre can be either a Thick-billed Murre or a Common Murre.

### **7. Safety Information:**

If using wood ramps, be careful of splinters.

### **8. Materials List (including any handouts or transparency masters):**

Powerpoint presentation or transparencies

paper (3 sheets for each group of 3 in your class labeled “Sphere” and “Cup”, and one sheet for each student marked “Egg”. All sheets need to be marked with an “X” to the left [or right] of middle. The “X” will be the starting point for rolling objects down the ramp.)

colored markers (sets of 3 different colors for each group can be used instead of individual sheets of paper)

tape

wood blocks (one per group of 3 students)

ramps (durable cardboard or plywood), one for each group of 3 students

paper cups

ping pong balls (or any balls of similar size)

non-sticky dough (e.g., Play-doh)

### **9. Methods/Procedure for students:**

#### **a. Pre-investigation work:**

If students are not familiar with rolling objects, start by introducing them to spheres. Help them understand that spheres, or balls, roll when they are motion. Divide the class into groups of 3. Provide each group with a block and ramp, a ball, a marker, and the paper marked “Sphere”. Tape the paper to the ramp so that the “X” is on the upward side of the ramp. Designate one member of each group as “Roller”, “Catcher”, and “Pathfinder”. The “Roller” holds the ball on the “X” until the “Pathfinder” tells her/him to let go. The “Catcher” catches the ball, and the “Pathfinder” traces the path on the piece of paper on the ramp. The groups can experiment with the height of the ramp to see if that affects the path the ball takes.

Once all the groups have a line traced for a sphere, replace the paper on the ramp with the “Cup” paper. Have them roll the paper cup at different heights and determine its path.

Ask the students to compare how the ball rolled and how the cup rolled. Ask them why the cup rolled the way it did [one side is larger than the other]. What determines which direction the cup will roll [the cup rolls with the largest side on the outside of the arc]?

Students having gone through the Balance and Motion FOSS kit should already be familiar with rolling spheres and motion.

### **b. Investigation work:**

Now introduce the students to eggs and the shape of eggs. Ask them if they think all eggs are the same shape. Ask them if they think eggs roll the same way as spheres. Have them predict how an egg will roll given their understanding of balls and cups. Have them draw their predictions or write their predictions on the blackboard.

Use the Powerpoint presentation or transparencies to introduce students to the seabirds and their egg shape (Note: *Slides include some animated text requiring a mouse click*). Have students think about what function that shape has. When you get to the slide that says to have the students make their own eggs (SLIDE #7), bring out the clay dough and let them make some murre eggs.

Armed with their own eggs, remind the students of their predictions and then let them roll their eggs down the ramp. As in the pre-investigation work, divide the class into groups of 3; each student will be the “Roller” for their own egg; other members will be the “Catcher” and the “Pathfinder”. Provide each group with a block and ramp, a ball, a marker, and the 3 pieces of paper each marked “Egg”. Tape a new “Egg” sheet to the ramp for each student. The “Roller” holds their egg on the “X” until the “Pathfinder” tells her/him to let go. The “Catcher” catches the egg, and the “Pathfinder” traces the path of the egg on the piece of paper on the ramp. Have the students test each of their eggs. Just like with the paper cup, students shouldn’t worry if the egg doesn’t actually roll all the way off the ramp. If time permits, have the groups experiment with the height of the ramp from flat to steep. If the ramp is flat, does the egg move? What could cause the egg to move? What is its path?

Ask the students to describe the paths they drew. Ask them why they think murre eggs are so much pointier than other eggs (e.g., chicken eggs). Have students think about where birds nest. Are nest sites flat or ramp-like?

### **c. Building on it:**

Return to the Powerpoint presentation and explain to students that murre nest on small shelves or rock outcrops on cliffs near the ocean. The ledge is not always flat, and the small space has to accommodate taking off and landing by adults, too. See if students can come up with some of the consequences for an egg at such a small and treacherous nest site [Slides 7 & 8:

easily knocked, it could roll off the cliff]. Slide 9 shows the path of the murre egg when it is knocked. [Slide 10 is for the extension.]

## 10. Assessment:

### Assessment could address:

- Did students understand the relationship between a shape and how it rolls? Could they describe how different shapes rolled? Did they have any guesses about how eggs would roll? Given an object, could they predict its motion?
  - Were students able to understand the arc of the murre egg? Could they follow how that shape may be adaptive for that particular nest site? Why wouldn't a chicken egg be shaped like a murre egg and have the same motion?
  - Did students enjoy activity?

## 11. Extension Ideas:

### *Other Egg Shapes Around the Schoolyard (and the Valley)*

Use the Powerpoint slide at the end of the presentation and have students create eggs from species around the schoolyard. See if they can come up with reasons for the shapes of these eggs. Birds nesting in environments where heat gain, water loss, or limited nutrients (calcium) are issues tend to lay round eggs. Osprey eggs tend to be round – they nest on open platforms where heat can be a factor. They build large stick nests that contain eggs, but the adults may have to leave the nest to find food, thus leaving unhatched eggs exposed to high temperatures. The low surface-to-volume ratio means less heat is given off (or absorbed) by the egg than an egg with a high surface-to-volume ratio (think about block versus cube ice; a bag of cube ice melts faster than the block because the cubes have so much more surface area than the block). Mourning Doves also nest in trees. They build precarious stick nests on branches, and their eggs also are round. Killdeer eggs are pointed. Although they nest on the ground, the eggs always pack closely together because of their shape. The packed eggs also lend to their camouflage. Mallard eggs may be shaped the way they are simply because the “traditional” egg shape is easier to lay than a big round ball. But who knows!

**12. Scalability:** This lesson could be scaled to grades 3-4 to explore animal adaptations (MCPS Standard #5: Life Science). In addition, by focusing on observations of egg size and shape (e.g., after a trip to the [Philip L. Wright Zoological Museum](#) at The University of Montana) first, students could be encouraged to develop an experiment based on their observations justified with literature review and understanding of habitats (MCPS Standard #1: Science as Inquiry).

## 13. Science Standards Accomplished:

### UNIFYING CONCEPTS AND PROCESSES STANDARD:

- *Evidence, models, and explanation:* Evidence consists of observations and data on which to base scientific explanations. Using evidence to understand interactions allows individuals to predict changes in natural and designed systems.
- *Form and function:* Form and function are complementary aspects of objects, organisms, and systems in the natural and designed world. The form or shape of an object or system is frequently related to use, operation, or function. Function frequently relies on form.

### CONTENT STANDARD A (Science as Inquiry):

- *Abilities necessary to do scientific inquiry*

- *Understanding about scientific inquiry*

CONTENT STANDARD B (Physical Sciences):

- *Position and motion of objects*

CONTENT STANDARD C (Life Sciences):

- *The characteristics of organisms*
- *Life cycles of organisms*
- *Organisms and environments*

MISSOULA COUNTY PUBLIC SCHOOLS SCIENCE CURRICULUM:

- *Standard #1 – Science as Inquiry*
  - Question and contribute information to class discussions. Ask questions, find answers, and compare the known and unknown involved in scientific investigations. Ask questions, find answers, and compare the known and unknown involved in scientific investigations.
  - Collect and record data.
  - Communicate the results of investigations to others.
- *Standard #2 – Unifying Concepts of Science*
  - Use grade-level appropriate strategies to apply scientific concepts, processes, and vocabulary which include the following:
    - Models, evidence, and explanation.
    - Change, constancy, and measurement.
    - Evolution and equilibrium.
    - Form and function
    - Design innovation.
- *Standard #3 – Humans and Science*
  - Investigate natural resources and environments.
- *Standard #4 – Physical Science*
  - Observe the motion of objects and develop a growing curiosity and interest in them
  - Solve problems through trial and error.
  - Observe and compare rolling systems.
  - Explore and describe the motion of rolling objects.
  - Acquire the vocabulary associated with motion.

#### **14. References:**

The Royal Alberta Museum has a great online exhibit about egg shapes and coloration (<http://www.royalalbertamuseum.ca/vexhibit/eggs/vexhome/sizeshap.htm>)

#### **15. List of Experts and Consultants:**

Philip L. Wright Zoological Museum ([http://zoologicalmuseum.dbs.umt.edu/about\\_us.htm](http://zoologicalmuseum.dbs.umt.edu/about_us.htm)) at The University of Montana has over 200 hundred egg specimens; the earliest of which were collected in the 1880's. They offer tours of the museum to school groups.

#### **16. Evaluation/Reflection by Fellows and Teachers of how it went:**

The students loved coming up with their own “egg” shapes and rolling them down the inclined plane. They experimented with different shapes and sizes of playdough. They were challenged by making the “egg” roll in an arc.

# Some birds nest on cliffs!



Photo by Duncan Wright

**These  
are  
murre**



USFWS photo

**Yikes!  
It's a  
long  
way  
down!**



Murres are a type of seabird that nests on these steep rocky cliffs

Here's what a murre egg looks like



Royal Alberta Museum photo

What do you notice about it's shape?

## More murre eggs

**They are big!**

**They are pointy!**



Photo by Francis J Pitocchelli, Saint Anselm College



Now, make your  
own murre egg

What kind of questions can we  
ask about this shape?

How will it roll?

Slide 7

Pause here and make your own eggs.

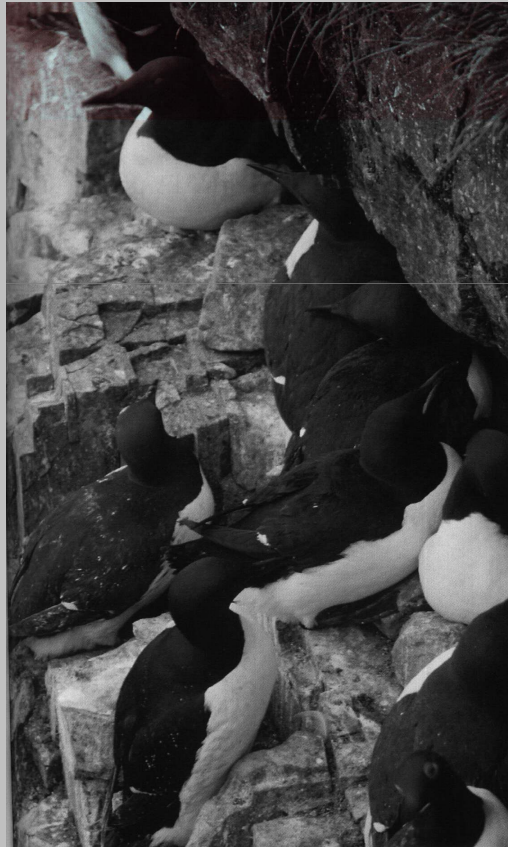
Murrelets must leave their nests  
to find food in the ocean

**Look at  
those big  
feet!!!**



USGS photo

## A closer look at murre



Cape St. Mary's (Newfoundland) photo

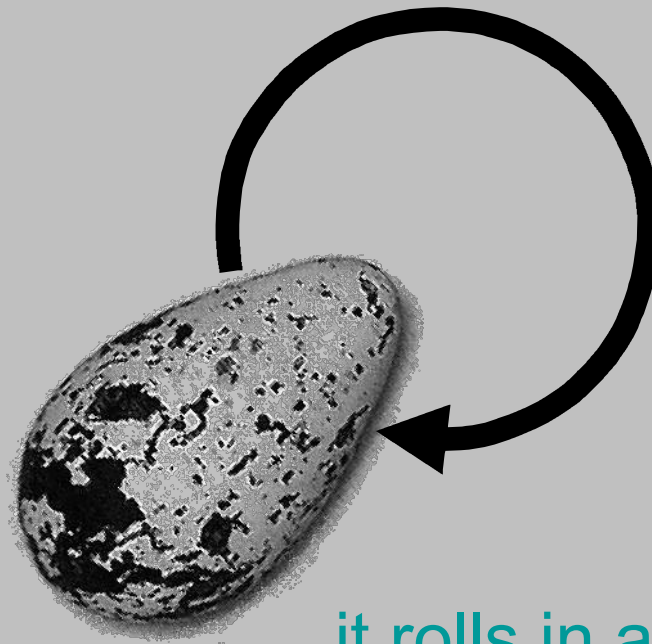
Look! An egg!



Photo by Brian Bell

What would  
happen if  
something knocked  
that egg?

When the egg is knocked out  
of place...



it rolls in a tight circle!



## Murre egg

Here are some  
other egg  
shapes to try

Mourning Dove



Mallard

Osprey



Killdeer

Pictures from <http://www.acornnaturalists.com/store/index.aspx>  
(Note: these are replica eggs you can purchase!)