

Foraging for Fish in a Melting Arctic: the Black Guillemots' Quest to Feed Their Young

Overview

This engaging topic and active game is inspired by a long-term scientific study of Black Guillemots nesting on an island near Barrow, AK. It introduces the life cycle of the Black Guillemot, how it raises its young, and the adaptations it is making to adjust to life in a changing Arctic.

Grade Level: Elementary and Up

Objectives

Students will know that:

- Black Guillemots are seabirds that live in the Arctic.
- Black Guillemots nest on land and care for their young.
- Black Guillemots find food, Arctic Cod, for their young under the sea ice.
- Scientists have found that the sea ice is changing and retreating. The shrinking ice is affecting animals that live in the Arctic.
- Black Guillemots are adapting to the retreating sea ice. They have to travel farther and farther to find food for their young. They are also choosing a different and less desirable food source called sculpin.

Students will be able to:

- Describe their experience collecting food from different distances.
- Count and compare the number of fish collected at each distance.
- Collect, record, analyze, and graph data.
- Describe the life cycle of the Black Guillemot.

Essential Questions and Topical Understandings (See Attached)

Standards

This lesson plan was developed prior to finalization of the Next Generation Science Standards and alignment of the Alaska Science Standards to them. When those standards are available, these activities will be re-aligned.

National Science Education Standards (NSES)

Content Standards, Grades K-4

Content Standard C: Life Science

- Characteristics of organisms
- Life cycles of organisms
- Organisms and environments

Content Standard F: Science In Personal and Social Perspectives

- b. Characteristics and changes in populations
- d. Changes in environments

Content Standards, Grades 5-8

Content Standard B: Physical Science

- c. Transfer of energy

Content Standard C: Life Science

- d. Populations and ecosystems
- e. Diversity and adaptations of organisms

Content Standard F: Science In Personal and Social Perspectives

- b. Populations, resources, and environments

Content Standards, Grades 9-12

Content Standard C: Life Science

- d. Interdependence of organisms
- e. Matter, energy, and organization in living systems
- f. Behavior of organisms

Other Standards

n/a

Materials

- Large, open space such as gym, hallway, or outside
- Containers that represent summer sea ice (bin, crate, etc.)
- Small containers that represent Black Guillemots' nest (basket, bin, etc.)
- Manipulatives for Arctic Cod (Popsicle sticks, clothespins, etc)
- Cup or bag for each child for collecting cod
- Timer or stopwatch
- Pencils, crayons
- Computer for showing images and video
- Flip Chart/White Board
- Recording sheet (see attached)

Teacher Background (See Attached) Background Information:

Preparation

- Measure out four different lines using either the gym floor or tape: Starting line, Line 1 (around 20 feet), Line 2 (twice the distance from Line 1), Line 3 (three times the distance from Line 1)
- Photocopy a recording sheet and graph paper for each student.
- Place bins that represent summer sea ice upside down on Line 1 equal distances apart.
- Place the same amount of fish under each container.
- Place containers that represent nests beside the starting line where students will line up.

Procedure

1. Show the Black Guillemot Intro picture (1) to the students and ask them what they notice (do not tell them which bird it is). Record responses (correct and incorrect) and any questions they may have, but do not provide answers. After you have collected this data, set it aside and introduce the Black Guillemot showing more of the pictures and resources provided.

Possible questions to consider asking students:

- What do you notice about this animal?
- What do you see?
- What color is it?
- What do you notice about its mouth?
- What are you wondering about?

Here are the main points to introduce using photos which you will reinforce later with a video:

Does the picture (2) give you any clues about where it lives?

- Black Guillemots live on the ice in the Arctic Ocean. They come to land to nest in the summer. They nest in cavities on rocky shorelines.
- They typically lay two eggs. (3) The incubation period is 28 days. Chicks grow at a rapid rate.
- They are ready to fledge in about 5 weeks. (4) For five weeks, both parents care and provide for the chicks. Parents forage for food under the summer sea ice. They feed their young Arctic Cod. (5, 6) The coverage of summer sea ice is drastically declining,

affecting how far parents have to travel to get food for their young. (7) Parents are beginning to feed their young a less desirable nearshore fish called sculpin. (8)

2. After discussing these ideas with the pictures, show the video. The video at <http://www.youtube.com/user/friendsofcooper/videos> illustrates the biology of the Black Guillemot living on Cooper Island near Barrow, Alaska, as well as the dramatic decline in sea ice cover. Facilitate a discussion about the changes in the summer sea ice cover. Pause the video at the beginning to orient students to the location (and where they live from there). Ask them what they think the white and blue parts are. Tell students you are going to ask them what they notice happening in the video. Run the video and then record children's ideas.
3. Provide a brief summary of the life history and habits of Black Guillemots emphasizing how Black Guillemots must travel under the sea ice for Arctic Cod to feed their young. Ask students what they (the students) like to eat and how far they must travel to get food. Compare this with the Black Guillemots.
4. Tell students they are going to play a game. Put students in groups (one group per bin) and have them line up at the starting line in their groups. Give them the directions:
 - Each group has one student at a time go for one minute.
 - Students run back and forth from nest to sea ice grabbing only one Arctic Cod and placing it in the nest.
 - After one minute, students stop and count the number of Arctic Cod they collected in their nests.
 - The students return Arctic Cods under the summer sea ice for the next set of students and record how many they collected on their recording sheet.

Example Directions: *"Today we are all going to pretend we are Black Guillemots. As you can see, I have placed bins out on the gym floor. These bins are the summer sea ice. Who remembers what lives under the sea ice that is important to the Black Guillemots? (Arctic Cod) I have placed Arctic Cod under the bins for you to grab and take back to your nest, which is placed at the starting line. The first person in line will have one minute to run (or fly) to your bin, grab one Arctic Cod, and run back to your nest to feed your chick. Only one person from your group goes at a time. See how many Arctic Cod you can get – remember – you are only allowed to grab one at a time since that's all that a Black Guillemot can carry. When the timer goes off, stop, walk to your nest and count how many Arctic Cod you collected. Return your Arctic Cod to the summer sea ice so the next person in your group has a turn. Walk over to this table to record how many you were able to collect."*
5. Set the timer to 1 minute. Make sure students are running back and forth and only bringing back one cod at a time, filling their basket. After their minute is up, they count their cod and record it on their sheet. Collect the cod and place them back under the bin for the next set of students. Repeat until everyone has had a chance to go.
6. After all students have taken their turn, quickly debrief with questions such as the following: How do you feel? Do you think your young will grow strong with the Arctic Cod you brought to them? What do you think will happen (to the number of cod we can collect) when we move the sea ice back to here? Have students share predictions.
7. Move the bins representing sea ice back to your second taped off spot. Repeat activity. Follow with questions. Move the bins representing sea ice back to your third taped off spot. Repeat activity. Follow with questions.
8. Collect materials and walk students back to the classroom where you will have a longer debrief with questions such as:
 - What do you notice about your data? Bar graph?
 - What happened as the sea ice moved farther and farther away from the nest?
 - In the Arctic Ocean, why is the sea ice moving farther away from the shore?
 - Why is it hard for a Black Guillemot to get to the sea ice to find food for its young?
 - What can we do to help the sea ice from shrinking?

Extensions

1. Recently, Black Guillemots have switched to bringing sculpin and other bottom fish to their young since the ice has moved so far off shore (photo 8). One extension would be to include comparing size, shape and calorie content of Arctic Cod to sculpin. The game could be extended to include retrieving sculpin for your young. Students could be introduced to the nutritional value of different foods and that cod are better for young than sculpin. Students would have to bring back twice as many sculpin as cod for the chicks to grow (and survive).
2. Have students draw a Black Guillemot as if they were sketching it and making observations in the field.
3. Egg study. Model the method that George Divoky uses to monitor when eggs are ready to hatch in his nest sites. Early eggs sink to the bottom of water while older eggs that have developed an air sac will float. You could use plastic eggs filled with more and less dense objects to model "early and late" eggs. Students could make predictions on sink and float based on how the eggs feel.
4. Guillemot eggs are camouflaged, but some sea bird eggs are not. Students can look at pictures of the Guillemot eggs and decorate their own by painting hard-boiled eggs. Students could also learn about camouflage and compare Guillemot and other sea bird eggs in their nests. Students could decorate eggs and build nests for their eggs.

Assessment

- Pre-assessment: Write down how students initially describe the Black Guillemot (only write down what they say, do not add anything to this).
- Post-assessment: Make a list of what students know about the Black Guillemot now. Compare and contrast pre-assessment to post-assessment. (Can be done as a group or with individuals)
- Recording Sheet: Assess students' data collection. Ask students what they noticed about the experiment. Ask them what they notice about their data set and bar graph. For younger children, help record their ideas. Possible others: Ask students to draw a picture of themselves doing the experiment.

Resources

- Polar bear on Cooper Island: <http://www.polartrec.com/resources/video/polar-bear-cabin-on-cooper-island-alaska>
- Polar bear exploring guillemot nest box on Cooper Island
<http://www.polartrec.com/resources/video/polar-bear-explores-nesting-box-on-cooper-island-alaska>
- <http://www.audubon.org/species/blagui1>
- http://www.allaboutbirds.org/guide/Black_Guillemot/sounds
- <http://www.arcticbiodiversity.is/index.php/en/ecosystems/arctic-sea-ice-...>
- <http://www.youtube.com/user/friendsofcooper/videos>

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Teacher Background

Black Guillemots are an Arctic seabird

Black Guillemots belong to the seabird family known as auks, or alcids. The most abundant seabird family in the Northern Hemisphere, the alcid family includes murrelets, puffins, auklets and murrelets. Guillemots nest on land and are generalists in their choice of the nest sites, where they incubate eggs and raise their young. Shoreline cavities are most commonly found on rocky shorelines or headlands, where guillemots are most abundant, but nesting regularly occurs in other natural cavities, such as driftwood piles and increasingly in man-made structures, such as docks and seawalls. Black Guillemots are diving seabirds that find their prey beneath the water's surface. Guillemots have a generalized bill that they use to feed on both fish and invertebrates, although parents feed nestlings fish almost exclusively. In arctic Alaska the most common food for parents to feed the young is the Arctic Cod, a high-energy fish that lives under the sea ice.

Scientist George Divoky studies Black Guillemots

Scientist George Divoky has been coming to the Arctic for more than 30 years to study the breeding biology and feeding ecology of Black Guillemots. He conducts his study on an island near Barrow, AK called Cooper Island. George has created man-made nesting sites for the guillemots and monitors the breeding and success of the colony. This extended study has become a valuable data set for monitoring long-term cycles and trends related to climate change.

Guillemots stay in the Arctic year-round

Every summer the Arctic is home to millions of seabirds, waterfowl and shorebirds, and with few exceptions all undertake major migrations at the end of the breeding season and spend the next nine months in more southern latitudes. In contrast, Black Guillemots in the western Arctic undertake limited migrations, wintering no further south than the pack ice (continuous mass of sea ice) in the central Bering Sea and apparently as far north as open water is present. There are regular winter observations from Point Barrow, where cracks and open water are maintained throughout the frigid winter by the movement of ice by winds and currents, and where guillemots are apparently unfazed by the extended darkness as the sun remains below the horizon for three months. This makes them an ideal monitor of arctic marine eco-systems.

Arctic Sea ice retreat

The Arctic sea ice cover is in decline. Data from many studies has shown that the extent or reach (coverage) of the ice, the presence of older sea ice, and ice thickness have all been decreasing over the last few decades. This decline is having an impact on plant and animal species whose life are tied to sea ice. We hear often in the news about the status of the megafauna like polar bears and walrus, but many other animal species are also being affected. Under-ice algae, invertebrates (nematodes, crustaceans), fish (Arctic Cod), and marine birds and mammals (Black Guillemots, seals) all form a unique ecosystem and are interdependent on one another and the ice.

Guillemots are dealing with a changing Arctic

The warming of the atmosphere in the Arctic has caused snow to now melt about a week earlier than it did in the past. This allows guillemots to enter their nest cavities earlier and they are able to lay their eggs earlier than in the past. Their ability to breed earlier in the season is an important adaptation in a region that has such a short summer period for birds to raise their young.

That same warming is also melting the pack ice where Black Guillemots prefer to feed. When the ice retreats north and out of the foraging range, guillemots have to find fish other than Arctic Cod to feed their young. After a period of adjustment to the loss of their preferred prey, they started to feed on sculpin, a fish not dependent on ice cover and abundant in the nearshore waters of the

Alaskan Arctic. Sculpin are not as energy rich as Arctic Cod so parents have to feed their young more of them.

The continuing decrease of summer sea ice means guillemots will have to lose their dependence on Arctic Cod if they are to persist in arctic Alaska. Their ability to switch to sculpin shows they can do that. As the waters of their feeding areas warm even more, it is likely that guillemots will start to find species of fish that are moving north from subarctic areas. Scientists predict that guillemots will likely respond to the appearance of those fish species by switching from sculpin to species that provide better quality food for their young.

A presentation developed by George and presented at the May, 2012, workshop in Barrow is available at:

http://www.polartrec.com/files/resources/presentation/36752/docs/brw_workshop_pt_2.pdf by

The presentation describes how the guillemots are adapting to their changing environment and the efforts of the Friends of Cooper Island, a non-profit scientific organization based in Seattle, Washington, to monitor their activities and breeding success through the use of nest boxes, data loggers and long term observations. Additional information about his on-going research is available at www.cooperisland.org.

Foraging for Fish

Name:

<i>Pack Ice Distance</i>	<i>Cod collected</i>

I noticed

Foraging for Fish Bar Graph

Number of Arctic Cod Collected	20								
	19								
	18								
	17								
	16								
	15								
	14								
	13								
	12								
	11								
	10								
	9								
	8								
	7								
	6								
	5								
	4								
	3								
2									
1									
	<i>Distance 1</i>			<i>Distance 2</i>			<i>Distance 3</i>		

I notice

I learned that Black Guillemots

1



Black Gullmot

2



3



4



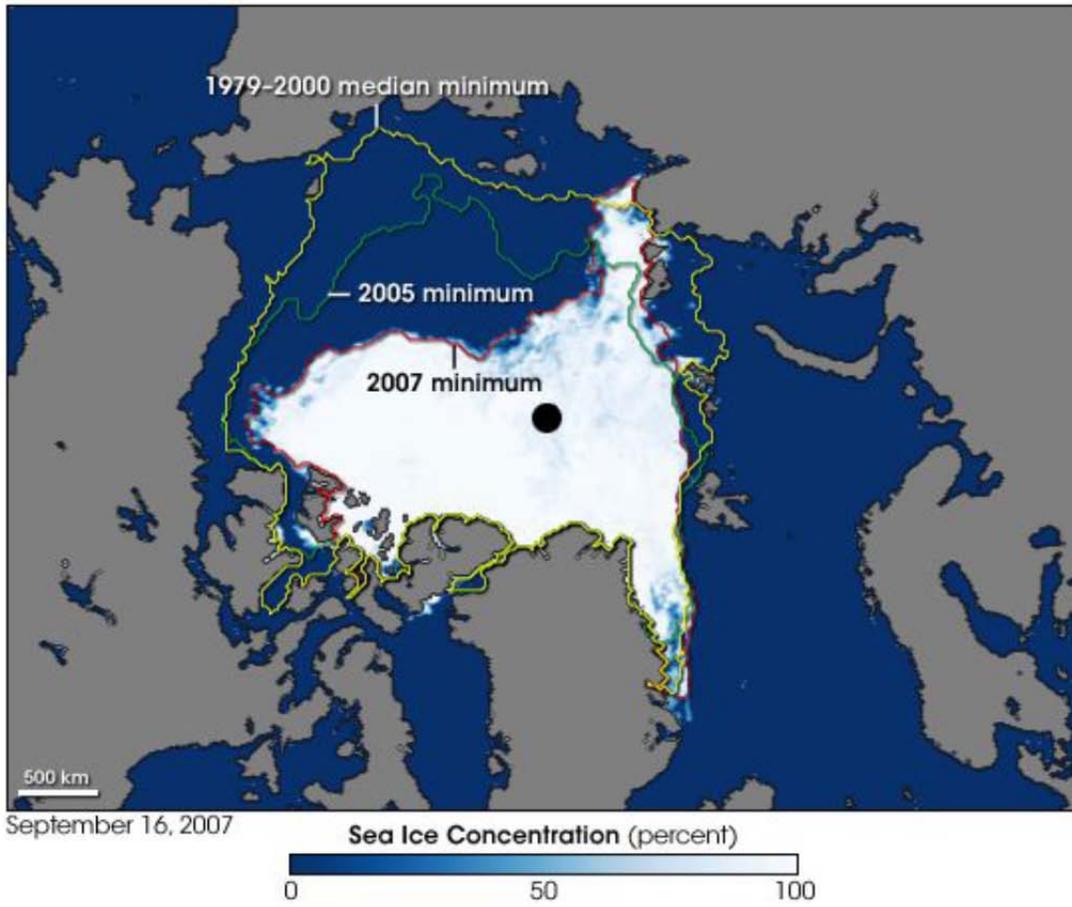
5



6



7



8



Essential Questions:

- **What is the life cycle of the Black Guillemots?**
- **What do Black Guillemots need to live?**
- **What happens when the food is farther away?**
- **Why are the Black Guillemots having to travel farther and farther to find food for their young?**

Topical Understandings:

- **Black Guillemots are sea birds that live in the Arctic. They live on the ocean but nest on land.**
- **Black Guillemots care for their young.**
- **Black Guillemots are tied to the sea ice. They feed under the ice and forage for food for young under ice.**
- **With the sea ice retreat, Black Guillemots have to travel farther to find food.**
- **Black Guillemots are having to adapt to a changing Arctic.**
- **Our understanding of Black Guillemots and changes in the Arctic have come from many years of scientific study near Barrow, AK.**