

Date: _____

Your Name: _____



**NEW ENGLAND
COMMON ASSESSMENT PROGRAM**

Released Science Inquiry Task

Cod on Georges Bank

2010

Grade 11

Science

Directions:

You will be completing an extended-response inquiry task called **Cod on Georges Bank**. Explain your reasoning for all of your answers. You may include labeled scientific drawings or diagrams to help explain your answers. Completely answer each question.

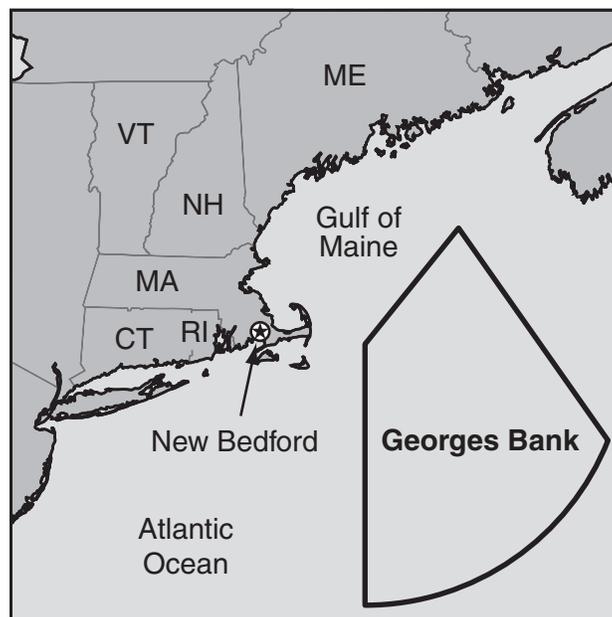
There are three parts to this task:

1. Forming a hypothesis
2. Organizing, presenting, and analyzing data
3. Using evidence and applying what you have learned

Cod on Georges Bank

Marissa's science class is learning how ecosystems change over time. They know that such changes can be caused by many different factors, including human activity, the weather, and the climate. To help his students understand how ecosystems can change, Marissa's teacher took the students on a field trip to the historic fishing town of New Bedford, Massachusetts, to investigate what happened to cod, a fish that many people depended on for food, on nearby Georges Bank in the last 80 years. Figure 1 shows where Georges Bank is.

Figure 1: Map Showing Georges Bank



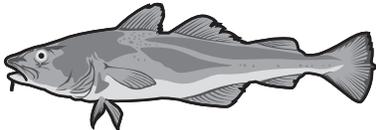
In New Bedford, the students learned that up until the early 1930s boats returned from Georges Bank full of cod. The students also learned that Georges Bank was the perfect location for cod fishing because it is shallow as well as rich in the nutrients that support the animals cod eat.

In New Bedford, Marissa walked past the docked fishing boats. She noticed that the fish catch was smaller than she expected based on the history of fishing at Georges Bank. She asked a fisherman why fewer fish were being caught. He explained that in the 1960s fishermen began to use factory trawlers to catch fish. The trawlers caught many more cod than before. The trawlers also caught cod that were older and bigger than the cod caught without factory trawlers. Soon after, the cod population began to decline.

In 1986, in an effort to help the cod population recover, the federal government started the Northeast Multispecies Plan (NMP). The NMP restricts the number and size of cod that can be kept. It seemed to Marissa that after more than 20 years under the guidance of the NMP the cod population had had enough time to recover. However, the fisherman told her that they still weren't catching many cod.

Back at school, Marissa and her classmates researched some basic facts about the biology of cod to find out why cod are vulnerable to and slow to recover from overfishing. They found a fact sheet at the library that gave some background information about cod. Figure 2 shows the Atlantic Cod Fact Sheet.

Figure 2: Atlantic Cod Fact Sheet

	
Feeding Behavior (Ecology)	Life History
<ul style="list-style-type: none"> • All cod eat plants and animals, especially small fish and crustaceans such as shrimp and snow crab. • Young cod feed on plankton (very small animals) and other small crustaceans and fish. • Cod feed at dawn or dusk. • The cod stocks have decreased, causing the fish that cod normally eat to become top predators in the food web. 	<ul style="list-style-type: none"> • Cod can produce a lot of offspring. • Females can lay between 2.5 and 9 million eggs in a single spawning. • Mature adults reproduce once a year during winter or early spring. • Spawning takes place near the seafloor where temperatures are between 0°C and 12°C and the water's oxygen content is suitable. • Sexual maturity occurs between ages 2 to 4, though some fish may not reproduce until age 7. • Older females lay more eggs than younger females. • Cod live in areas where the seafloor has a lot of hiding places, which provide good protection for young cod.

Comments

In U.S. waters, Atlantic cod are managed as two stocks:

1. Gulf of Maine stock, and
2. Georges Bank and southward stock.

Both stocks make up important year-round commercial and recreational fisheries. Cod stocks off eastern Canada and New England collapsed in the early 1990s with the start of large-scale commercial fishing. Today, these stocks are reported to have decreased by 96% since the 1850s. Although the government has limited fishing for the past few decades, the populations of these stocks have not recovered, and at this point scientists are unsure if the cod stocks will.

The students wondered if the NMP had been successful. They considered these three possible reasons that might have contributed to the collapse of the cod population:

- Changes in the food available to cod
- Competition with other species for food
- Overfishing

Marissa’s teacher told the class they would be conducting an investigation about the cod population and fishing practices. He asked the students to think of a research question they could investigate.

The students decided to investigate this question:

Research Question

How has the cod population on Georges Bank been affected by fishing practices?

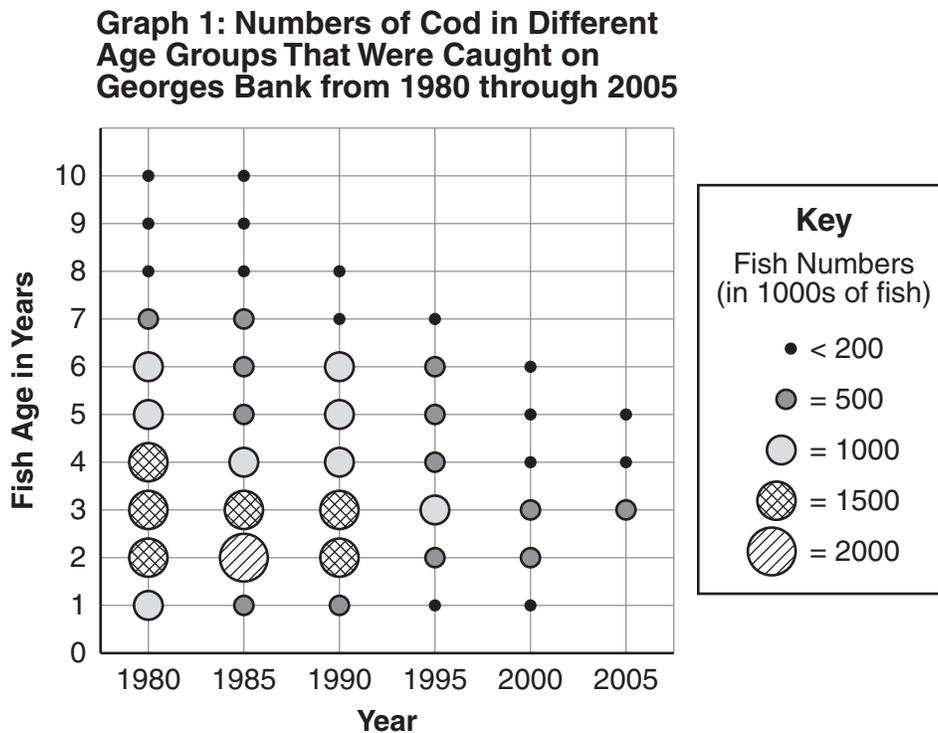
Part 1: Forming a Hypothesis

Answer question 1 on page 1 in your Student Answer Booklet.

- 1 Based on the background research provided in the story and in Figure 2, write a **hypothesis** about the effect fishing activities have on the cod population on Georges Bank. Explain your reasoning.

Part 2: Organizing, Presenting, and Analyzing Data

Marissa found this graph from the Northeast Fisheries Science Center in Woods Hole, Massachusetts. It shows the age spans of the cod caught from 1980 through 2005. Graph 1 shows the numbers of cod in the different age groups.



Answer question 2 on page 1 in your Student Answer Booklet.

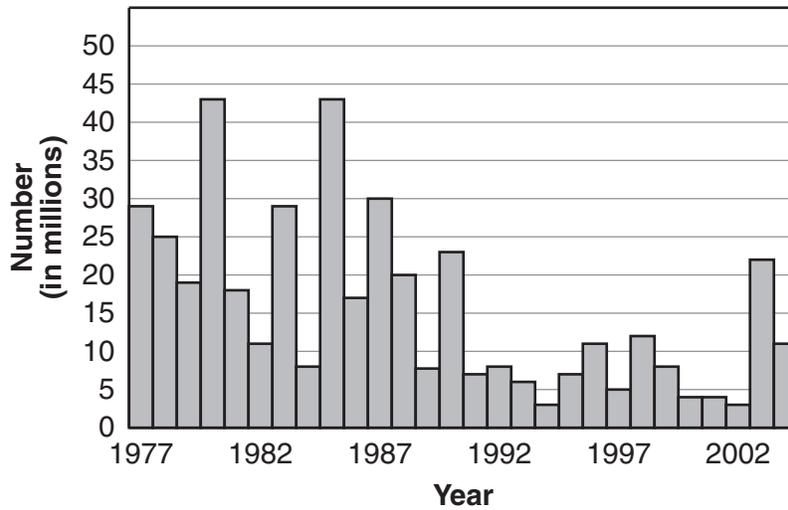
- 2 Use the information in Graph 1 to describe how the size and age distribution of the cod population changed from 1980 to 2005.

Marissa visited the National Marine Fisheries Service (NMFS) Web site and learned that while the cod fishery had collapsed in other places, there was still commercial and recreational cod fishing on Georges Bank.

According to the Web site, scientists studying cod analyze two trends in the cod population over time:

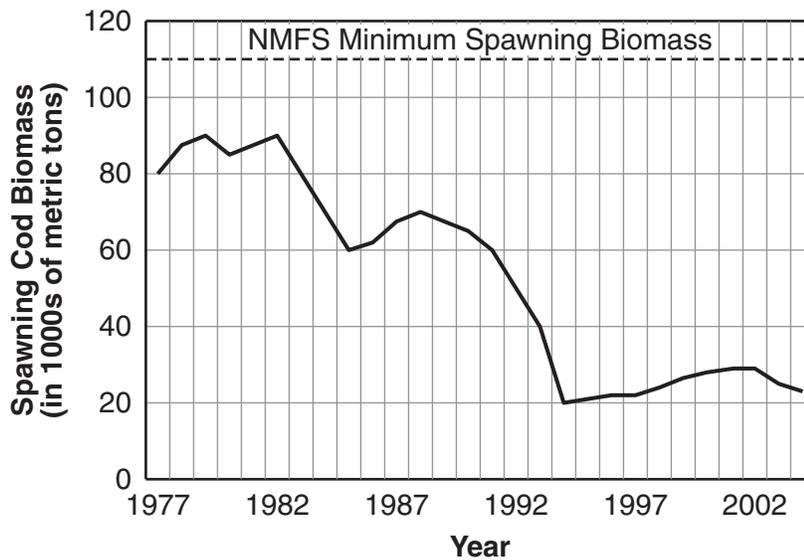
- Young fish—an estimate of the number of young cod added to the population each year (Graph 2), and
- Spawning fish biomass—the total amount of cod old enough to reproduce (Graph 3).

Graph 2: Young Cod Added to the Population Each Year



Adapted from <http://www.nefsc.noaa.gov/sos/spsyn/pg/cod/>

Graph 3: The Cod Spawning Biomass (1977–2003): The Total Amount of Cod Old Enough to Reproduce



Adapted from http://www.nmfs.noaa.gov/sfa/domes_fish/StatusoFisheries/2006/2006RTCdefinitionsFINAL.pdf

Answer question 3 on page 2 in your Student Answer Booklet.

- 3 Describe the general trend of the young cod added to the population shown in Graph 2 from 1997 to 2003. Use specific examples from the graph to support your answer.

Answer question 4 on page 2 in your Student Answer Booklet.

- 4 Describe the relationship between the number of young cod added to the population and the spawning biomass. Use specific examples from Graph 2 and Graph 3 to support your answer.

Marissa found this information in a newspaper:

The federal government has tried various methods to regulate cod fishing, including closing areas, limiting fish and net mesh sizes, and establishing quotas per fishing boat. NMFS helps inform lawmakers about what levels of fishing are sustainable. According to the NMFS guidelines, the Atlantic cod on Georges Bank are being overfished when their breeding stock biomass is less than 108,400 metric tons (mt).

Answer question 5 on page 3 in your Student Answer Booklet.

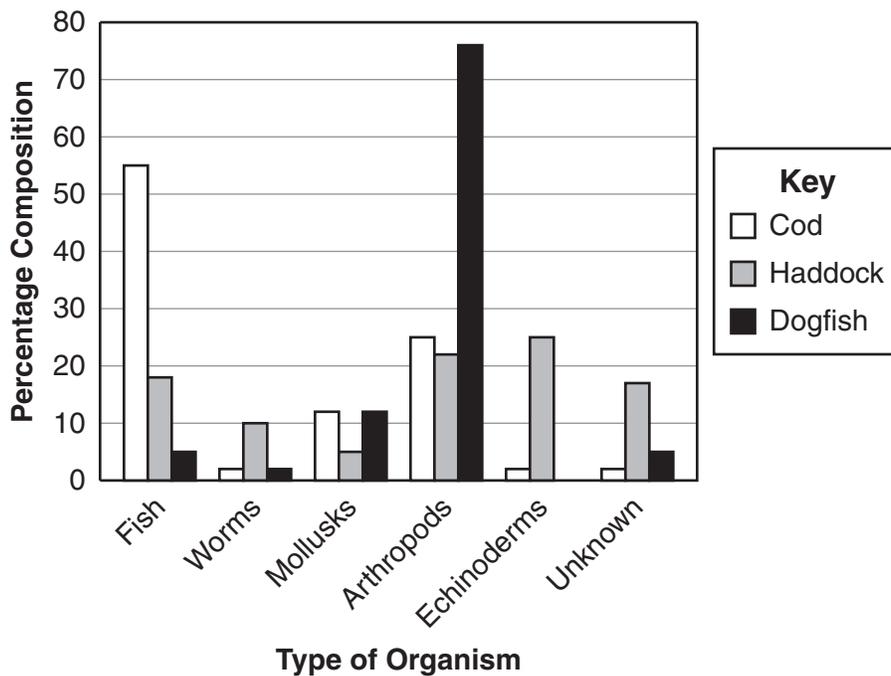
- 5 Use the NMFS guideline for minimum breeding stock biomass and the data in Graph 2 and Graph 3 to explain the effect of fishing on cod recovery. Use evidence to support your explanation.

Marissa learned that in the last 20 years there has been a shift in the populations of organisms living on Georges Bank. The populations of other fish, such as haddock and dogfish, increased as the cod population declined.

Marissa wondered if haddock and dogfish ate the same kinds of food as cod. She found a research paper titled “Trophic Role of the Atlantic Cod in the Ecosystem,” which included data about the stomach contents of hundreds of fish that had been caught on Georges Bank during 2008. The paper explained that scientists were able to understand the diet of each kind of fish by looking at the contents of their stomachs.

Graph 4 shows the types of organisms that cod, dogfish, and haddock eat.

Graph 4: Stomach Contents of Cod, Haddock, and Dogfish in 2008



Adapted from Jason S. Link, Bjarte Bogstad, Henrik Sparholt & George R. *Trophic role of Atlantic cod in the ecosystem*, FISH and FISHERIES, 2009, 10, 58–87

Answer question 6 on page 3 in your Student Answer Booklet.

- 6 Based on the information in Graph 4, do dogfish and haddock compete with cod for food? Use **two** examples from the graph to support your answer.

Answer question 7 on page 4 in your Student Answer Booklet.

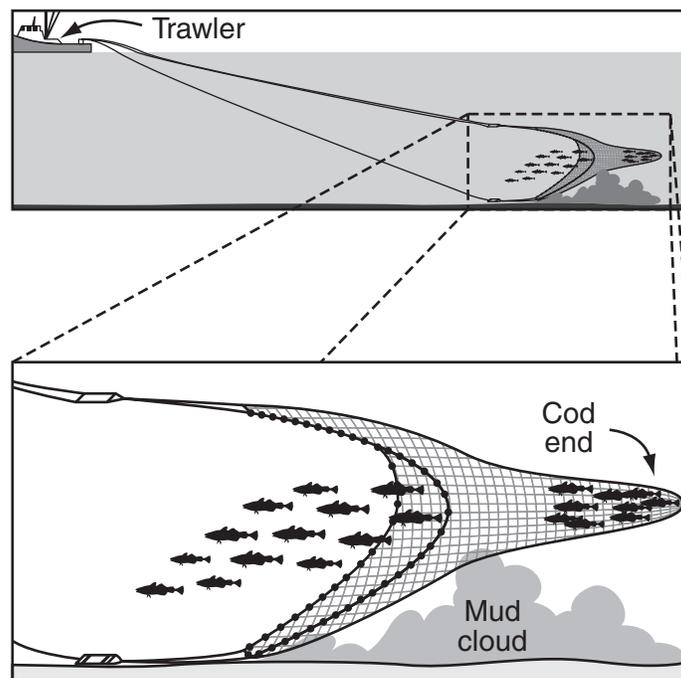
- 7 What else does Marissa’s class need to know to determine whether competition for food between cod, dogfish, and haddock might have had an impact on the cod population?

Marissa and her classmates wondered whether changes in fishing technology really can affect fish populations.

The class knows that the seafloor where bottom fish reproduce usually includes boulders, rocks, and pebbles. The students know this kind of environment is a relatively safe place for cod to lay their eggs and for young cod to mature because it gives them places to hide.

Marissa’s class decided to learn more about the trawlers the fisherman talked about. They found out that during the last 30 years, a type of fishing called “bottom trawling” has become a common method for catching ground fish such as cod. Bottom trawlers have heavy buckets, chains, and cables that scrape shrimp and fish into a net as it is dragged along the ocean floor. As a result of this process, rocks are swept up, plants are pulled out, and animals that live in the mud are killed. The natural state of the seafloor is dramatically changed in places where this kind of fishing takes place. Figure 3 shows a diagram of a trawler dragging its nets on the ocean floor.

Figure 3: Bottom Trawler Dragging Nets on the Ocean Floor



Part 3: Using Evidence and Applying What You Have Learned

Answer question 8 on page 4 in your Student Answer Booklet.

- 8 As new evidence becomes available, scientists often develop new hypotheses. Look at your original hypothesis on page 1 of your Student Answer Booklet. Based on what you have learned during this investigation, propose a new hypothesis about the cod population on Georges Bank. Use specific information from the investigation to support your reasoning.

