Migration Math

Theme: **Natural History**

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Subject Areas
Science, Math

Duration
42-minute class period

Setting
Classroom

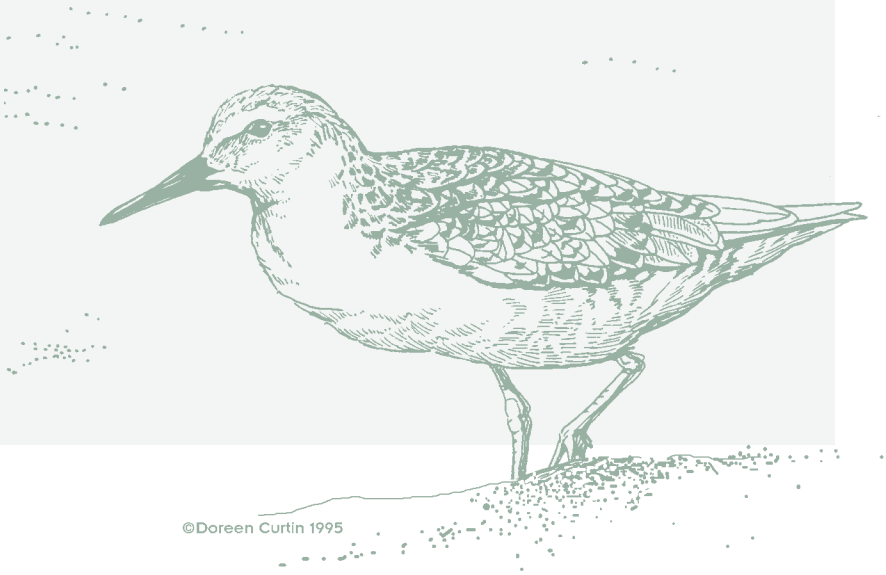
Skills
Reading comprehension, computation, mathematical reasoning

Charting the Course
Relating a short story about shorebird migration to mathematical calculations is a unique approach to this topic. The shorebird migration and the horseshoe crab connection is a significant component of the Down Jersey region and deserves in-depth investigation, study and understanding by the students that reside within the area.

Vocabulary
Migration,extinct, arachnids, population

Correlation to New Jersey Core Curriculum Content Standards

Mathematics
4.1 (5, 6)
4.2 (1, 4, 5)
4.3 (6, 7)
4.4 (3, 7, 10, 11)



Migration Math

Objectives

Students will be able to:

1. Develop mathematical formulas
2. Solve mathematical problems
3. Explain their solution steps
4. Explain reasons why the answer is probably correct

Materials

Paper

Copy Me page 1 and 2

Pencils

Background

Review the answer sheet.

Additional activities on shorebirds and horseshoe crabs contained in this guide.

Procedure

Warm Up

Read the Migration Math Copy Me page 1. This can be done aloud using round robin or popcorn reading. Explain that the students will be doing math problems based on the story.

The Activity

Distribute Go Figure (Copy Me page 2). Students should solve the problems showing their formulas and computation calculations.

Wrap Up

Go over the problems. Students should be able to give reasons why they think their answers are correct.

Assessment

Collect Go Figure sheets. Check for understanding of directions to show formulas, calculations, and answer check.

Extensions

Call the Endangered and Nongame Species Program (ENSP) at (609)292-9400 and ask for the actual data for the shorebird migration for the current year. Apply the mathematical formulas to the data. Hypothesize about the trends in the number of migrating shorebirds.

Resources

New Jersey Audubon Society, Center for Research and Education

600 Route 47 North
Cape May Court House, NJ 08210

Phone: (609) 861-0700
Fax: (609) 861-1651

Visit their website at www.nj.com/audubon

Wetlands Institute

1075 Stone Harbor Boulevard
Stone Harbor, NJ 08247-1424

Phone: (609) 368-1211
Fax: (609) 368-3871

Visit their website at www.wetlandsinstitute.org

Endangered and Nongame Species Program

P.O. Box 400
Trenton, NJ 08625

Phone: (609) 292-9400

Visit the Division of Fish, Game and Wildlife website at www.state.nj.us/dep/fgw

Student Worksheet — *Migration Math*

Instructions: Read the migration story. On a separate sheet of paper, solve the math problems and help the shorebirds complete their migration.

¡Hola! ¿Como Esta? I am Sandy Sanderling in Costa Rica pumping up my body fat for the big migration to Delaware Bay before I fly on to northern Canada. Round trip migration flights of 10,000 km to 25,000 km are not uncommon for us shorebirds. Did you ever wonder why we fly north instead of south to breed? Check out a world atlas. The Northern Hemisphere has 50 times more land than the Southern Hemisphere. More land area means more food and space for feeding and nesting. So why not just stay in the warm tropics? It's a question of food supply. There is plenty of food in the Southern Hemisphere for everyday living, but it's not the type most migratory birds need for breeding. Scientists think that we need the Arctic wetland insects to acquire the energy necessary for mating, egg laying, and nesting. Of course, winter in the Arctic brings a food shortage, so we fly south for the winter.

Scientists aren't completely certain about our ancestral origins, but some think we may be the dinosaurs who survived the Cretaceous disaster. One thing that the fossil record does show is that we've been here a very long time, at least since the Jurassic Period. That's older than *T. rex*! As old as birds are, our favorite New Jersey food source is even older. The horseshoe crab is literally a living fossil, a survivor of a largely extinct class of arachnids that dates back 360 million years. We don't actually eat the horseshoe crab, but we depend on the rich eggs to build up our flight fat for the journey to northern Canada. We time our arrival in Delaware Bay to coincide with the annual migration of horseshoe crabs that takes place during the full moon of May (mid-May). Horseshoe crabs mate and lay eggs on the sandy shoreline of Delaware Bay. We shorebirds flock there by the millions to snap up the eggs before loggerhead turtles and finfish munch them down. Scientists estimate that shorebirds such as ruddy turnstones, sandpipers, sanderlings, and red knots consume about 320 tons of horseshoe crab eggs during the two week mating season.

In recent years, the number of shorebirds and horseshoe crabs along the Delaware Bay beaches has been declining. Horseshoe crabs are not a human food animal. However, human harvesting of horseshoe crabs seems to be having a great impact on the survival of both horseshoe crabs and shorebirds. Commercial fishermen use the chopped-up horseshoe crabs to catch conch and eel, which are primarily sold to Japan. It's estimated that more than one million pounds of horseshoe crabs were harvested last year. That's twice as much as the 1980 harvest. Although a million pounds sounds like a lot, it was 15 to 20 times higher at the turn of the century. Scientists who have studied horseshoe crabs say that it took 20-30 years for the horseshoe crab to recover from the over-harvesting that took place early in the twentieth century. It takes nearly a decade for a horseshoe crab to reach maturity. One thing that has been observed is that when the horseshoe crab population declines, the shorebird population declines and when the horseshoe crab population increases, the shorebird population increases.

It's hard to say what will happen to me and the other shorebirds as the year 2000 approaches. New Jersey and Delaware are habitat to 90% of the east coast horseshoe population. Over-harvesting in Asia along with the loss of spawning grounds has made the Japanese horseshoe crab an endangered species. Scientists studying the Delaware Bay warn that conservation is needed now to save the North American horseshoe crab and all of us who depend on the eggs for survival.

Copy Me page 2

Go Figure

1. It takes about four million horseshoe crabs to support one million shorebirds. What is the ratio of crabs to shorebirds?

2. A female horseshoe crab lays about 7,000 eggs each time she deposits eggs in the sand. If a female horseshoe crab deposits eggs between 11 and 13 times during the spawning season, how many total eggs will she deposit? What is the average number of eggs laid by a female horseshoe crab? Explain your reasoning.

3. One shorebird can eat at least 2,000 horseshoe crab eggs per day. If a female horseshoe crab makes one deposit a day, what percentage of her eggs is likely to be consumed by a shorebird in one day? (Note: The eggs are very small and buried in the sand. The shorebird may be eating eggs from more than one horseshoe crab. Some of the eggs may be washed away or eaten by fish or gulls. However, the percentage will give you a rough idea of the percentage of eggs consumed by shore birds.

4. If a shorebird flies 6,000 km at 50 kph, how many hours will she fly during her migration? (A Semipalmated Sandpiper was observed flying from Maine to Guyana in two days at an average speed of 65 kph. Many shorebirds make these long flights without stopping!)

5. To make the final flight to the Arctic, a shorebird will increase its body weight 60-80% in two to three weeks at Delaware Bay. If you were to increase your weight by 70% in two weeks, what would you weigh?

Answer Sheet

Migration Math

1. It takes about four million horseshoe crabs to support one million shorebirds. What is the ratio of crabs to shorebirds?

   4,000,000 horseshoe crabs/1,000,000 shorebirds
   therefore, the ratio is 4:1 horseshoe crabs to shorebirds

2. A female horseshoe crab lays about 7,000 eggs each time she deposits eggs in the sand. If a female horseshoe crab deposits eggs between 11 and 13 times during the spawning season, how many total eggs will she deposit? What is the average number of eggs laid by a female horseshoe crab? Explain your reasoning.

   Formula: number of eggs/deposit X number of deposits = number of eggs
   7,000 X 11 = 77,000 eggs 7,000 X 13 = 91,000 eggs

   Average number of deposits would be 12 times,
   which is halfway between 11 and 13.
   7,000 X 12 = 84,000 eggs

3. One shorebird can eat at least 2,000 horseshoe crab eggs per day. If a female horseshoe crab makes one deposit a day, what percentage of her eggs is likely to be consumed by a shorebird in one day? (Note: The eggs are very small and buried in the sand. The shorebird may be eating eggs from more than one horseshoe crab. Some of the eggs may be washed away or eaten by fish or gulls. However, the percentage will give you a rough idea of the percentage of eggs consumed by shore birds.

   total eggs per deposit = 7,000
   eggs eaten by shorebird = 2,000

   $$\frac{\text{eggs eaten by shorebird} = 2{,}000}{\text{total eggs per deposit} \quad 7{,}000} = 29\%$$

4. If a shorebird flies 6,000 km at 50 kph how many hours will she fly during her migration? (A semipalmated sandpiper was observed flying from Maine to Guyana in two days at an average speed of 65 kph. Many shorebirds make these long flights without stopping!)

   distance = 6,000 km
   speed = 50 kph

   $$\frac{\text{distance}}{\text{speed}} = \text{time} \qquad \frac{6{,}000\ \text{km}}{50\ \text{kph}} = 120\ \text{hours}$$

5. To make the final flight to the Arctic, a shorebird will increase its body weight 60-80% in two to three weeks at Delaware Bay. If you were to increase your weight by 70% in two weeks, what would you weigh?

   Formula: weight X 1.70 = increased weight

   Answers will vary.
   Example: 100 lb. person would weigh 170 lbs. at the end of two weeks.