Instructional Recipe

Who is the Better Navigator. . . You or the Animals?

Grade 9-12
World Geography
Cross Curricular Connection: Astronomy
Education Service Center Region 20

Online research and information resources available through a partnership between the Texas State Library and Archives Commission, the Texas Education Agency and Education Service Center, Region 20
http://web.esc20.net/k12databases

Step 1 – Ask

Objectives: Students will identify navigational mechanisms both humans and their animal friends employ to *find their way.*

Introduction: Secrets of bird navigation remain a mystery to many bird watchers. Even scientists don't fully understand how birds migrate thousands of miles. Some animals travel thousands of miles and end up at exactly the river, island, or beach they call home. How they find their way, or navigate, is a mystery. After all, animals don't have maps or language, as humans do. What, then, do they use to navigate so precisely?

http://www.flickr.com/photos/
Octant with box c 1790 M Holm and Company England

Ask:

- ★ How do baby loggerhead turtles make their way out to sea and back to the beach where they hatched?
- ★ How do bees make their way from flower to flower and back to the hive all of the time?
- ★ How do salmon find the exact river where they hatched?
- ★ How do birds know where to migrate?
- ★ How did the ancient mariners navigate?

Vocabulary:

- ★ Transponders
- ★ Regional magnetic field
- ★ Northern and Southern gyre
- ★ Mental Maps
- ★ Innate sense of direction

TEKS:
Science 112.48. Astronomy Science Concepts.
The student knows how mathematical models, computer simulations, and exploration can be used to study the universe. (D) The student is expected to: identify the historical origins of the perceived patterns of constellations and their role in ancient and modern navigation.
Cross-Curricular TEKS
World Geography TEKS: Social Studies Skills.
113.21(E)
The student applies critical-thinking skills to organize and use information acquired from a variety of sources including electronic technology. The student is expected to: (E) use a series of maps, including a computer-based geographic information system, to obtain and analyze data needed to solve geographic and location problems.
Technology Application TEKS: 126.6.8(A)
(8) **Solving problems.** The student uses research skills and electronic communication, with appropriate supervision, to create new knowledge. The student is expected to: (A) participate with electronic communities as a learner, initiator, contributor, and teacher/mentor and use technology to participate in self-directed and practical activities in the larger community and society.

Step 2 – Investigate

Click here for internet links/URLs

K-12 Online Subscription Resources: Use search strategies (directional sense and birds), (innate sense and direction and animals),

- ★ Unlock the Secrets of Animal Navigation. Preview (cover story) By: Janes, Patricia; Neistat, Van. Scholastic SuperScience, Apr2001, Vol. 12 Issue 7, p6, 4p, 4 color; Reading Level (Lexile): **870**; (*AN 4613771*)
- ★ Secret of a Bee's Odometer. Preview By: Mackenzie, Dana. Science Now, 02/04/2000, p1, 1p; Reading Level (Lexile): **1320**; (*AN 2806588*)
- ★ Sea Turtles, Lobsters, And Oceanic Magnetic Maps. Preview By: Lohmann, Kenneth J.; Lohmann, Catherine M. F. Marine & Freshwater Behaviour & Physiology, Mar2006, Vol. 39 Issue 1, p49-64, 16p, 2 diagrams, 3 maps; DOI: 10.1080/10236240600563230; (*AN 20380172*)
- ★ Ancient Mariner. Preview By: Amodeo, Chris. Geographical, Jun2002, Vol. 74 Issue 6, p8, 0p, 1 bw; Reading Level (Lexile): **1260**; (*AN 6696739*)

Additional Websites:

Latitude Changed the World
Learning Page
National Geographic's Xpedition's Mental Map
Orientometer Interactive Game

Books:

Fiction: Gilkersen, William. *Ultimate Voyage.* 1. Boston, MA: Shambhala Publications, 1998.
Nonfiction: *Tracking Animal Migration with Stable Isotopes*, Volume 2 (Terrestrial Ecology)

Step 3 – Create

Click here for internet links/URLs

- ★ Read the article "Unlock the Secrets of Animal Navigation" and take notes on the scientific research being conducted. Include the evidence that has been found to indicate how these animals find their way over migration routes. Then discuss the techniques scientists believe animals use to navigate.
- ★ Ask students to work in groups to brainstorm the ways in which people navigate innately (using only their instincts and brains rather than maps and compasses).
    1. Do humans have the same capabilities as the animals they have read about?
    2. Do all people have the same innate navigational capability?
    3. Do some people seem better at navigation than others? Why?
    4. Use an interactive Venn diagram for this activity to determine where animals and humans have similar navigational abilities.
- ★ Ask students to think about their own sense of direction.

Technology Link -

- ★ Try this interactive game to test human skills of orientation. Orientometer Interactive Game
- ★ Create a wiki space and have students comment on the questions listed above.
- ★ Interactive Venn Diagram. http://www.readwritethink.org/materials/venn/
- ★ More interactive graphic organizers: http://lexiconsys.com/graphic_organizer.html

Step 4 – Discuss

Click here for internet links/URLs

- ★ Students will complete the orienteering activity as a way to understand the skills needed to navigate from one point to another.
- ★ Engage the students in a whole-group discussion about the orienteering experience.
- ★ Discuss the methods they used to navigate through the activity. How does this differ from animal or insect navigation? (Use the Gathering Matrix during the discussion to compare information about human and animal navigation.)
- ★ Students will write up the results of the orienteering activity in a Word document and submit the document to the teacher-hosted wiki space for a grade.

Technology Link –
Wikispaces.com
PBwiki.com

Step 5 – Reflect

Click here for internet links/URLs

- ★ Students will complete a written quiz that covers the reading from the articles in Step 1.
- ★ When the quiz has been completed, students will go to the teacher-created wiki space and upload their quiz documents for teacher correction. (The wiki provides a date/time stamp, allowing teachers to note the exact time the quiz was submitted.)

Technology Link:
Wikispaces.com
PBwiki.com

Internet Links/URLs

Articles may be located by either the accession number (AN) or the persistent URL.

Step 2 – Investigate

- **Unlock the Secrets of Animal Navigation**
  http://web.ebscohost.com/ehost/detail?vid=1&hid=4&sid=1163b861-7dbc-44d1-9d45-62dbe57f9f25%40sessionmgr10&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#db=sch&AN=4613771

- **Secret of a Bee's Odometer**
  http://web.ebscohost.com/ehost/detail?vid=1&hid=4&sid=273a77e2-f0ed-42f2-97a9-baed798e480d%40sessionmgr10&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#db=sch&AN=2806588

- **Sea Turtles, Lobsters, And Oceanic Magnetic Maps**
  http://web.ebscohost.com/ehost/detail?vid=1&hid=4&sid=63e0298c-afc2-4ac1-8eed-fa7fde4aa7b8%40sessionmgr11&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#db=a9h&AN=20380172

- **Ancient Mariner**
  http://web.ebscohost.com/ehost/detail?vid=1&hid=4&sid=f57aa416-3b7c-4d4f-91b6-b1ab0f6060b8%40sessionmgr11&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#db=sch&AN=6696739

- **Latitude Changed the World**
  http://www.ruf.rice.edu/~feegi/index.html

- **Learning Page**
  http://www.ruf.rice.edu/~feegi/learn.html

- **National Geographic's Xpedition's Mental Map**
  http://www.nationalgeographic.com/xpeditions/standards/02/index.html

- **Orientometer Interactive Game**
  http://www.nationalgeographic.com/xpeditions/activities/02/popup/orient.html

- ***Tracking Animal Migration with Stable Isotopes*, Volume 2 (Terrestrial Ecology)**
  http://www.amazon.com/Tracking-Migration-Isotopes-Terrestrial-Ecology/dp/0123738679/ref=si3_rdr_bb_product

Step 3 – Create

- **Unlock the Secrets of Animal Navigation**
  http://web.ebscohost.com/ehost/detail?vid=1&hid=6&sid=9992afeb-584b-43df-88d5-c034596ae77b%40sessionmgr11&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#db=sch&AN=4613771

- **interactive Venn diagram**
  http://www.readwritethink.org/materials/venn/

- **Orientometer Interactive Game**
  http://www.nationalgeographic.com/xpeditions/activities/02/popup/orient.html

- **http://lexiconsys.com/graphic_organizer.html**

Step 4 – Discuss

- **Wikispaces.com**
  http://www.wikispaces.com/

- **PBwiki.com**
  http://pbworks.com/

Step 5 – Reflect

- **Wikispaces.com**
  http://www.wikispaces.com/

- **PBwiki.com**
  http://pbworks.com/

Quiz Questions

Date_____
Name: _____
Teacher: _____
Wiki Login/Password_____

Scientists have to design experiments that other researchers can copy exactly. How well can you duplicate the methods and conclusions you just read about? Try it and see!

1. In the article “Unlock the Secrets of Animal Navigation,” the author already knew this fact before he started his experiment:

a. bees carry mental maps.

b. bees never fly on cloudy days.

c. bees use the sun's position to help them navigate.

2. After their experiment, William Irwin and Ken Lohmann knew that loggerhead turtles sensed Earth's magnetic field because

a. baby turtles were attracted to magnets.

b. brass bars confused the turtles, but magnets did not.

c. magnets confused the turtles, but brass bars did not.

3. Robert Beason wanted to know

a. if bobolinks were pulled south by Earth's magnetic field.

b. if bobolinks could see Earth's magnetic field as a color.

c. if bobolinks' brains responded to magnets.

4. Salmon have a unique way of finding their way home. They

a. smell the particular odor of the stream in which they were born.

b. see familiar landmarks as they swim.

c. sense Earth's magnetic field.

ORIENTEERING SKILLS ACTIVITY

INSERT ORIENTEERING SKILLS CHARTS FROM PAGE 10 IN PRINT GUIDE FOR SHOW 402
Birds travel thousands of miles without using a compass and map as we know them. Could you? Put your navigational skills to the test with this orienteering activity.

A sheepherder has an ancient map with symbols that represent different types of terrains. He wants to follow the route on the map, but wants his lamb to gain close to 50 pounds during the 10-month trip. He knows the lamb's potential weight gain while grazing for a month in each type of terrain. Using the map grid in the graphics file and directional compass, follow the directions and find out if his lamb fattened up.

MATERIALS

- colored pencils
- compass (or protractor)

PROCEDURE

1. Make a compass as your instructor directs. Put the hole in your compass over symbols so you can see them through the compass. Always align the compass so it points North (keep edges parallel to the lines).

2. Begin at map coordinate A-1 (marked with an X). Refer to the list of moves and draw a line on the map to the next location. Write the new coordinate, type of terrain and the lamb's potential weight gain in your blank data table. Repeat for all locations.

MOVE #	ANGLE/DIRECTION	DISTANCE
1	45 degrees	2.5 km
2	Due North	5.5 km
3	235 degrees	3.7 km
4	65 degrees	7.7 km
5	16 degrees	8.0 km
6	Due West	3.0 km
7	25 degrees	10.0 km
8	Due South	8.0 km
9	295 degrees	11.0 km
10	155 degrees	5.8 km

QUESTIONS

1. How far did the sheepherder drive his flock?
2. How much weight did the lamb gain?
3. Which map grid was crossed most?
4. Plot your own 10-month trip and write directions for someone else to follow. Use a different color to draw the solution on your map. Limit the lamb's growth to 50 pounds.

ANSWERS

1. 59.5 kilometers
2. 46 pounds
3. B - 4 is crossed most (4 times)
4. Answers will vary, but many students would keep the flock around hills and lakes, since the average weight gain is 5 pounds. Over a ten-month period, lambs would gain 50 pounds.

LAB NOTES

- You can use this activity to illustrate navigational and map skills.
- The orienteering activity can be done as a paper and pencil assignment. Or use the basic ideas to create a larger orienteering course inside or outside the school building.
- Review basic compass directions and their angle counterparts. This activity will work better if your compass indicates directional angles. * To make a non-magnetic direction-only compass: On a 3" x 3" or larger card, use a protractor to draw compass directions and angles with a sharp pencil or felt-tipped pen. Start at North (360 degrees and 0 degrees), then work around every 10 degrees to East (90 degrees), South (180 degrees) and West (270 degrees). Split the 10 degree lines with other lines to make 5 degree increments. After the compass points are drawn, punch a hole at the intersection of all lines.

NOTES: all vertical lines point North-South. All horizontal lines point East-West.

NOTES & DISCUSSION

- What specialized memory systems do birds use to help them navigate? What systems do other species use? (FRONTIERS Show 201 features a story about the navigational abilities of sea turtles. In some species of lizards, a third eye functions as a homing device.) How have human navigators and explorers made use of similar systems over the ages?

- How does the pigeon/landmark experiment set up by the Wiltschko research team demonstrate the scientific method? Can students think of ways to change or improve on the experiment? Discuss the concept of "failure" in scientific research.

- Pick a popular destination like the nearest mall. Have students tell each other how to get there. Do they rely on measured distances, street names or visual landmarks? Ask students to draw maps of their routes to school. How many different kinds of maps are produced?

- The student activity is an adaptation of an orienteering challenge. Originally developed to teach navigation skills to Swedish soldiers, orienteering is a popular international sport that combines map reading abilities and survival skills. Using a topographic map and compass, participants follow a set course and pick up clues or points along a series of checkpoints. The fastest finisher with the highest score on the prescribed course wins.

NOTE: Credit for this activity goes to: Maryland Science Education Consultant Frank Weisel.
http://www.pbs.org/safarchive/4_class/45_pguides/pguide_402/4542_bird.html#act1
For more orienteering projects you may write to : U.S. Orienteering Federation, P.O. Box 1444, Forest Park,

Gathering Matrix

Student_____
Date_____ Period_____

Humans	Bees	**Category** **Characteristics**	Turtles (Loggerhead Turtles)	Birds (Bobolinks)	Fish (Salmon)
		Example: Uses site recognition to navigate			

Note:
The Gathering matrix is for comparing up to four or five items and their different characteristics. This map allows the student to simultaneously compare various characteristics of several items using information they have gathered in their reading. Teachers may pre-populate this table, or, during a brainstorming activity, have students select the characteristics they want to research.