LEARNING ACTIVITY I:
Finding Your Way Around Without Visual or Sound Cues

OVERVIEW

In this activity, students will play a series of simple games to investigate navigation without visual and sound cues.

SCIENCE & MATHEMATICS SKILLS

Observing, collecting quantitative data, creating graphs, interpreting data, drawing conclusions, communicating

PREPARATION TIME

15 minutes

CLASS TIME

45 minutes

MATERIALS

- Access to an open area
- Measuring tape
- Timer (watch or clock with second hand)
- Graph paper, one sheet per student
- Pencil (pen or chalk is acceptable), one per student
- Bell
- Blindfold, one per student
- Candy to reward for foraging
- Statistical calculator

BACKGROUND

The brain is able to interpret information from several different body systems to estimate position. Visual cues, information from the otolith organs in the inner ear, sound cues, and information from the motor system are used to determine spatial orientation.

MAJOR CONCEPTS

- The brain combines information from several different sources to estimate position.
- Inertial navigation (navigation based on motion-related cues) can provide direction without visual or auditory cues.
- The environment can be navigated with some success by solely using feedback received by the brain from self-motion sensors in the body.

This activity allows students to investigate how well the central nervous system is able to estimate position based on information other than visual and sound cues.

PROCEDURE 1

Navigating Without Visual or Sound Cues

1. Have each student take a partner and a blindfold to an open area.
2. Designate an area as "home" base by placing a piece of paper on the ground where the students are, or mark the spot with tape forming an "X" on the ground or on the floor.
3. Have one member (subject) of each student team tie the blindfold over his/her eyes so he/she cannot see anything. This is a test to see if the student can navigate without visual cues. Encourage the students not to cheat.
4. Once blindfolded, each subject should walk around continuously for 30 seconds, like an ant foraging for food, and then try to return to the same spot where he/she started (Figure 57). Have the students make at least four turns as part of the path. They may go anywhere, as long as they try to end up at the starting place after 30 seconds. Each student's partner should let him/her know how much time has elapsed every 10 seconds. Have the partners move around so that the subjects cannot use the sound of their partners' voices as the cues for "home."

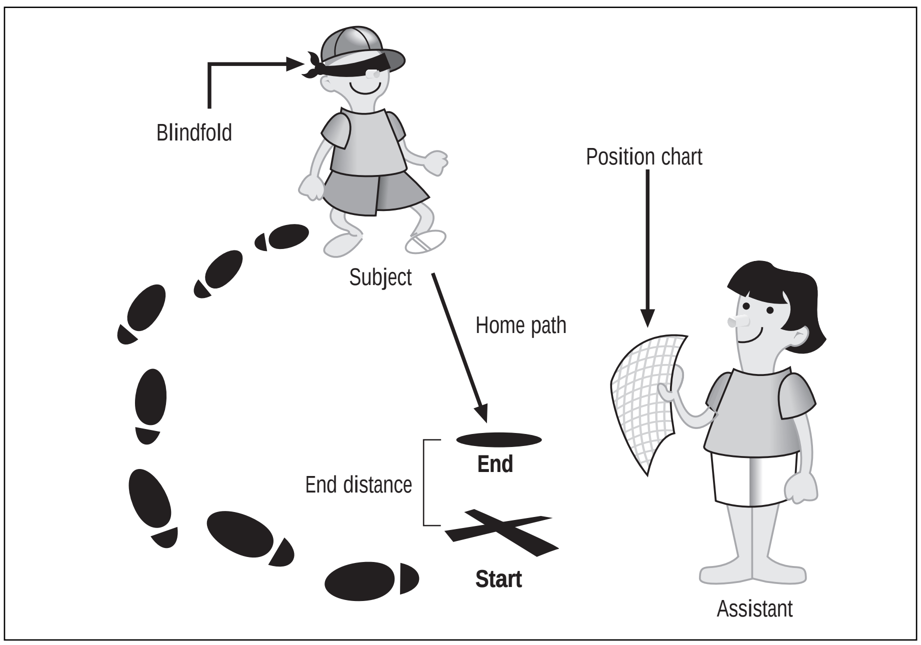

Figure 57 *Diagram of student walking blindfolded to show how inertial navigation can provide direction without sight or sound.*

5. Make sure that the partners do not give the blindfolded students any hints. The environment should be as quiet as possible so that students receive no sound cues. Once each blindfolded student believes he/she has returned to home base (or, after the 30 second time limit is

reached), instruct him/her to remove the blindfold and measure how far he/she is from the starting mark. This distance should be recorded. Instruct the students not to worry if they end up far away from "home" after their first try.

6. To add excitement, distribute little packets of candy at random and have the students forage on hands and knees blindfolded, starting from a location called home, marking the floor (or pavement, if you are outdoors) with something they cannot feel, such as chalk. Then ring a bell and have them try to get back to home base within five seconds. The students might pretend that they are foraging ants and that the bell is a danger signal. Thus, they would try to get back "home" quickly.

Each student should have the opportunity to try this experiment at least once.

PROCEDURE 2

Using Quantitative Information to Assist Navigation Without Visual or Sound Cues

Note to Teacher: *Encourage students not to make any audible clues that might alter results. The environment should be quiet.*

1. Have your students repeat the previous activity, again blindfolded. But this time, instead of having the blindfolded students wander around randomly, have them count the number of steps they take in each direction.

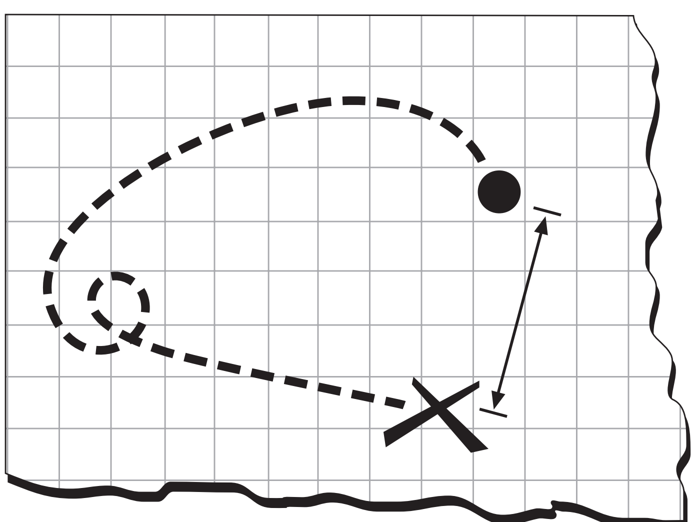

Figure 58 *Diagram of a position chart.*

2. The partner should help the blindfolded student by writing down the number and direction of steps taken by the blindfolded student. Partners can try to chart the student's course by drawing the student's position at each step on a sheet of graph paper (Figure 58).

3. At 30 seconds, the blindfolded students should try to find their way "home" by guessing where they are, using how far they have gone in each direction as a cue. Direct each blindfolded student to tell his/her partner how far, and in which

direction(s) he/she thinks he/she needs to travel in order to reach home. (It is acceptable if the partner looks at the chart to see if the blindfolded student is correct, but the partner should not give any hints.)

4. The student should now try to find home. Once the blindfolded students reach the place they believe to be "home," have their partners measure the distance from where the students ended to the actual starting place, or "home." Have students compare their estimates of the distance to home with the actual measurements. Each student should try the experiment.

PROCEDURE 3

Using a Pre-established Pattern to Navigate Without Sound or Visual Cues

1. All students should be blindfolded for this exercise. As many students can participate at one time as available space will allow.

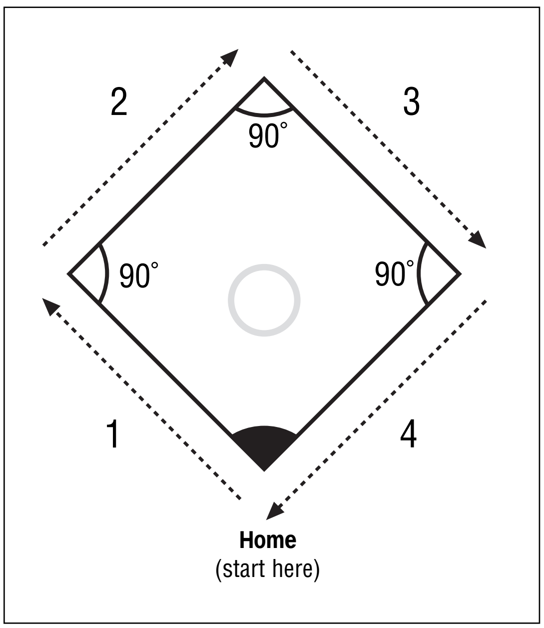

Figure 59 *Diagram of a pre-established pattern.*

2. Students should blindfold themselves and try taking 10 steps forward from their "home" mark. They should then turn 90˚ to the right, take 10 more steps, turn 90˚ to the right again, take 10 more steps, and stop (Figure 59). Ask the students if they think they are back to where they started yet.

3. Have the blindfolded students turn 90˚ to the right and take 10 more steps. Have the students add all their 90 degree turns to determine how many degrees they have rotated in total.

4. Ask the students where their brains tell them they are. Direct them to lift their blindfolds and see if they are "home." The students should measure how far they are from their mark and record the measurement. If the students counted accurately, they should be close to the place where they started.

5. Have students compare measurements from the three trials. Have them identify the trial in which they navigated most accurately and the trial in which they were least accurate in returning to home. Why do they think the results varied from one trial to another?

Evaluation

REVIEW QUESTIONS

1. **What types of information does the brain use for navigation and determining position?**
   The brain receives and utilizes sensory information from the eyes, ear, and nose to determine position.

2. **Is it possible to estimate position using information from only one or two sources?**
   Yes. It is possible.

THINKING CRITICALLY

1. **What is the minimum amount of sensory information needed for navigation?**
   A minimum of two sensory information is needed for navigation.

2. **Was navigation successful without visual cues?**

3. **How much error occurred when using each of the tactics?**

4. **Which tactic produced the least error? Why?**

5. **How much more or less difficult would the task have been if one could walk up and down walls?**

SKILL BUILDING

1. Have students pool the class data from each of the trials, compute the mean distance from "home" for each trial and, using a statistical calculator, find the standard deviations (averages) of each of the trials. Have them use this information to decide whether the results of each trial are different or not.

2. Have student teams devise their own experiments to further investigate navigation without visual cues.

STUDENT ACTIVITY SHEET

Finding Your Way Around
Without Visual or Sound Cues

Name ____ Date _________________

Student Name	Procedure 1	Procedure 2	Procedure 3
Total			
Average			