Science Activity Unit:

The Senses

Unit Introduction: This unit is based upon the FOSS Human Brain and Senses course and the NIH Brain course in which students have the opportunity to explore the awesome and complex functions of the brain. Through many different activities the students will be able to work cooperatively and build upon many process skills such as observing, measuring, predicting, and controlling variables. They will also have the chance to develop scientific habits of mind such as being open-minded.

The lessons in this unit are part of a larger unit in our seventh grade curriculum on the systems of the human body. The human body is a topic of interest to many students because it is something that they can relate to. They are usually very curious about how their bodies respond to their environment. As part of the nervous system unit, the students will engage in activities that will help them to understand how the senses are used to help the brain interpret the environment. Our driving question would be "How do our senses help us?" Before beginning their study of the senses, they will learn about the structure and function of the brain. Next, they will explore the role of the five senses. Although the senses are something that they may have already studied in elementary school, this unit will help them to develop a deeper understanding of how they work in relation to the complex nervous system. Some of the activities will include a carousel of the five senses, modeling the pathway of information to and from the brain, and designing experiments to test reaction time. To follow these lessons, they may explore the world of perception and illusion.

Brief Description of Group to be Taught: Seventh grade students at Coakley Middle School in Norwood. There will be a total of 91 students divided into 5 classes each with 12-24 students per class. One class is advanced while the remaining four are mixed ability. Each mixed ability classroom has approximately 20-30% of students on IEP's.

Science Modules: *Human Brain and Senses*, FOSS Curriculum (Delta Education, 2001).
The Brain: Our Sense of Self, National Institute of Health Curriculum (BSCS, 2005)
Human Biology and Health, Science Explorer (Prentice Hall, 2000)

Unit Length: Minimum of eight 45 minute classes.

Science Activity Unit:

Lesson: Using our Senses

Relationship of this Lesson to the unit: This lesson will introduce the students to how the senses pick up information from the environment and send the information to the brain. This will lead up to further lessons in which they will learn about how messages are sent to the brain and how the brain perceives these messages.

Massachusetts Frameworks Strand and Learning Standard: Life Science standard #6: Identifying the general functions of the major systems of the human body and describing ways that these systems interact with each other.

Concepts:
- How the senses are used to help interpret one's surroundings.
- How receptors are used to send sensory messages to the brain for processing.

Processes:
- Observing and predicting

Science Habit of Mind:
- Look at a matter from many sides before drawing a conclusion. Do not jump to conclusions or decide on the basis of one observation; deliberate and examine until you are as sure as you can be.

Other Subject Area Objectives:
- Writing detailed descriptions.

Session Length: 3 (45 minute) sessions

Materials Needed: (Per group of 4)

Station 1: 4 pipe cleaners and 4 straws
Station 2: Bag filled with a cotton ball, marble, sponge, penny, and eraser.
Station 3: 4 flavored jellybeans
Station 4: 6 identical glass bottles (each filled with different levels of water), wooden mallet, cardboard screen.

Day 1

TIME	PROCEDURE	CONCEPT
	Prep: Setup 4 stations with materials and directions (fill glass bottles with different levels of water, fill bags, re-supply jellybeans). There may need to be more than one setup of a station if there is a larger number of students in a class.	
5 mins	**Introduction:** 1. Ask: Have you ever walked into to your house and realized before you even got into the kitchen that someone had baked chocolate chip cookies? How did you know? Students should know that they could smell the cookies. 2. Ask: How did you know that it was chocolate chip cookies and not something else? They may say that they recognized the smell from another time that they had been baked. 3. Explain that in today's lesson they will investigate how their senses are	

	used to help them interpret their surroundings.	
10-15 mins	**Activity setup:** 1.Explain to the students that they will be working in their groups on this activity. Remind them that the getter gets the materials, the recorder reminds the group members to write down their data, the reporter shares the team's findings with the rest of the class, and the starter keeps the group on task. 2.Assign each student group a table for their home base. Tell them to note which number is at their seat. They can then refer to the posted role chart to see what their role is for the day. Remind them that it will change from activity to activity. 3. Explain to them that their task for this lesson will be to conduct investigations at four different stations by following the detailed instructions at the stations. (see attached worksheets for descriptions of each station) There will be stations for each of the senses (sight, hearing, touch, smell/taste) Remind them to be sure to record their observations in their journals. 4. Explain that they will only have time to complete one station today and that they will continue their investigations on the next day. (Note: The teacher may choose to have every student work on the same investigation at a time rather than rotating through the stations.)	Roles and groups.
10-12 mins	**Activity:** 1.Tell students that they may begin by working at the station that is found at their home base table. 2.Let them know that they will have ten minutes at their first station and that the teacher will ring the bell when it is time to rotate. They should rotate to the next station number (ie: 1 to 2, 2 to 3, 3 to 4, and 4 to 1). 3.The teacher should circulate around the room to be sure that students are performing the activities correctly and safely. They should also be sure that everyone is doing their assigned jobs (getter, recorder, etc). 4.After 9 minutes, give a warning ring. One minute later ring the bell for them to rotate.	**Process skill:** Observing and predicting
5 mins	**Wrapup:** 1.With 5 minutes left in class, ask students to neaten the stations they are at. 2.Ask them to write down two things that they have learned so far from this investigation in their journals. 3. Remind them that we will continue the investigation the next day and that they should begin at next station in the rotation.	

Day 2

2 mins	**Introduction:** 1. As students enter the classroom, remind them that we are continuing the investigation from the day before. Tell them to begin at the next station in their rotation and to be sure to check their role for the day.	

Science Activity Unit:

30-35 mins	**Activity:** 1.Tell students that they may begin. 2.Remind them that they have ten minutes per station. 3.The teacher should circulate around the room to be sure that students are performing the activities correctly and safely. They should also be sure that everyone is doing their assigned jobs (getter, recorder, etc). 4.After every 9 minutes, give a warning ring. One minute later ring the bell for them to rotate.	**Process skill:** Observing and predicting
5 mins	**Wrapup:** 1.When each group has finished, ask students to neaten the stations they are at and return to their home base. If it is the last class of the day, have the getter return materials to the teacher's workstation. 2. Ask them to write down three things that they had learned from this investigation in their journals.	

Day 3

10 mins	**Introduction:** 1. Have students get into their groups to discuss their findings from the previous day and to determine their final conclusions.	
30-35 mins	**Discussion:** 1.Have the reporters from each group share their findings with class. 2.Post the findings on the board. 3. Ask: What have you learned about our senses from these experiments? Why do you think our senses are important? Students may suggest that they help us to understand and interpret our environments. They may also find that in many cases the use of one sense is sufficient in the understanding of something, but sometimes you must use more than one sense (ie: taste and smell) 4.Ask: What organs are used to sense things? Eyes, nose, ears, mouth, skin. 5.Ask: What about the brain? What is its role? Explain that it is used to process and recognize information that is sent from the sensory organs. Remind students of the different regions of the brain and how there are regions that are used to process each of the senses. 6. Ask: How do you think this information gets from the sensory organs to the brain? Explain that the eyes, nose, tongue, skin, and ears all have receptor cells that receive the information and send it to the brain for processing.	**Concept:** Role of the senses and receptor cells.
5 mins	**Wrapup:** 1. Assign homework: Have students write a brief explanation of how each of the senses sends information to the brain when they eat a sandwich.	

Science Activity Unit:

	Novice	**Competent**	**Expert**
Process Skills Observing and Predicting	Observations and predictions were not accurate based on data. Few or no details were provided.	Made some accurate observations and predictions based on the data provided. Some details are provided.	Made accurate observations and predictions based on data provided. Details are provided.
Habit of Mind Look at a matter from many sides of before drawing conclusions	Does not realize that more than one sense may be needed to interpret a situation. Draws conclusions before gathering enough data.	Realizes that sometimes more than one sense is needed to interpret a situation but cannot provide an accurate explanation.	Realizes that sometimes more than one sense is needed to interpret a situation and can provide an accurate explanation.
Concepts How senses are used to interpret surroundings and the role of receptors in sending messages	Is unable to recognize the role of the receptors of the senses in sending signals to the brain.	Is able to identify that the five senses are uses to help interpret the environment. May be able to correctly identify that receptors are used to send those signals to the brain.	Can clearly explain how each of the five senses uses receptors to send signals to the correct region of the brain for processing.

Worksheets

Station 1: Why Do You Need Two Eyes to See?

In this activity you will investigate how your two eyes work together to allow you to see.

1. With your arms fully extended, hold a plastic drinking straw in one hand and a pipe cleaner in the other.
2. With both eyes open, try to insert the pipe cleaner into the straw.
3. Now close your right eye. Try to insert the pipe cleaner into the straw.
4. Repeat step 3, but close your left eye instead of your right eye.
5. Record observations and try to offer an explanation for what happened.

Teachers notes: Students should find that it is harder to insert the pipe cleaner when they have one eyed close. They may notice that closing one eye impairs their ability
to judge depth.

Station 2: What's in the Bag?

Your challenge is to use only your sense of touch to identify the objects in the bag. You will not look inside the bag. You may take the objects out of the bag.

Record your observations of each of the objects and try to identify each of the objects based on your observations.

Teachers Notes: Students should be able to identify most of the objects by only using their sense of touch. They should realize that they can determine characteristics such as size, shape, texture, and weight, but not color, scent, or taste.

Station 3: What flavor is it?

1. Choose a jellybean and predict what flavor you think it is. You may only touch the jellybean at this time. Explain what observations led you to your prediction.

2. You may now taste your jellybean. BUT, you must pinch your nose closed. Chew slowly and do not swallow yet. Record your observations.

3. You may now finish chewing your jellybean without pinching your nose. Allow your sense of smell to work. Record your findings.

Teachers notes: Students may predict a flavor based on color but find out after testing it that it is different. They should realize that when they pinch their nose they can only taste sweetness not flavor. The flavor cannot be detected until the sense of smell is introduced.

Station 4: Matching Tones

1. At this station you will find two sets of bottles separated by a cardboard divider. Two people will have one set of bottles and the other two will have the other set of bottles. Pairs should not see each other's bottles.
2. The first pair should play a tone by striking a bottle with the wooden mallet.
3. The second pair should respond by striking one of their bottles to try to match the tone.
4. If you are the responding team, record how many tries it takes you to match the tone correctly. Repeat then switch roles.

Science Activity Unit:

Record your answers to the following questions in your journal.

5. Were you able to match the tones on the first try? Did you get more accurate results with practice?
6. How did you determine which bottle to try? What does this tell you about sound?

Teachers notes: Students should find that after several tries they can begin to distinguish which tone matches based on the sound that is made with different levels of water.

Science Activity Unit:

Lesson: Neural Pathways

Relationship of this Lesson to the unit: This lesson explains the how neurons help the brain respond to stimuli. The students will act out a neural pathway of information to and from the brain. This will lead up to the lesson on reaction time.

Massachusetts Frameworks Strand and Learning Standard: Life Science standard #6: Identifying the general functions of the major systems of the human body and describing ways that these systems interact with each other.

Concepts:
- Identify stimuli and responses.
- Role of neurons in sending messages to the brain and the sequence of the neural pathway

Processes: communicating

Science Habit of Mind: Open minded, willing to change your mind in the face of reliable evidence, and respect another's point of view.

Other Subject Area Objectives:
- Descriptive journal writing

Session Length: 2 (45 minute) session

Materials Needed: (Per group of 4)
- ❑ neuron transparency
- ❑ book
- ❑ neuron cards

Day 1

TIME	PROCEDURE	CONCEPT
10 mins	**Introduction:** 1. When the class has settled into their seats, drop a book in the front of the class. 2. Ask: What just happened? Some may say there was a loud noise or that a book dropped. 3. Ask: What did you do when you heard the book drop? Some may say they jumped, their heart raced, they were scared. 4. Explain that those actions (jumping, heart racing) were responses. 5. Ask: What were you responding to? They should answer that they are responding to the book being dropped or to the loud sound. 6. Explain that they are responding to a stimulus. 7. Ask the students to write in their journal what they think the definitions of a stimulus and response are based on what they just learned. 8. Discuss answers as a class.	
10-15 mins	**Discussion:** 1. To reinforce the idea of stimulus and response, propose the following scenario: Suppose you looked up and saw a book sliding off of a table right over your foot. What would you do? Most students will reply that	

	they would move their foot. Ask: What is the stimulus in this problem? Book falling. Ask: What is the response? Moving your foot. 2. Ask: How do you think you know to respond to stimuli? Students may recognize from the previous lesson that a message is sent to the brain to be processed and back.	
	3. Ask: How do you think a message is sent to the brain and back? Suggest for them to think about how other messages are usually sent. Some may respond through mail, the internet, or over the telephone. 4. Ask: How do messages from the internet or telephone get sent? Some may suggest through electrical wires. 5.Explain that messages to the brain are also sent out along electrical wires called nerves and that nerves are made up of message carrying cells called neurons.	
10-15 mins	**Part B: Introduction to neural pathways.** **Introduction:** 1. Display a transparency of a neuron. Ask students to make observations. They may comment that it is long and thin, and has parts sticking out. 2. Explain that the neuron is made up of three parts: the dendrite, the cell body, and the axon. Point out the three parts on the overhead. 3. Explain that the dendrites carry impulses toward the cell body and the axon carry impulses away from the cell body. These axons and dendrites are sometimes called nerve fibers. Nerve fibers are bundled together as a nerve.	Concept: Role of neurons in the transfer of information
5 mins	**Wrap up:** 1. Have students write down three things that they have learned today in their journals. 2. Assign homework: Worksheet problems to identify stimulus and response of different scenarios.	

Day 2

5 mins	**Introduction:** 1. Review stimulus and response by going over homework. 2. Review the parts of a neuron.	
10 mins	**Activity:** 1. Ask students to stand and form a line around the classroom. Explain that they will model information flow (messages) through a neural pathway. A neural pathway is a path of information flow through the body. Each student represents one neuron along the pathway. 2. Ask students to hold out their arms forming a fist with their right hand and leaving their left hand open. Students should stand close to one another but leave a space between adjacent hands. Explain that as neurons, the open left hand represents their axon end, and their right fist represents the dendrite end. 3. Tell the students that they will be passing information through their	Process: Communicating

	model pathway by using their open hand to tap the fist of the person next to them. 4. Start the flow of information through the pathway by tapping the fist of the rightmost student of the line with your left hand. Each student should pass the information along by using their axon (left hand) to tap the dendrite (right fist) of the student next to them. Allow the information to be passed through the entire line of students. 5. Now ask a student in the middle of the line to face the opposite direction from the rest of the line, leaving the same hands open and fisted. 6. Once again start the flow of information by tapping the fist of the rightmost student in line. 7. Ask: What happens to the signal? Students may say that it stops. 8. Ask: Why did it stop? Students may come up with the idea that the open hand can only send information and the fist can only receive information.	
10 mins	**Discussion:** 1. Have students return to their seats. Ask: What does this experiment suggest about the information flow through neurons? Be sure that students understand that information flows though neurons in one direction only. Axons receive information and dendrites send it. The brain itself is made of neurons and it sends billions of electric messages from place to place in the brain. 2. Explain that there are three types of neurons. Sensory neurons, interneurons, and motor neurons. Explain the role of each.	
10-15 mins	**Activity** 1. Provide each group with a set of cards labeled with the following: receptor, stimulus, muscle, motor neuron, sensory neuron, and interneuron. 2. Challenge each group to arrange the cards in order. 3. The teacher should circulate throughout the room with a checklist. As they get to each group they should listen to students rationale for putting the cards in order. They should mark off the concepts and processes each student demonstrates.	**Process:** Communicating **Science habit of mind:** Open minded, willing to change your mind in the face of reliable evidence, and respect another's point of view.
5 mins	**Wrap up:** 1. Discuss results as a class. 2. Have getters return the pile of cards. 3. Assign homework: Worksheet "Sending a message" from Foss.	

Science Activity Unit:

	Novice	**Competent**	**Expert**
Process Skill Communicating	Does not clearly describe and present their ideas.	Somewhat describes and presents their ideas based on factual evidence.	Clearly describes and presents ideas based on factual evidence. Able to persuade others of their ideas
Habit of Mind Open minded, willing to change your mind in the face of reliable evidence, and respect another's point of view	Is not open to accepting others suggestions and does not make any suggestions to the group.	Is willing to suggest and accept some ideas based on evidence.	Willing to suggest and accept others ideas based on evidence from the lesson.
Concept • Identify stimuli and responses • Role of neurons in sending messages to the brain and the sequence of the neural pathway	Cannot correctly identify the stimuli and responses of different scenarios. Cannot identify the different neurons. Cannot arrange them in the correct order for the neural pathway.	Correctly identifies some of the stimuli and responses of the different scenarios. Correctly identifies some of the neurons and their roles. Arranges most of them in correct order.	Correctly identifies the stimuli and responses of the different scenarios presented. Correctly identifies the roles of each of the types of neurons. Correctly arranges them in order for the neural pathway.

Science Activity Unit:

Lesson: Reaction Time

Relationship of this Lesson to the unit: This lesson explains the how reaction time influences responses to stimuli, particularly visual stimuli. It will lead into a discussion and investigation of the factors that may affect reaction time in humans.

Massachusetts Frameworks Strand and Learning Standard: Life Science standard #6: Identifying the general functions of the major systems of the human body and describing ways that these systems interact with each other.

Concepts:
- Reaction time in response to stimuli.
- Factors that affect reaction time in response to a stimulus.

Processes: controlling variables

Science Habit of Mind: Be curious. Be careful and accurate in observations.

Other Subject Area Objectives:
- Math: Calculating averages.

Session Length: 3 (45 minute) sessions

Materials Needed: (Per group of 4)

- ❑ Crisp dollar bill
- ❑ ruler

Day 1

TIME	PROCEDURE	CONCEPT
2 mins	**Part A: Introduction**: Hold up a crisp dollar bill to the students. Ask: Do you think it would be easy to catch this dollar if it dropped through your fingers? Tell them that you are going to challenge them to catch a dollar bill but that there are a few rules.	
15-20 mins	**Activity:** 1. Explain that they will work with a partner in their group and take turns trying to catch the bill. One person will hold the bill out in front of them and the other person will position their index finger and thumb about 6-7 cm apart, near the bottom of the bill. As the person holding the bill drops it, their partner will try to catch it. Remind them that they are not to touch the bill before it is dropped. A false start is grounds for disqualification. Tell them to note the steps they took to catch the dollar bill and any observations they made in their science journals.	

10 mins	**Discussion:** 1**.** After each partner has had a turn and they have written their steps/observations, have the table group discuss their results. 2. The reporter from each group should then share their results with the whole class. Student observations may include that it was hard to do. 3. Ask: Why do you think it might have been hard to do? Some may respond that it takes time to "react" or "respond". 4. Ask: What are you responding or reacting to? Some may point out that you are reacting to seeing the bill drop. Remind students of the terms stimulus and response. 5. Ask: What is the stimulus in this activity? Seeing the dollar bill drop. Ask: What is the response? Closing your fingers. 6. To introduce the idea of reaction time, ask: Why did it take time for you to react to the dollar bill? Explain that after a message is received by the eyes, time is required to send it to the brain, process the information, and send out a response message. 7. Ask: How long do you think it took for your brain to respond to seeing the dollar drop? Students will probably respond that it takes seconds. Reinforce the idea that the time it takes for our brains to respond to stimuli is called reaction time.	**Concept:** Reaction time
5 mins	**Wrapup:** Assign homework: Write a paragraph describing how reaction time affects any activities in your life (ie: baseball)	

Day 2

10 mins	**Introduction: Reaction Time** 1. Review the dollar bill activity by reminding students of the concepts of stimulus, response, and reaction time. 2. Ask: Do you think there is a way that we could measure reaction time? Accept all answers. 3. Hold up a ruler. Ask: Do you think we could use this? Let the students try to figure out that they could use the markings on the ruler to help measure reaction time.	**Concept:** Reaction time
30 mins	**Activity:** 1. Assign students their roles in their groups. 2. Tell students that their assignment is to design an experiment to test reaction time using the ruler. 3. Remind the students that they should be sure to control all variables and to conduct at least five trials per subject and calculate their average for more accurate results. 4. After the teacher approves their design, the students may begin their investigation. 5. The teacher should circulate the room to make sure that the students are	**Process skill:** Controlling variables **Process skill:**

	using the correct procedure, doing their assigned job, and recording the results in their journals. 6. When the students have finished collecting their data, have them calculate the averages for each of the members of their group.	Calculating averages
5 mins	**Wrapup:** 1. Clean up. Have getters return materials. 2. Let the students know that we will discuss the results together as a class the next day.	

Day 3

10 mins	**Introduction:** 1. Have students get with their groups and review their results from the previous day. 2. Provide conversion charts to each group to help them convert their measurements on the ruler to real reaction times.	
15-20	**Discussion:** 1. Have reporters share the average reaction times for each of the group members with the class. 2. Post all responses on the board. Calculate the class average. 3. Explain that the average reaction time is between 15-25 hundredths of a second. 4. Ask: Do you think that all people have the same reaction times to certain stimuli? They will probably agree that people can have different reaction times. If not, point out a baseball player trying to hit a ball. 5. Ask: Do you think there are any factors that may influence a person's reaction time? Possible ideas may include age, gender, practice, time of day, etc.	**Process skill:** Calculating averages
15-20	**Activity:** 1. Tell students that their assignment is to design an experiment to test a factor that may affect reaction time with their groups. 2. Remind the students that they should be sure to control all variables. 3. The teacher should circulate through the room with a checklist to identify which groups are designing controlled experiments.	**Process skill:** Controlling variables
2 mins	**Wrap up:** 1. Have reporters share their group's ideas with the class. *** If time permits, have the students test their experiments in class on the following day. If not, it could be assigned as an at home lab or as a research project.	

*** If time permits, we could also use PASCO's EKG probes to measure muscle contraction.

Science Activity Unit:

	Novice	**Competent**	**Expert**
Process Skill Controlling variables	Unaware of different variables and unable to design a controlled experiment	Aware of different variables and able to control many of them especially height of drop and positioning of hand.	Aware of and able to control all variables effectively including finger distance, height of drop, practice, gender, age, etc.
Habit of Mind Be curious. Be careful and accurate in observations	Did not keep accurate records of their observations.	Maintains somewhat accurate records of the data collected. May have used charts.	Maintains accurate and detailed records of all data collected. Includes organized charts, drawings, labels, and procedures.
Concept • Reaction time in response to stimuli. • Factors that affect reaction time in response to a stimulus.	Does not understand that it takes time for a reaction to be processed and does not recognize that factors may have an effect on that reaction time.	Understands that it takes time for a reaction to take place and that there are factors that may affect that reaction time.	Understands that it takes time for a reaction to take place because of the neural pathways. Understands that factors such as age and practice have an effect on reaction time and why.