Title: Nervous System Lab Practicum: Twelve activities that demonstrate or illustrate an action or characteristic of the nervous system.

Grade Level and Course:
7th grade, Life Science
10th grade, Biology

Materials:
- Each activity listed has a materials list.

Instructional Resources Used: (concept maps, websites, think-pair-share, video clips, random selection of students etc.)
- Hands on investigation and exploration; student group work

California State Standards
Grade 7, Life Science:
5. The anatomy and physiology of plants and animals illustrate the complementary nature of structure and function. As a basis for understanding this concept:
   a. Students know plants and animals have levels of organization for structure and function, including cells, tissues, organs, organ systems and the whole organism.
   b. Students know organ systems function because of the contributions of the individual organs, tissues and cells. The failure of any part can affect the entire system.

Grade 10, Biology:
9. As a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable (homeostatic) despite changes in the outside environment. As a basis for understanding this concept:
   b. Students know how the nervous system mediates communication between Different parts of the body and the body's interactions with the environment.
   e. Students know the functions of the nervous system and the role of neurons in transmitting electrochemical impulses.

Common Core State Standards
Grade 7 Writing:
10. Write routinely over extended time frames (time for research, reflections, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes and audiences.
Grade 7 Speaking and Listening:
4. Present claims and findings (e.g., argument, narrative, summary presentations), emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details and examples; use appropriate eye contact, adequate volume and clear pronunciation.

Grade 10 Writing:
10. Write routinely over extended time frames (time for research, reflections and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes and audiences.

Grade 10 Speaking and Listening:
4. Present information, findings, and supporting evidence clearly, concisely, and logically (using appropriate eye contact, adequate volume and clear pronunciation) such that listeners can follow the line of reasoning and the organization, development, substance and style are appropriate to purpose (e.g., argument, narrative, informative, response to literature presentations), audience and task.

Lesson Objectives:
- Students will experience twelve activities that demonstrate or illustrate an action or characteristic of the nervous system.

Differentiation Strategies to meet the needs of diverse learners: In the written Responses to each activity:
- English Learners: Students will record answers for each activity with complete sentences and illustrate a component of the activity. e.g., For Activity 3, a drawing of what the inside of the box may be.
- Special Education: Students who have difficulty expressing their answers in writing will give their answers to their partner who in turn will record responses. Students may also draw/diagram their thoughts.
- GATE: Students will reference each answer with a textbook or other source citation. All written answers will be in complete sentences. An oral presentation of at least two activities will be given to table groups at the completion of the two days’ activities.

ENGAGE
Describe how the teacher will capture students’ interest.
- The day prior, teacher tells the students that during the next two days they will be investigating and experiencing the nervous system.
- The teacher will greet the students outside the room, with the door closed. He/she will tell the students that the room looks very different today and that they need to place their backpacks in the back and get out a pencil only. The room will be set up for the twelve activities. The anticipation of the unknown should spark student interest.

What kind of questions should the students ask themselves after the engagement?
- Students will ask: What are the twelve activities about?
- Will I get to choose who I work with?
- What things about the nervous system will we learn about today?

**EXPLORE**
- Describe the hands-on laboratory activity that the students will be doing.
- List the “big idea” conceptual questions that the teacher will ask to focus the student exploration.

**Activity 1 How Sensitive Are You?**
Purpose: To learn which areas of the skin have more pressure sensory cells than others parts of the skin.
Materials:
- paper clip
- metric ruler
- Lab paper
Procedure:
1. Students will measure the distance between two tips of the paper clip to determine the distance between two sensory nerves for pressure.
2. Students will write down the distance when your partner goes from feeling one pressure point to feeling two pressure points.
3. Students will test this on the palm of their hand, fingertips, forearm, upper lip, forehead, shoulder, cheek, sole of their foot, calf and nose.
Results:
Students will record each distance on their own paper. These results will be shared later at their table groups.

Note: the following descriptions only include the purpose as each has its individual materials, procedures and results.

**Activity 2: Numb!**
Purpose: To demonstrate how the brain interprets messages from sensory receptors in the skin.

**Activity 3: Pictures from Sound**
Purpose: To show that the mind can change sound messages and sensory touch signals into mental pictures.

**Activity 4: How Simple is a Task?**
Purpose: Inferring

**Activity 5: How Does Your Knee React?**
Purpose: Inferring

**Activity 6: Concentration**
Purpose: To test your power of concentration.

**Activity 7: In the Way**
Purpose: To demonstrate the body's automatic balance responses.

**Activity 8: Ready or Not**
Problem: Do people's reaction times vary at different times of the day?
Purpose: Developing hypotheses, controlling variables, drawing conclusions.

**Activity 9: Why Does the Pencil Seem to Bend?**
Purpose: To demonstrate how light is bent when it passes through water.

**Activity 10: Hot or Cold?**
Purpose: To demonstrate that sensations of cold and hot can be deceiving.

**Activity 11: Chair Balance Lift**
Purpose: To demonstrate the difference between the center of gravity of a boy and girl.

**Activity 12: Smelly**
Purpose: To determine temperature affects odor.

*Adapted from Janice Van Cleave*

EXPLAIN

- What is the “big idea” concept that students should have internalized from doing the exploration?

**Nervous System**

Tasting, smelling, seeing, hearing, thinking, dreaming, breathing, heart beating, moving, running, sleeping, laughing, singing, remembering, feeling pain or pleasure, painting, writing...you couldn't do any of these things without your central nervous system!

**What is the nervous system?**
Made up of your brain, your spinal cord, and an enormous network of nerves that thread throughout your body, it's the control center for your entire body. Your brain uses information it receives from your nerves to coordinate all of your actions and reactions. Without it, you couldn't exist!

**What are nerves?**
They're the thin threads of nerve cells, called neurons that run throughout your body. Bundled together, they carry messages back and forth just the way that telephone wires do. Sensory nerves send messages to the brain and generally connect to the brain through the spinal cord inside your backbone. Motor nerves carry messages back from the brain to all the muscles and glands in your body.

- List the higher order questions that the teacher will ask to solicit student explanations for their laboratory outcomes, and justify their
Please find the higher order questions listed with each individual activity.


**EXTEND**

- How is this knowledge applied in our daily lives?
  - Balance, coordination, concentration, sensory input, reflexes, and reactions all affect our daily lives.
- What are some other opportunities for extension that the students might have?
  - Students will create a graphic organizer illustrating examples of reflexes, balance, coordination, senses,

**Background Knowledge for the Teacher:**

Students were first introduced in grade one to the complementary nature of structure and function when they studied different shapes of animal teeth and inferred the kinds of food those animals eat. Students in grade three studied the eternal physical characteristics of organisms and considered their functions as a matter of adaptation. Students in grade seven will deepen their understanding of internal structures, a topic that was introduced in grade five.

Anatomists and physiologist consider at different levels the internal structures of living organisms. ... Organs themselves may have specific tissues; for example, the white and gray matter of the brain can serve multiple functions.

Students also study the intricate structures of the eye and ear, which have well-understood functions in sight and hearing. ... From California Department of education, Standards and Framework.

*adapted from Janice Van Cleave:

Student pages are attached.
NERVOUS SYSTEM LAB PRACTICUM

ACTIVITY 1: How Sensitive Are You? (*JVC): 5 points

**Purpose:** To learn which areas of the skin have more pressure sensors than others.

**Materials:**
- paper clip
- paper and pencil
- ruler
- a partner

**Procedure:**
1. Straighten a paper clip and bend it into the shape of a U.
2. Make sure the tips are level with each other.
3. Now, ask your partner to close his/her eyes.
4. Arrange the ends of the clip 1 cm apart.
5. Touch both ends of the clip gently (and at the same time) onto the back of your partner’s hand and ask if they only felt one pressure point or two.
6. If your partner felt only one pressure point, spread the tips of the paper clip and try again. Record the distance when your partner goes from feeling one pressure point to feeling two.
7. To make it difficult for your partner to guess the answer, watch both the distance between the tips, and whether you actually place one or both tips on their skin.

~Try this on the palm and back of the hand, fingertips, forearm, upper arm, and other parts listed below. Be sure to record the distances.

**Results:**

<table>
<thead>
<tr>
<th>Area</th>
<th>Distance (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fingertips</td>
<td></td>
</tr>
<tr>
<td>Upper lip</td>
<td></td>
</tr>
<tr>
<td>Cheek</td>
<td></td>
</tr>
<tr>
<td>Nose</td>
<td></td>
</tr>
<tr>
<td>Palm</td>
<td></td>
</tr>
<tr>
<td>Forehead</td>
<td></td>
</tr>
</tbody>
</table>
Which part of your body can two points be detected with the smallest tip separation?

What is the most sensitive part?

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**ACTIVITY 2: Numb (**JVC): 5 points**

*Purpose:* To demonstrate how the brain interprets messages from sensory receptors in the skin.

*Materials:*
- pencil

*Procedure:*
1. Use the index finger and thumb of your right hand to rub the upper and undersides of the index finger of your left hand.
2. Hold the pencil in your left hand against the underside of the index finger on that hand.
3. Rub the upper side of your left index finger and the pencil at the same time.

*Results:* When the pencil is held against the finger and both are rubbed, it feels as if part of your finger is numb. Why?

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**ACTIVITY 3: PICTURES FROM SOUND,** (**JVC): 5 points

*Purpose:*
To show that the mind can change sound messages into mental pictures.

*Materials:*
- 2 shoe boxes
- 2 marbles
- cardboard dividers
**Procedure:**

Give your partners the two boxes. Ask them to rotate each box back and forth. Listening for the sounds heard to determine the shape of the open space inside each box.

**Results:**

What does your partner say about the shape of the inside of the box and why?

_______________________________________________________________________________________________

**ACTIVITY 4: HOW SIMPLE IS A TASK, 5 points**

**Purpose:**
To learn how to make inferences.

**Materials:** paper pencil penny

**Procedure:**
1. Trace the outline of a penny in twelve different places on the paper.
2. Number the circles from 1 through 12. Write the numbers randomly, in no particular order.
3. Now pick up the penny again. Put it in each circle, one after another, in numerical order, beginning with 1 and ending with 12.

**Think It Over: Inferring** Make a list of all the sense organs, muscle movements, and thought processes in this activity.

<table>
<thead>
<tr>
<th>Sense Organs:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscle Movements:</td>
<td></td>
</tr>
<tr>
<td>Thought Processes:</td>
<td></td>
</tr>
</tbody>
</table>

Compare your list with your table group’s lists. What organ system coordinated all the different processes involved in this task? ____________________________

**ACTIVITY 5: How Does Your Knee React?, 5 points**

**Purpose:**
To learn how to make inferences.

**Materials:**
Table a partner
Tips: Be careful to not be silly and mess around at this station! Serious damage can be done if you strike each other too hard on the kneecap!

Expected Outcome: Students’ legs will swing forward.

Think It Over:
Inferring-When might it be an advantage for your body to react very quickly and without your conscious control?

ACTIVITY 6: Concentration (*JVC): 5 points
Purpose: To test your power of concentration.

Materials: Chair

Procedure:
1. Sit in the chair with your feet on the floor.
2. Use your right foot to trace a clockwise pattern in front of your body.
3. Keep your foot going in a circle while you move your right hand around in a clockwise pattern in front of your body.
4. Continue tracing the circular pattern with your foot, but change the hand pattern to an up-and-down motion.

Results: It is easy for the foot and hand to perform the same pattern of movement, but difficult to move them simultaneously in two different patterns. Why?

ACTIVITY 7: In the Way (*JVC): 5 points
Purpose: To demonstrate the body’s automatic balance responses.

Materials: Wall

Procedure:
1. Stand with your feet about 12 inches (30 cm) apart, and with your right foot and right shoulder against the wall or cupboard.
2. Try to bend your left knee so your left foot is lifted 4 inches above the floor.

Observations: ___________________________________________________________

Why? (Hint: center of gravity) ___________________________________________
ACTIVITY 8: Ready or Not, 5 points
Materials: meter stick partner

Problem:
Do people’s reaction times vary at different times of the day?

Procedure:
1. Have your partner hold a meter stick with the zero end about 50cm above a table.
2. Get ready to catch the meter stick by positioning the top of your thumb and forefinger just at the zero position.
3. Your partner should drop the meter stick without any warning. Using your thumb and forefinger only, no other part of your hand), catch the meter stick as soon as you can. Record the distance in centimeters that the meter stick fell. This distance is a measure of your reaction time.

Record three trials here: ______cm ______cm ______cm

Questions:
Did the distances measured increase or decrease with each trial? _____ Discuss how you can use this activity to find out whether people’s reaction times vary at different times of day. Consider the questions below.
   a. What hypothesis will you test?
   b. What variable do you need to control?
   c. How many people will you test? How many times will you test each person?

ACTIVITY 9: Why Does the Pencil Seem to Bend? (*JVC): 5 points
Purpose:
To demonstrate how light is bent when it passes through water.

Materials: 500 ml glass beaker 250 ml water pencil

Question: What happens to light when it goes through water? How does this affect what you see when you look at the pencil in the water?

ACTIVITY 10: Hot or Cold? (*JVC): 5 points
Purpose:
To demonstrate that sensations of cold or hot can be deceiving.

Materials:
three 6 qt (6 liter) bowls thermometer
ice cubes spoon
cold and warm tap water
**Procedure:**
1. Fill two of the bowl ¼ full with cold tap water. Allow one bowl to stand for 5 minutes to reach room temperature. This will be the medium water.
2. Add 1 cup of ice cubes to the second bowl. Use the spoon to stir until the ice cubes are about half melted.
3. Fill the third bowl ¼ full with warm tap water. This will be the warm water. Use the thermometer to make sure it is about 113 degrees Fahrenheit (45 C).
4. Place the bowls on a table with the cold water on your right, the medium water in the middle, and the warm water on your left.

**Results:** ____________________________________________________________

**ACTIVITY 11: Chair Balance Lift, 5 points**

**Purpose:**
To demonstrate the difference between a boy’s and girl’s center of gravity.

**Materials:**
chair against a wall

**Procedure:**
1. Place feet up to the line, lean forward, bending at the waist.
2. Place your head touching the wall, and your hands on the sides of the chair seat.
3. Attempt to lift the *chair* and *your head* off the wall *simultaneously*.

**Observations:** ________________________________________________________

Why do you think there was a difference?

________________________________________________________________________

**ACTIVITY 12: Smelly, 5 points**

**Purpose:**
To determine how temperature affects odor.

**Materials:**
4 Tablespoons (120 ml) chocolate ice cream
Two 5 oz (150 ml) paper cups

**Procedure:**
1. Place 2 Tablespoons of ice cream in each cup.
2. Place one cup in the freezer and leave the other cup sitting at room temperature.
3. Remove the cup from the freezer and smell its contents.
4. Smell the contents of the unchilled cup and compare it to the smell of the other cup’s contents.

**Observations:** ________________________________________________________

Why? (Hint: odor, vapor, vaporize):

________________________________________________________________________