

Lesson Title: *Sensory Systems*

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Topic: *Information processing -sensory systems*

Signals in our environment and how they are picked up- how do we sense light, sound, temperature?

Targeted Grade Level: *4th grade, but it could be adapted for 3-5*

Time Needed: *2-3 days*

Subject Integration: Science, Engineering, Reading & Writing

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts:
<ul style="list-style-type: none"> • <u>Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.</u> • <u>Develop a diagram or simple physical prototype to convey a proposed object, tool, or process.</u> 	<p>LS1.D: Information Processing How do organisms detect, process, and use information about the environment?</p> <p>Different sense receptors are specialized for particular kinds of information; Animals use their perceptions and memories to guide their actions.</p>	<p>Students understand that a system is a group of related parts that make up a whole and can carry out functions its individual parts cannot. They can also describe a system in terms of its components and their interactions.</p>

<p>Standard 1: Oral Expression and Listening GLE 1: Pose thoughtful questions after actively listening to others.</p>	<p>Standard 1: Physical Science GLE 6: An object can be seen when light reflected from its surface enters the eyes. EO a: Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. (4-PS4-2) (Boundary Statement: Does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision or how the retina works.)</p>	<p>Standard 2: Life Science b: Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. (4-LS1-2) (Clarification Statement: Emphasis is on systems information transfer.) (Boundary Statement: Does not include the mechanisms by which the brain stores and recalls information or the mechanism of how sensory receptors function.)</p>	<p>Writing and Composition GLE 2: Write informative/explanatory texts using text structures appropriate for the purpose and developed through facts, definitions, concrete details, precise language, and domain-specific vocabulary.</p>
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Other Standards

Ocean Literacy Core Principle 5: The ocean supports a great diversity of life and ecosystems.

- a. Ocean ecosystems are defined by environmental factors and the community of organisms living there. Ocean life is not evenly distributed through time or space due to differences in abiotic factors such as oxygen, salinity, temperature, pH, light, nutrients, pressure, substrate and circulation. A few regions of the ocean support the most abundant life on Earth, while most of the ocean does not support much life.
- b. There are deep ocean ecosystems that are independent of energy from sunlight and photosynthetic organisms. Hydrothermal vents, submarine hot springs, and methane cold seeps rely only on chemical energy and chemosynthetic organisms to support life.

Measurable Objectives:

Students will develop a system model of a human sensory system as well as a system model for a fish sensory system.

Students will be able to accurately label the components of a system model and the interactions between components.

Students will be able to think critically about changes in a system and how they will affect the system. This will be measured by students hypothesizing what could change and supporting that hypothesis with evidence.

Rubric:

System Model

4	3	2	1
All major and minor components of the system are labeled. The Direction and interactions are correctly labeled with arrows.	All major components of the system are labeled. The Direction and interactions are correctly labeled with arrows.	Some components of the system are labeled. The interactions are labeled. For Example: "brain- sends message- to hand muscles"	Student attempted to name parts of the system

5E Model	5E Objectives
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Engage

Introduce the lesson with an anchoring phenomenon. Facilitate student questions, discussion, etc. as appropriate. Learn about what students already know and want to know.

Procedure:

Students should prepare their science notebooks to write down two questions and one statement.

The teacher should play the video “How Animals see the world”

As students watch, they can write down their wonderings or things that come to mind.

Students may share with their partner or group depending on the setup. After sharing with each other, the students should share their partner’s question or comment. This encourages active listening.

The teacher should record questions, and assumptions on a chart paper for all to see. Questions may include: Why do some animals see different colors? Why can some animals see farther?

If no one bring it up, the teacher may ask “Do animals smell things, or taste things differently?” or “Are other senses different between animals and humans?”

Modifications

Students who struggle with writing should have teacher or para support to get their thoughts out on paper.

Standards Addressed

Standard 1: Oral Expression and Listening

GLE 1: Pose thoughtful questions after actively listening to others.

Formative/Summative Assessments Formative assessment of student understandings will be collected through auditory answers and written questions.

Resources

https://www.youtube.com/watch?v=vHhDHk-kBYY&ab_channel=Jaw-DroppingFacts



Explore

Plan for students to engage in hands-on activities that are designed to facilitate conceptual change.

Procedure:

Students will be constructing a 'pinhole camera' from the Science Learning Hub. The materials and procedure listed below can be found in the full document linked in the resource section.

What you need

- Copies of the student instructions Make a pinhole camera.
- 2 x hollow cylinders of slightly different diameters so that one fits snugly inside the other (tubes from plastic wrap and paper towels can fit together well) OR 2 x sheets of A3 size black cartridge paper
- 1 x translucent plastic bag – plastic bags from the supermarket vegetable aisle work well
- Aluminium foil
- Rubber band
- Cellotape
- Magnifying lens

Make a pinhole camera

1. Roll one sheet of black A3 paper into a hollow cylinder of 30 cm length with a diameter of approximately 7 cm and tape along the entire length of the tube.
2. Place translucent plastic across one end of the tube you have made (or the tube from plastic wrap) so that it is flat with no wrinkles. Hold it in place with a rubber band. This forms the screen on which the image will be projected. Trim the excess plastic and then tape the plastic all the way around the tube to hold it taut and in place. Remove the rubber band.
3. Roll the second sheet of black A3 paper around the first tube (or use the tube from the paper towels). Ensure that it is a snug fit, but so that the inside tube can still slide easily within the outside tube.
4. Cut a square of aluminium foil approximately 10 x 10 cm. Place this to form a flat surface over the end of the outside tube. Fold the side of the aluminium foil around the outside of the tube and hold it in place with a rubber band. (You may use black paper instead of aluminium foil.)
5. Use a sharp pencil to place a small hole of 1 mm diameter in the centre of the aluminium foil.
6. Place the inner tube inside the outer tube. Ensure that the plastic screen is at the same end of the tube as the aluminium foil.
7. Pull the inside screen slightly away from the aluminium foil so that the hole and the screen are separated.
8. Point the hole towards a sunny scene and hold the open end to your eye. Make sure the Sun is behind you. You may like to look at a student standing about 5 metres in front of you. Observe what happens if the person waves their arms and jumps up and down.

9. Record your observations. Investigate what happens to the size, brightness and sharpness of the image when:

- the screen is further or closer to the hole
- the size of the hole is increased
- several holes (e.g. 5 holes) are used at the same time
- a large hole (e.g. 1 cm diameter) is used
- a magnifying lens is placed over the same sized (e.g. 1 cm) large hole

10. With the lens attached and the image sharply in focus:

- What happens when the screen is moved slightly further away from the hole?
- Without moving the screen, observe what happens to the focus of the image when a smaller hole (e.g. 3 mm diameter) is placed just in front of the lens.

Modifications

Some of the directions may need a language shift for clarity. For example “ensure” could be rewritten as “make sure.” Alternatively, the directions could be looked at as a whole class and students could make notes about the meanings of unfamiliar words. Students will most likely need refreshers around the words “diameter” “translucent” “cylinder” and “taut.”

Spanish translations- “diámetro” “translúcido” “cilindro” “tenso”

Standards Addressed

Standard 1: Physical Science

GLE 6: An object can be seen when light reflected from its surface enters the eyes.

EO a: Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen. (4-PS4-2) (Boundary Statement: Does not include knowledge of specific colors reflected and seen, the cellular mechanisms of vision or how the retina works.)

Formative Assessments

The teacher should ask some of the prompting thought questions from pages 2,3, & 4 of the resource. Are students actively making connections?

Resources

Pinhole camera lesson and discussion questions

<https://www.sciencelearn.org.nz/resources/58-pinhole-cameras-and-eyes>

Explain

Facilitate opportunities for students to explain their understanding of concepts and processes and make sense of new concepts.

Procedure: The goal of this section is for students to explain their understanding by constructing a system model of their pinhole camera and a system model of an eye.

The teacher will model how to draw a system model.

The teacher may choose to model 'how the touch system works' so that it is separate from the student work.

Students will examine a diagram of a human nose and olfactory gland as well as that of a fish. In their groups they may discuss what is the same, and what is different. Students should make a short jot about the similarities and differences, and then try to make a system model of the Olfactory system AS A GROUP.

The class should come back together and compare system models from groups. Did everyone have the nostrils as the first part of the system? Did anyone include air movement?

This same procedure will be done with the optic nerve and lobes. **However**, this time students will be asked to create their own system model in their journal.

The teacher should roam, supporting with question prompts like "Are there any pieces missing from your system?" "Which direction does your system flow?"

Modifications

Some students will need a premade graphic organizer for their system model. OR, the teacher could draw the number of boxes necessary for them, and they just need to label the components and how they interact.

Some of the words like "occipital lobe" can be re-labeled as "brain" for lower readers.

Standards Addressed

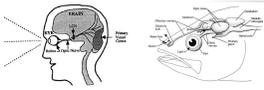
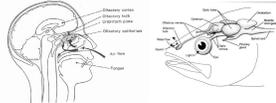
Life Science

GLE 1: Organisms have both internal and external structures that serve various functions.

- Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution.

Formative Does the model show that the student understands the components and interactions of the system?

Resources

<p>Teacher modeling a system</p>  <p>Label the parts of the system</p> <p>Then show the movement of the system and how they affect each other.</p>	 <p>Ask: How are these systems the same? How are they different? What is the first part of the system? The last part?</p>	 <p>Ask: How are these systems the same? How are they different? What is the first part of the system? The last part?</p>
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Elaborate

Provide applications of concepts and opportunities to challenge and deep ideas; build on or extend understanding and skills.

Procedure:

Students should pick an organism from the list below. Then students should create a system model to show how the organism's sense works.

Senses that work in the Dark

Many fish use other sensory systems instead of vision. These fish have adapted to life without light, either because they are nocturnal or because they live in areas of the sea so deep that little or no light reaches them.

Flashlight Fishes produce their own illumination with the aid of a colony of bioluminescent bacteria.	Hatchet Fishes have very large eye lenses to collect all available light.	Blackbar soldierfish- Often swims upside down under cave ceilings. Emits rapidly repeating pulses of sound. Aggregates around coral reefs and deeper rocky reefs	Popeye catalufa- nocturnal, live in sheltered areas and caves as deep as 300 ft. they have specialized eyes that enable them to see well in low light conditions.	OR investigate: The lateral line on a fish is a sensory system that detects water movement surrounding the fish. Although mostly used at close range, the sensitivity of the lateral line could detect the wake left by a fish. Just by sensing the wake, the predator can determine the size of its prey and which direction it swam, helping the predator hunt and capture prey in complete darkness.
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Students will use the classroom research resources to find out more about the sensory system they chose.

The teacher should be supporting students with skimming and scanning the resources.

Modifications

Some students will need a premade graphic organizer for their system model. OR, the teacher could draw the number of boxes necessary for them, and they just need to label the components and how they interact.

ELL students may

Standards Addressed

Life Science: a. Organisms have both internal and external structures that serve various functions. b: Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

Formative Assessment Does the model show that the student understands the components and interactions of the system?

Resources

https://docs.google.com/document/d/1BNe2aAhUiz2c9_cPurGzWjXbkFUQ8-uur-GbUzm3MJE/edit



Evaluate

Assess students knowledge, skills and abilities.

Procedure:

Students will show a deep understanding for sensory systems by hypothesising problems that could occur and supporting their thinking with evidence. Big question: What happens when something is changed in the system?

Scenario #1- An oil spill has blackened the surface of a nearby coast. Zero light is able to penetrate the oil. How will lack of light affect some fish? Will any fish still be able to get around in the water?

Scenario #2- A brand new floating concert stage has opened up next to a local reef. People are excited about being able to look at the fish while they listen to music. The music is very loud and the sound waves travel into the water. How will this affect some fish?

Students should be able to write their thinking for 1-2 of the scenarios.

Modifications

Students may choose to use provided sentence frames for their thinking.

Standards Addressed

Life Science: a. Organisms have both internal and external structures that serve various functions. b: Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

Physical Science: An object can be seen when light reflected from its surface enters the eyes.

Writing and Composition: Write informative/explanatory texts using text structures appropriate for the purpose and developed through facts, definitions, concrete details, precise language, and domain-specific vocabulary.

Summative Assessments Student writing will be judged for their effort at their current level. Did they provide a hypothesis about how the scenario would affect the fish? Was their hypothesis based in evidence? Did they extend their thinking to think of a solution?

Resources



Teacher Background Knowledge:

Signals go to nerves or neurons and go to our brain

The brain processes that information to the correct part of the brain (switch board operator)

Then it moves to action- could be immediate like a reflex on something hot, or calculated “learned” behavior

Signals are electromagnetic, mechanical, and chemical

Plants can grow towards light - phototropism

<https://thewonderofscience.com/videos/2017/12/10/ls1d-information-processing>

Many fish use other sensory systems instead of vision. These fish have adapted to life without light, either because they are nocturnal or because they live in areas of the sea so deep that little or no light reaches them.

LS1.D: INFORMATION PROCESSING

How do organisms detect, process, and use information about the environment?

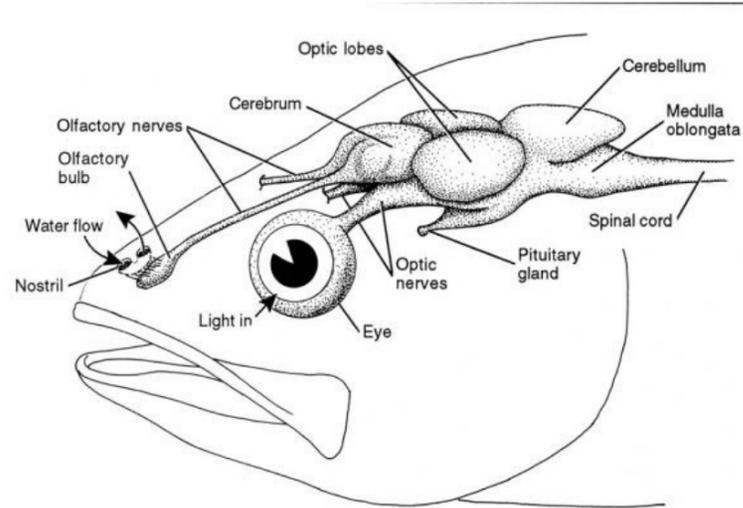
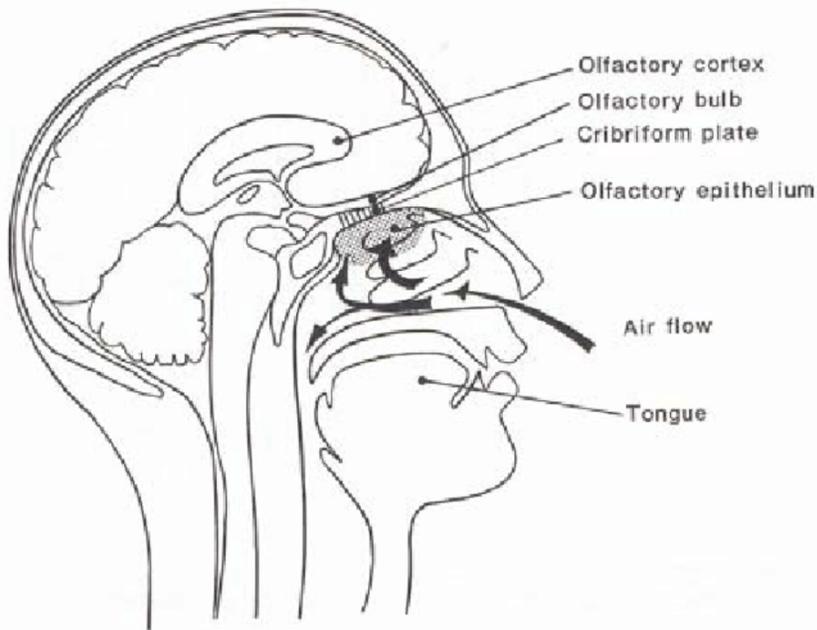
An organism's ability to sense and respond to its environment enhances its chance of surviving and reproducing. Animals have external and internal sensory receptors that detect different kinds of information, and they use internal mechanisms for processing and storing it. Each receptor can respond to different inputs (electromagnetic, mechanical, chemical), some receptors respond by transmitting impulses that travel along nerve cells. In complex organisms, most such inputs travel to the brain, which is divided into several distinct regions and circuits that serve primary roles, in particular functions such as visual perception, auditory perception, interpretation of perceptual information, guidance of motor movement, and decision making. In addition, some of the brain's circuits give rise to emotions and store memories. Brain function also involves multiple interactions between the various regions to form an integrated sense of self and the surrounding world.

Grade Band Endpoints for LS1.D

By the end of grade 2. Animals have body parts that capture and convey different kinds of information needed for growth and survival—for example, eyes for light, ears for sounds, and skin for temperature or touch. Animals respond to these inputs with behaviors that help them survive (e.g., find food, run from a predator). Plants also respond to some external inputs (e.g., turn leaves toward the sun).

By the end of grade 5. Different sense receptors are specialized for particular kinds of information, which may then be processed and integrated by an animal's brain, with some information stored as memories. Animals are able to use their perceptions and memories to guide their actions. Some responses to information are instinctive—that is, animals' brains are organized so that they don't have to think about how to respond to certain stimuli.

Sheet resources are available below

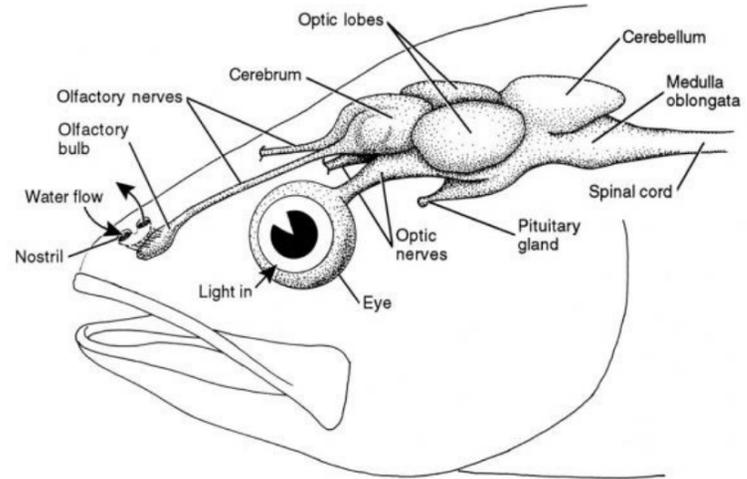
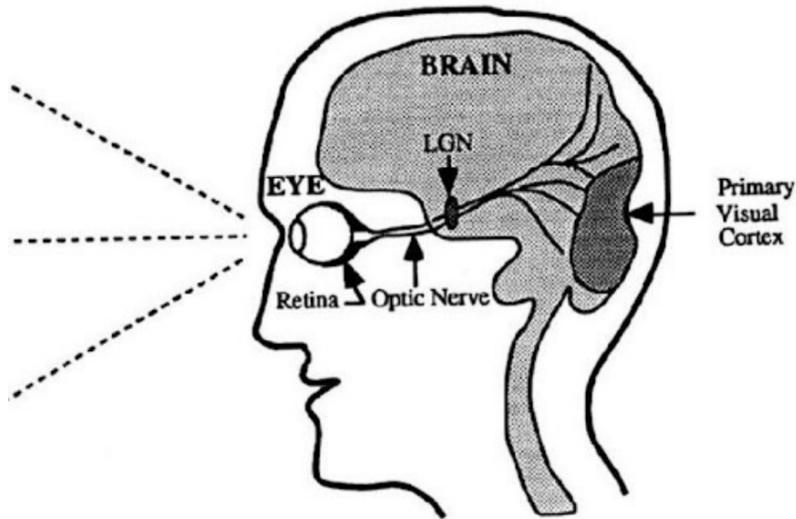


Ask:

How are these systems the same?

How are they different?

What is the first part of the system? The last part?

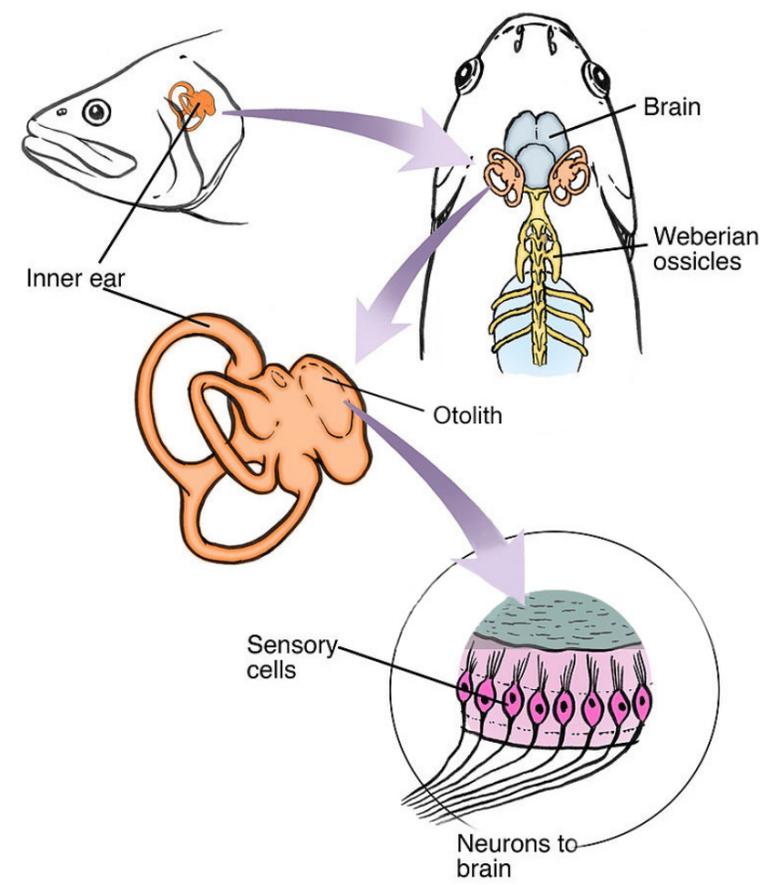
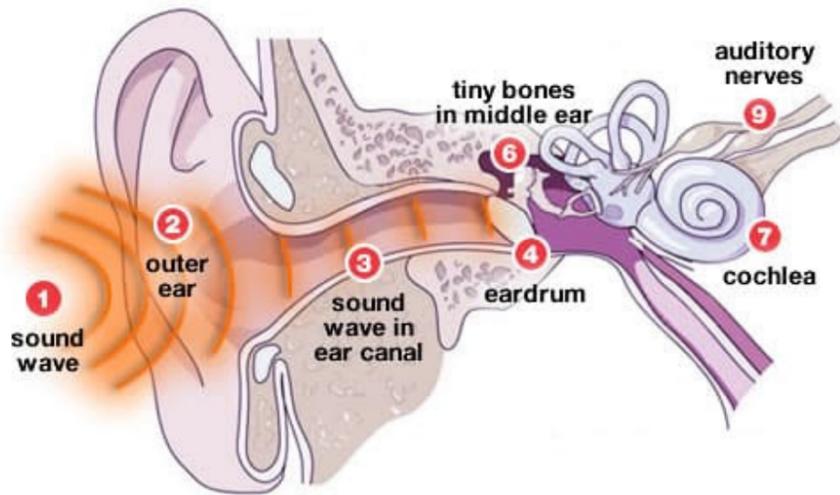


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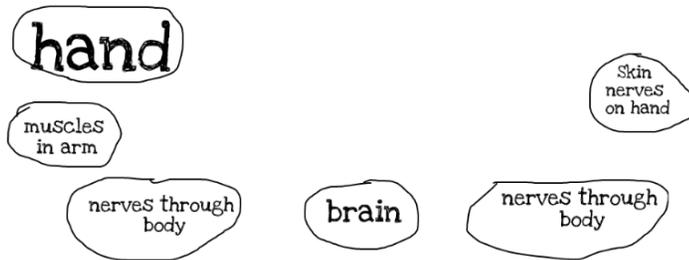
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What is the first part of the system? The last part?

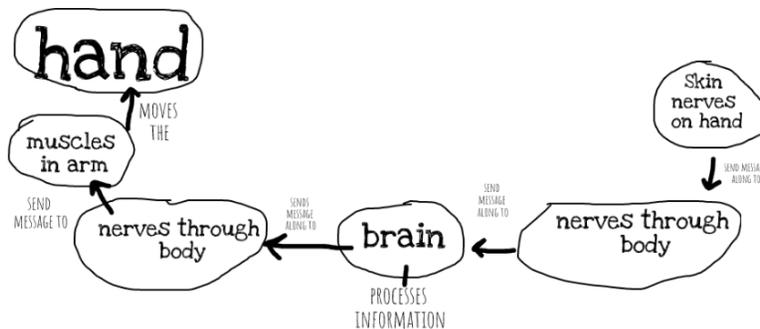
Teacher modeling a system

System: hand touching
Something hot



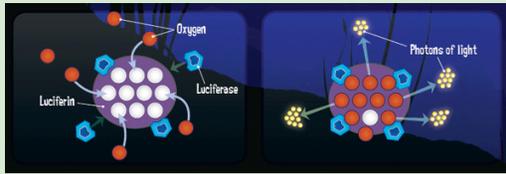
Label the parts
of the system

System: hand touching
Something hot



Then show the
movement of
the system
and how they
affect each
other.

What is Bioluminescence?



[What is bioluminescence?](#)

[Que es bioluminescence -en Espanol](#)

<https://kids.kiddle.co/Bioluminescence>

<https://answersingenesis.org/kids/animals/bioluminescence/>

<http://www.seasky.org/deep-sea/bioluminescence.html>

<https://www.getepic.com/app/read/41612>

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Large Eyes



[Hatchetfish facts](#)

[hatchetfish article](#)

[typical vs tubular eyes](#)

[popeye-catalufa facts](#)

[Fish Eye structure](#)

[Diagram of fish eye vs human eye](#)

How do fish make sounds?



[How do fish talk to each other- video](#)

[Diagram of sonic muscle](#)

[Fish Acoustics- article level 4](#)

[Fish sounds- video](#)

[Do fish make sounds- article](#)



Scenario #1- An oil spill has blackened the surface of a nearby coast. Zero light is able to penetrate the oil. **How will lack of light affect some fish? Will any fish still be able to get around in the water? What will change in their system?**

Some fish will not be able to _____
_____. Some fish will be able to use _____.
If the amount of light changes in this system then _____
_____.

Scenario #2- A brand new floating concert stage has opened up next to a local reef. People are excited about being able to look at the fish while they listen to music. The music is very loud and the sound waves travel into the water. **How will this affect some fish? What will change in their system?**

Some fish will not be able to _____.
Some fish will be able to use _____.
If the sound waves change in this system then _____
_____.





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