CORPS
Central Oklahoma Rural Partnership For Science

PHENOMENON-BASED INSTRUCTIONAL TASK | **GRADE LEVEL:** 4th Grade

# MAKING "SENSE" OF WORMS AND EYEBALLS - SENSORY PROCESSING

## TARGETED DCI AND/OR ASSOCIATED PE

**PE | 4-LS1-2**
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.

**DCI | INFORMATION PROCESSING**
Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain.

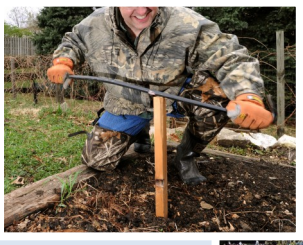
Animals are able to use their perceptions and memories to guide their actions.

## POSSIBLE DRIVING PHENOMENA

### Student observation or initial interaction:

Students observe a picture or video of a practice called worm charming, which is also known as worm fiddling or worm grunting. The activity has been used to collect worms for bait fishing. A wooden stake or implement is driven into the ground and a metal object is rubbed across it until the ground begins to vibrate. The vibration causes worms to crawl rapidly to the surface. There are numerous videos* and photos of this practice on the internet. It is best to turn the sound off on videos so students do not hear an explanation before they have a chance to provide their own ideas.

*Videos can be found by searching for "Worm Grunting."



**Worm Charming**

**Worm Charming Competition**
Willaston County Primary School, England

### Student observation or initial interaction:

The images below represent what happens to the pupils in different levels of light. Rather than look at images, students should watch what happens to each other's eyes as light levels change. They should notice the reaction of the pupils and begin to think about why the change happens. There are also videos* of pupils dilating on the internet.

**LIGHT** **DARK**

Students can also look at pictures or videos of the eyes of other animals to see that the pupils can have different shapes for different purposes. In general, all animal pupils respond to light. In some cases, other stimuli also cause pupils to change size or shape.

*Videos can be found by searching for "Pupil Dilation."

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**Phenomenon explanation for teachers:**

Worm charming is a simple but effective way of gathering earthworms for fishing bait that has been passed down through generations by fisherman and bait merchants. Also known as worm grunting, worm fiddling, worm calling, worm snoring, and various other regional names, it involves rubbing wood and metal together to create vibrations in the soil. A wooden stake, pitchfork, or other implement is pushed into the ground and rubbed with another object, usually made of metal. This rubbing triggers vibrations in the soil and serves as a stimulus to earthworms, who respond by moving to the surface as a means of self-protection.

Research studies have shown that the digging of underground tunnels by certain species of American moles produces an escape response in earthworms. Comparisons of recordings of vibrations generated by bait collectors and moles suggest that both sounds are similar. Worm charmers are mimicking the sound of moles and causing a flight response from the worms.

Scientists have also observed animals above ground, such as wood turtles and herring gulls, vibrating the ground by tapping on it to capture emerging earthworms. It has been shown that only certain types of vibrations cause worms to respond. The earthworms are responding to specific frequencies generated by certain types of predators.

Earthworms do not have ears, but their bodies can sense ground vibrations from animals moving nearby. Their nerves can detect light, vibrations, and even some tastes, causing the muscles of their bodies to make movements in response.

**Phenomenon explanation for teachers:**

Most higher order animals have a complex eye that includes a mechanism to control the amount of light that enters. The transparent outer covering of the eye is called the cornea. Just behind the cornea is the iris, which is a circular membrane that gives eyes their color. The job of the iris is to control the amount of light that enters the eye through an opening called the pupil, which looks like a black circle. The pupil appears to be black because most of the light that enters the eye does not escape. In dim light, the pupil gets larger (dilates) to allow more light to enter the eye. In bright light, it gets smaller (contracts) to prevent too much light from entering. The amount of available light varies during a day, and pupils respond and react accordingly as light levels change. The diameter of the human pupil can change from 1.5 millimeters to more than 8 millimeters.

Light entering the eye is detected by the retina, a membrane at the back of the eyeball containing cells that are sensitive to light. Nerve impulses triggered by the light shining on the light-sensing cells travel via the optic nerve to the brain. Some impulses return from the brain (through the optic nerve) and back to the muscles in the iris that control the size of the pupil. More light creates more impulses, causing the pupil to close. The light acts as a stimulus, and in response the muscle in the iris contracts to change the size of the pupil.

It has also been shown that, in addition to controlling the amount of light that enters the eye, pupils can change size in response to emotional stimuli, such as anger, fear, love, or excitement.

Pupils in other animals behave in similar ways to those of humans, although mechanisms vary with different species. These differences are adaptations that have occurred according to the needs and environments of the different species.

## HOW DOES THE PHENOMENON CONNECT TO THE DCI OR PE?

These phenomena allow students to extend their understanding of the structure and function of animal parts to include animal senses that represent a behavior structure that guides animals' actions and can help them survive. As students investigate how senses like sight and touch function to collect information, they can create diagrams explaining their understanding of how that information might be transferred. Student diagrams might include the process of information transfer and the parts of the system that might be impacting this process. Students are not expected to understand detailed mechanisms by which the brain stores and recalls information or the detailed mechanisms for how sensory receptors function. Students should be able to identify cause and effect patterns related to animal behavior. They should identify these as stimulus-response patterns, but using this specific vocabulary is not necessary. They can use a sentence structure such as: [Animal] uses its [body structure] to sense [stimulus] and responds by [action]. Students can create models and use them to explain these relationships. For example: students can collect observational data that examine ways in which dark and light settings affect pupil (eye) function. Students can display their understanding of this phenomenon through model diagrams and use their models to explain how animals use specialized sense receptors (eyes) to sense light that can be processed by the brain to guide their actions.

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## GATHERING AND REASONING IN ORDER TO CONSTRUCT AND REFINE EXPLANATIONS:

*How could students gather evidence using SEPs and CCCs that will help them construct/refine a supported explanation of the phenomenon?*

### 1. INITIAL ENGAGEMENT WITH THE PHENOMENON:

- Students observe a video of worm charming or a worm charming competition. The video should be shown without narration or stopped before an explanation of the phenomenon occurs. Alternatively, the teacher can describe the practice of worm charming to students, with or without pictures
- Students are asked to generate an initial explanation for why worms come to the surface because of this practice. This explanation can be revisited and/or revised over the course of instruction or at the end of instruction.

**Focus Question:** *Why do earthworms respond to worm charming by coming to the surface?*

### 2. CONTINUING EXPLORATION:

- Students can observe earthworms and identify structures such as head, mouth, anus, and segments. They should note that earthworms do not have "eyes" or "ears." They can observe how earthworms move and burrow.
- Students can plan and conduct investigations in which worms are exposed to various stimuli and their responses are recorded. Examples of stimuli that can be introduced are:
  - Light/dark
  - Heat/cold
  - Odor (ammonia/alcohol/food)
  - Sand/soil
  - Sound or vibration
  - Moisture
- An authentic approach to the guiding question could be for students to try to charm worms themselves, assuming a suitable environment is accessible.
- Students can research ways that other animals respond to their environment and/or identify stimulus/response patterns in various animals.
- Students can observe ways in which plants respond to stimuli, such as turning toward the light, reacting to touch, or reflexively capturing insects

### 1. INITIAL ENGAGEMENT WITH THE PHENOMENON:

**Focus Question:** *How do our eyes react to changes in light?*

Students investigate pupil reactions in other students and record their observations. This activity can be done in pairs. Light levels can be changed in different ways such as:

- Turning lights on and off in the room and observing a partner's eyes
- Having one person close and cover their eyes and watch what happens when the eyes are uncovered.
- Shining a weak beam flashlight near another person's eyes and then taking it away. (WARNING: Close supervision is required for this activity. Students should not shine flashlights directly into the eyes of another student.)

### 2. CONTINUING EXPLORATION:

**Focus:** *Why do pupils get larger in the dark and smaller in the light?*

Students are first asked to generate an initial explanation that answers this question. This explanation can be revisited and/or revised over the course of instruction or during instruction.

- Students can conduct additional investigations in which levels of light are changed to see if there is an observable pattern between light level and pupil size.
- Students can look at diagrams of the parts of the eye to help them understand how the eye works.
- Students can investigate some of the properties of light, such as brightness, color, reflection, absorption, and path.
- Students can research how messages from the eye are transferred to and from the brain.
- Students can check their pets to see how their pupils respond to light. (WARNING: Close supervision is required for this activity. Students should not shine flashlights directly into their eyes.)
- Students can observe pictures of the eyes of different animals and make inferences about why some of them have different shapes.



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**GUIDING QUESTIONS:**

- What structures does an earthworm have that might help it sense its environment? How does an earthworm move?
- What have you observed that indicates that earthworms are sensing stimuli (light, sound, objects, etc.)?
- Based on your observations, what senses do earthworms have? How do you know this?
- What do you think earthworms are sensing that would cause them to come to the surface during worm charming?
- What causes earthworms to move in different ways at different speeds?
- Why do animals need to sense things?
- What questions do you still have about how earthworms sense their environment?
- How do animals use body structures to sense their environment, and what do they do with that information?
- How do messages travel from sense receivers to other body parts that cause movement?
- Do plants have senses? What kind of data might you gather to answer this question?

**GUIDING QUESTIONS:**

- What pattern do you see in the way pupil size changes with the amount of light?
- What structures of the eye work together to help make sure the right amount of light enters the eye?
- Why do you think the eyes need to control the amount of light entering them?
- Why do humans need to sense light?
- Can animals see when there is no light? (This is an important physical science concept. It is related to the properties of light.)
- Do other animals besides humans have pupils in their eyes? If, so do they do the same thing as human pupils?
- How might the eyes of animals who come out at night and sleep during the day be different from the eyes of animals that sleep at night?
- Why is light important to animals and plants?
- How are messages from the eyes processed by animals?
- What do animals do with messages they receive from their sense of sight? How is this information processed?

**COMMUNICATE FINAL EXPLANATION OF THE PHENOMENON:**

*How might students communicate their understanding of the targeted DCI or PE in an explanation supported by evidence?*

**Possible formats for constructing explanations of this phenomenon.**

- Students can refine their initial explanation in written or verbal form.
- Students can construct a model showing how earthworms sense their environment and respond to it (diagram, skit, etc.). They should use this model to explain the cause and effect relationship between stimuli and their responses.
- Students can research another animal and present a model showing how this animal uses its senses to receive information and responds to it in ways that are unique when compared to other animals.
- Students can create a chart or diagram comparing sense receptors, stimuli, and responses of different animals.

**Possible formats for constructing explanations of this phenomenon.**

- Students can refine their initial explanation in written or verbal form.
- Students can construct an evidence-based argument using the "How I Know It" strategy. Students draw a circle in the center of their paper and a larger rectangle around the circle. In the circle, students write their revised answer to the question, "Why do pupils get larger in the dark and smaller in the light? Students are then asked to think about how they know this based on their exploration and research. They write this evidence outside the circle, in the rectangle.
- Students can draw a model showing how the eye works. Students can label parts and use arrows to indicate how information is processed in the system. Students can use the models to share their explanation with a partner or group.
- Students can research eyes of another animal with pupils that react or are shaped differently than human pupils. They can create or present an explanation for this difference that shows how stimuli are processed or used differently according to each animal's survival needs (examples: goat, cat, horse, gecko).



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