



*Students will go on a hike at nighttime to gain an understanding of the various senses and adaptations animals use at night to survive. The lesson includes using all 5 senses.*

### LESSON LENGTH:

- 2 hours

### GOALS:

- To increase understanding of animal adaptations to living nocturnally.
- To increase the students' comfort level with being in the forest at night.

### OBJECTIVES:

Students will be able to:

- Identify nocturnal animal adaptations during a night hike
- Use some of their senses (touch, smell, hear, sight) to acclimate themselves to the darkness and night
- Discover various ways animal use darkness to their advantage

### NATIONAL, STATE, LOCAL STANDARDS

#### North Carolina Standard Course of Study

- Bio.2.1 Analyze the interdependence of living organisms within their environments

### STUDENT TAKEAWAYS FROM LESSON:

- **Essential question/ theme**
  - What happens at night in the forest? In what ways is it different from the day?
- **Key concepts and vocabulary**
  - Nocturnal (adj) - done, occurring, or active at night. Animals that are awake and active at night.
  - Diurnal (adj) - of or during the day. Animals that are awake and active during the day.
  - Crepuscular (adj) - of or relating to twilight (dawn and dusk). Animals that are awake and active most often at dawn and dusk.
  - Echolocation (noun) - the location of objects by reflected sound, in particular that used by animals such as dolphins and bats.
  - Luminescence (noun) - the emission of light by a substance that has not been heated.
  - Bioluminescence (noun) - the biochemical emission of light by living organisms such as fireflies and deep-sea fishes.
  - Triboluminescence (noun) - the emission of light from a substance caused by rubbing, scratching, or similar frictional contact.
    - Chemiluminescence (noun) - the emission of light during a chemical reaction that does not produce significant quantities of heat.
  - Rhodopsin (noun)- a purplish-red light-sensitive pigment present in the retinas of humans and many other animal groups.
  - Rod (noun) - a light-sensitive cell of one of the two types present in large numbers in the retina of the eye, responsible mainly for monochrome vision in poor light.
  - Cone (noun) - a light-sensitive cell of one of the two types present in the retina of the eye, responding mainly to bright light and responsible for sharpness of vision and color perception. Humans have three types of cones.
  - Chemoreception (verb) - when a biological sensor (chemosensor) responds to a chemical substance and generates a biological signal.
  - Thigmotactic (noun) - movement of an organism toward or away from any object that provides a mechanical stimulus.
  - Vibrissae (noun) - any of the long stiff hairs growing around the mouth or elsewhere on the face of many mammals, used as organs of touch; whiskers.
  - Plumage (noun) - a bird's feathers collectively.

## **ASSESSMENTS:**

- Formative
  - Writing in journal about changes (or not) on being in the woods at night.
  - Writing in journal new, interesting, or favorite adaptations of nocturnal animals.
- The vocabulary words can be used in a bingo or jeopardy game

## **DIVERSITY (REACHING STUDENTS OF ALL LEVELS/ABILITIES):**

- There is a lot of information and new terminology here. Feel free to adjust based on the group.
- Engages all senses.

## **MATERIALS & EQUIPMENT:**

- Introduction & Closing
  - Personal journal for each student
- Sound activity
  - Bandanas to use as blindfolds
  - A rope (optional)
- Sight activity
  - Notecards and crayons
  - White lifesavers (1/student)
  - Flashlight or lighter
- Smell activity
  - Scented markers

## **LOCATION:**

- Along a trail that is fairly free of rocks, logs, stumps, raised roots, etc.
- Along a trail that has some topographical changes.

## **RISK MANAGEMENT & SAFETY CONCERNS:**

- For activities requiring movement, steer clear of areas with safety hazards (e.g., rough terrain, uneven ground)

## **BAD WEATHER ALTERNATIVE:**

- Attempt the night hike on another night or later in the evening. You might be able to complete the hike in light rain conditions, though ending the night wet might not be ideal.
- If short on time, choose the activities that make the most sense depending on your location and student interest.

## **PRE-LESSON PREPARATION:**

- Set out enough blindfolds for each group (if not done in the dark)
- Prepare colored notecards and crayons for sight portion
- Make sure the lighter turns on or the flashlight has batteries
- Scope out the trail beforehand for any major obstructions to be wary of during the hike
- Count to make sure there are enough wintergreen mints for each student (1-2 per student)



# LESSON:

- **Pre-hike preparation (30 mins)**
  - The day before or right before the night hike, ask the students to write in their journals and answer the question: How do you feel in the woods at night?
  - There can be a brief discussion about their thoughts, if the students are willing to share.
- **Introduction (5 min)**
  - Brief introduction into nocturnal, diurnal, and crepuscular to set the stage for the night's activities. Ask students what they know about the words nocturnal, diurnal, and crepuscular. Responses can include animals that fall under the category or the definition itself.
  - Tell the students that the activities today will take place in the dark as they use their various senses.

**\*\*\*NOTE: There are a LOT of different activities here: feel free to pick and choose based on your group and their level of engagement!\*\*\***

## Sound (Part 1)- Blindfolded walk (20 min)

### ENGAGE

Walk blind folded in a single file to a destination.

- A leader should walk in front and at the end of the line of students for safety. They do not have to stay right on the trail for the whole walk.
  - Ex: Leaving the trail to crunch in leaves or walk over a stump.
- Have a discussion to agree upon the sound signals your group will use to indicate bumps/stumps in the trail(the leader of the line should do this) and to indicate when all members are caught up in the line (the caboose should do this).
  - Ex: owl hoots, stomping foot. ← this can be decided as a group or the leader/caboose can decide)
- If you are worried your group will not be able to complete this activity, tie a long rope from one tree to another and let participants hold onto the rope.
- Encourage group to be very quiet and remain spaced out. If terrain is tricky, students can follow each other with a hand on the shoulder of the person in front of them.
- If dark enough, students don't need blindfolds.
- Walk to destination! Once at destination, remove blindfolds.

### EXPLORE/EXPLAIN

- Explain to students: *Humans rely heavily on our sense of vision, so that was probably difficult for you. For lots of animals, other senses are dominant, making it easier or even preferable to be active at night. During this night hike, we'll explore some of the adaptations that animals have in order to live nocturnally.*
- Ask and have students discuss the following questions:
  - *What did you hear when you were blind folded?*



- *Why might sound/hearing be important at night? What adaptations might animals have to improve their hearing?*
- *What animals have big ears and might be active at night?*
- After the students discuss some animals that might be nocturnal, get students to cup hands behind ears like a deer and then remove a few times (even while the instructor is talking). Do they notice a difference?
  - Ask students what animals they can think of that have ears shaped like cups.
  - Explain: *Cupped ears like those seen on deer, raccoons and mice allow for those animals to take in or funnel more sound into their ears.*

### EXTEND/ELABORATE/FUN FACTS

- *Owl ears are asymmetrical to improve locating sounds (such as a mouse scurrying) when hunting. Their ears allow them to triangulate their prey.*
- *Did you know that owl wings are shaped so that they do not make any sound when they fly? The shape of the edges of their feathers alters air turbulence and absorbs noise to help them sneak up on their prey at night.*

### Sound (Part 2)- Moth/ bat game (20 min)

- This activity should be done while the sun is setting to help students' eyes adjust.

### ENGAGE

- Have one student be the bat (blindfolded), another be the moth (blindfolded or not) and have the remaining students form a circle around them. The remaining students are the trees, who say "Tree" if the bat gets too close to the edge of the circle. The bat and moth can only walk (not run). When the bat claps once, the moth must clap twice. The goal is for the bat to catch the moth and the moth to stay away from the bat as long as possible.

### EXPLORE/EXPLAIN

- **Echolocation:** Ask students for a definition of echolocation and how that concept relates to the game they just played.
  - Explain: *Some nocturnal animals, such as bats, have echolocation. The animal produces a high-pitched sound-wave that reflects off all objects and returns to the animal. The animal can tell how big the object is and how far away it is by the intensity and pitch of the echo.*

### EXTEND/ELABORATE/FUN FACTS

- *How did it feel to be a bat? Did you find it difficult or easy to catch the moth?*
- *How did it feel to be a moth? What strategy did you use to not get caught by the bat?*
- *Only a few other mammals are known to use this sense: Dolphin, porpoises, and toothed whales also use echolocation - helps them "see" in dark or cloudy water.*



## Sight (Part 1)- Crayon activity (10 min)

### ENGAGE

- Ask the students if they think they can see color at night and why/why not.
- Pass out note cards and crayons (students get one each).
- Have each student draw a picture of something silly.
- Ask them to look at their notecard and guess the color crayon they have. Have them tell a nearby student what they think their color is.
- Have the student cover one eye gently without putting pressure on their eye. Tell them it's up to them to be honest-they're only harming their ability to see something cool if they take their hand off.

### EXPLORE

- Turn on a light or a lighter while they still have one eye covered, so they can see their notecard and prepare for the next sight activity.
  - Ask students if their crayon was the color that they thought it was.

### EXPLAIN

- While the light is on and one eye is still covered, explain:
  - *Inside your eyes, there are rods and cones. Cones allow you to see color (a good way to remember this is that both words have "co" in them, i.e. cone and color). Cones are only active during the day. So although some of the students will swear that they can tell colors, they're only seeing in gray-scale (the point of the notecard activity) or really in blue-scale; rods are sensitive to blue light!*
  - *Rods allow you to see motion. Wave your hand so that they can see that. Rods are active all the time.*
  - *Talk about the parts of the eye: The colored part is the iris (irises are also colorful flowers). Inside that is the black part-the pupil-which is actually a hole. That's why the doctor looks at your eyes-he's actually looking inside the hole to see the blood vessels behind it. The pupils allow light to enter your eye so that you can see. Pupils change size all the time, which is controlled by a muscle. When it is very light out, your pupils contract (get smaller) so only a small amount of light is going in. When it is dark out (right now), your pupils dilate (get larger) to let more light in. That's why when someone turns a light on after you've been sitting in the dark, it hurts--your eyes were dilated, so when the light was turned on, a ton of light floods into the eye.*

### EXTEND/ELABORATE/FUN FACTS

- Ask if any of the students have used a red light to look at owls at night. Ask them if they know why this is done.
- Then you can explain: *Owls have no cones and cannot see color, so when a red light is used to illuminate them, they cannot sense the light.*
- *Owls have plain plumage partly because they cannot see color and do not need brightly color feathers like other bird species to attract a mate.*



## Sight (Part 2) - Covered-eye activity (10 min)

- This activity should happen in the dark

### EXPLORE

- Turn off the light; then have the students remove their hands from their one eye and switch between looking through each eye.
  - Ask the students: *What difference do you see?*

### EXPLAIN

- *The eye can produce a chemical called rhodopsin. This allows you to see in the dark better. It takes about 45 minutes for it to build to maximum levels. (A sunset takes about 45 minutes to occur, so if you're outside during sunset, you are gradually getting night vision until you have it completely when the sun is finally down.) Rhodopsin song: rho, rho, rhodopsin forming in your eye. Helps you see in the night so you don't trip and die. Between the rhodopsin and pupil dilation you can have night vision.*

### EXTEND/ELABORATE/FUN FACTS

- *Most nocturnal animals have adapted protruding eyes and enlarged pupils that allow more light to enter the eye. Again, an owl is a great obvious example.*
- *Many nocturnal animals have more rods than diurnal animals to increase their ability to see at night.*

## Sight (Part 3)- luminescence/wintergreen activity (15 min)

- This activity should happen in the dark

### ENGAGE

- Hand out wintergreen mints. Have everyone pair up and decide who is going first. Explain that when you say "go," the person who is going first will take the mint, put it into their mouth, stare at the partner, and with mouth visibly open bite down on it. The partner can make sounds like "ooh and ahh," but should not say what happened. Then they can switch.

### EXPLORE

- Students will see what they call a spark but what is actually an emission of light. It's the sugar, peppermint, and oxygen in the air. The friction of biting down on it causes them to react together, and light is emitted. This is called triboluminescence.

### EXPLAIN

- Ask students to break down or do word associations with the words luminescence, bioluminescence, and chemiluminescence. (Luminescence: sounds like illuminate = light given off. Chemiluminescence: chemi = chemical. Bioluminescence: bio = life).



- Ask students if they can think of any examples of chemiluminescence. *Example: glowsticks. When you crack them, you're causing the chemical reaction to occur. When these chemicals (that had been separated inside the tube) mix, they react together, and this reaction produces light. The types of chemicals will determine the color of light emitted.*
- Explain: *bioluminescence is the ability of an organism to produce its own light. This can be used for communication, locating food/attracting prey, and self-defense.* Ask students if they can think of any animals that can produce bioluminescence (i.e., fireflies, fish, etc.)

### EXTEND/ELABORATE/FUN FACTS

- You can find an example of bioluminescence down by the water sometimes. Have the students scratch the wet sand and they will see flashes of light. These are phytoplankton; they are signaling to each other warning that danger is near.

### Smell (5 min)

#### EXPLORE

- Pass around a few scented markers. Have the students tell the group what they smelled.

#### EXPLAIN

- *Our sense of smell detects airborne molecules, unlike taste, which senses dissolved molecules. Chemoreception, which is both taste and smell, is thought to have evolved before the other senses. Smell is taken in by a region in the nose with millions of receptor cells. The degree of smell depends upon the size of this region, which varies based on the animal's reliance on smell. The more receptors, the greater the sense of smell. Many nocturnal animals such as foxes and raccoons have an acute sense of smell (i.e., far more receptor cells than humans). This allows the animal to find food many miles away. Smells like pine scent and skunk scent are just a few scents we might encounter on our night hike.*

### EXTEND/ELABORATE/FUN FACTS

- *Wolves have 250 million nasal epithelium cells compared to humans' 5 million cells! That's 50 times more than we have.*
- *While owls are nocturnal, owls have no sense of smell! Many diurnal birds of prey like eagles and hawks cannot smell either. Owls have other night-based adaptations like incredible sight and hearing.*

### Touch (10 min)

#### ENGAGE/EXPLORE

- The students will go on another walk along the trail. Instruct the students to notice the topography of the trail and how the trail feels under their feet. Instruct students to sometimes use one foot on the trail and one off of the trail.
- Ask the students to describe what they felt during the walk. *Was the ground hard? Soft? Crunchy? Bumpy? Did the feel of the trail affect how you moved your feet or body?*

#### EXPLAIN



- *The sense of touch is very important to many nocturnal species and is well-developed in burrowing animals and amphibians. All vertebrates have receptors in their skin that recognize touch, pressure, pain, and temperature changes. Whiskers are another sensory organ that extend touch past the skin for many mammals such as cats, rats, and mice. These specialized hairs are called vibrissae. The arrangement of these whiskers is not random: they form an ordered grid with shorter whiskers at the front and longer whiskers at the rear. Each individual hair follicle is connected to 100–200 nerve cells, so small deflections of the vibrissal hair can cause a sensory response.*

### EXTEND/ELABORATE/FUN FACTS

- *Seal whiskers are each served by around 10 times as many nerve fibers as those in rats and mice.*

### Final Reflection

### EVALUATE (15 min)

- Ask the students to record in their journal: How do you feel in the woods at night, and how did tonight's hike change your perception?
- What was the thing you learned that excited you the most about adaptations in nocturnal animals?

### REFERENCEMATERIALS/RESOURCES

- Whiskers: <https://en.wikipedia.org/wiki/Whiskers>
- Nocturnal animals book: [https://books.google.com/books?id=YIUQPtK8J9kC&pg=PA10&lpg=PA10&dq=smell+nocturnal&source=bl&ots=N\\_JanvzN2D&sig=l-UCQBOjunCHFe1IUqvP58eX39U&hl=en&sa=X&ved=0ahUKEwj1kdSfu\\_PXAhVhc98KHcz9Bb4Q6AEIUDAG#v=onepage&q=touch&f=false](https://books.google.com/books?id=YIUQPtK8J9kC&pg=PA10&lpg=PA10&dq=smell+nocturnal&source=bl&ots=N_JanvzN2D&sig=l-UCQBOjunCHFe1IUqvP58eX39U&hl=en&sa=X&ved=0ahUKEwj1kdSfu_PXAhVhc98KHcz9Bb4Q6AEIUDAG#v=onepage&q=touch&f=false)
- Nocturnal adaptations: <https://www.seaturtlecamp.com/nocturnal-adaptations/>
- Other night hike lesson plans: <https://fyi.uwex.edu/uphamwoods/files/2014/10/Night-Hike-Lesson-Plan-1.pdf>

