Virtual Creature Festival: Something Slimy!

Slimy, oozy, ooey-gooey! These boneless wrigglers have squirmed their way into our hearts with their fascinating anatomy, behavior, and their vital role in our planet's food web!

Invertebrates can sometimes be easily overlooked, especially when they have a little added "ick factor", but they are so interesting once you take the time to learn a little bit about their day to day lives! Many popular invertebrates are of the crunchy-shelled variety, but this packet focuses on the slimy and squishy members of this group, including slugs and snails, caddisflies, and crane flies.

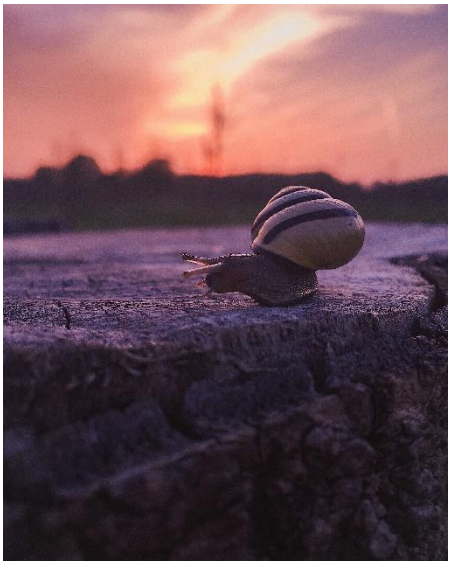


Image courtesy of 30daysreplay via Unsplash

In this packet created for Duke Farms' Virtual Creature Fest, you will find a whole host of "edu-taining" material suitable for anyone interested in learning! For formal educators, these materials align with all current Next Generation Science Standards and offer a wonderful guide for exploring in the classroom with your students. For informal educators, caregivers, and families, this packet has been designed to lead exploration and learning in whatever environment where you live and work!

This packet was created as part of the *I Spy a…* class series. Each of these short introductory programs act as a tool to get kids engaged with the material that will be later found in the activity packet. Be sure to check out the Duke Farms classes page for all our upcoming programs, so you don't miss any of the upcoming *I Spy a…* classes and much, much more!

This packet includes:

We thank you for taking part in our Virtual Creature Fest and wish you happy explorations!

The Tale of a Sime Trail

In this lesson, students are introduced to the fascinating and complex biology of snail and slug slime. They are then invited to explore these concepts hands-on. Educators and caregivers are encouraged to share all the included resources with students and children and then continue the learning either on their own or together! Happy (snail) trails!

Image courtesy of needpix.com

If snails and slugs are famous for anything, it's being SLIMY! Both animals are **gastropods**, a name that separates them from other animals in the taxonomic phylum **Mollusca**, which includes animals ranging from clams to squids! A common trait shared by the majority of these animals is that they have parts of their bodies that are soft, squishy, and pretty slimy; they are reliant on a layer of **mucus** to protect their skin from desiccation (drying out), which is not entirely unlike the function of the boogers inside your nose and wetness of the inside of your cheeks. Mucus itself is a gel that contains salts and *mucins* - a type of glycoprotein that attracts and holds lots of water. Like it or not, you too produce mucus that is very similar to that of slugs and snails because, for both us and them, it is vital for preventing important body surfaces from drying out, cracking, and creating painful cuts that are then vulnerable to infection.

Chromolithograph of gastropods published in Natural History of the Animal Kingdom, 1885. Courtesy of ancestryimages.com

Slugs and snails are way ahead of us in the mucus game, however! They produce multiple types of slime that help them interact with their habitat, which tends to be damp, cool areas such as forest floors, near or in bodies of water, in gardens, etc. The first type of slime produced by these squelchy critters is a thinner type that covers their entire bodies, giving them a shiny appearance and in some cases also giving them a nasty taste to prevent predators from snatching them up! The second type is produced for movement. Have you ever noticed a slug or snail climbing straight up a pane

of glass? They can do so because this second type of slime is more *viscous* and contains chemicals that make it function simultaneously like glue and a lubricant! The slug or snail produces this slime at the front of their *foot* (the underside of their body) and then glides across it by contracting and relaxing the foot in a wave-like motion.

The mucus also tells a story about that particular slug or snail through various chemicals contained in it; when it gets left behind in a shiny, silver trail, it can be followed by other snails or slugs and tell them all about the health, sex, and type of individual that left it! Unfortunately, this adaptation of slimy messages is not all friendly; some slugs are predators and use the chemical trails left by other slugs to hunt them down and make a meal out of them! Just like all species of animals on this planet, slugs have adapted complex and intertwined relationships with each other and their environments throughout their evolution. ***In the following activities, students can gather more of an understanding of the function of slug slime through hands-on exploration! Go outside, get a little messy, and have fun learning!***

Activity 1: The Slickest Slime

Objective: Introduce participants to the concept of snail and slug locomotion and behavior related to slime production. Create an understanding of the physics of friction and the various types of slime produced by gastropods that affect their behavior.

Materials:

- Vegetable oil
- 7 cups water
- 10 teaspoons Metamucil powder
- Optional toy slugs and snails, can also use gummy worms or similar objects
- Large plastic bin lid or similar smooth, flat, movable surface
- Collection of other textures surfaces, such as brick, concrete, wood, metal, glass,
- Hand wipes for cleanup!

Procedure: Vegetable oil represents the thinner slime found on the slug's entire outer surface, while the Metamucil and water mixture creates much more viscous and sticky type of slime that simulates the type used by slugs to crawl forward and stick to surfaces. Make this mixture by dissolving the Metamucil into the water in a saucepan and then heating the mixture on medium-high heat for about 5-7 minutes while stirring frequently. Continue heating and stirring until it reaches a desired gloopy, sticky consistency and then let it cool before handling.

Image courtesy of Michal Jarmoluk via Pixabay

Present the students with the chosen items that represent the slugs and have them attempt to push them across the various surfaces without any oil or slime on them. Discuss the sensation, difficulty level, and their ideas about why it may be hard to push them across each surface. Prop the bin lid or similar surface up to create a steep downward angle and then have the students place their slugs at the top before letting go and observing how, if at all, they reach the bottom. Did they fall? Did they move at all? Did they slide? How fast or slow did they move?

Let the students then manipulate the oil with their fingers and feel the textural difference between their bare fingers and then with the oil. Do the same with the slime mixture. Then allow them to coat the slugs and repeat the activity on the bin lid. How did the behavior change? Finally, coat the bottom of each slug with the slime mixture and repeat the activity again. Discuss the differences between each circumstance.

Have students experiment freely by pushing the slugs across each different surface using the various methods; without any lubrication, with just oil, and with the slime.

Discussion:

- Does your body produce any slimy or oily materials that help you stay healthy?
- How do you think it would feel to be slimy from head to toe?
- In how many ways is your body different from a slug or a snail? Do you have any similarities?
- What other animals produce bitter or dangerous chemicals that keep them safe?

Activity adapted from ALSC Blog and Lemon Lime Adventures (neither affiliated with Duke Farms)

Activity 2: Can You Out-Slime the Leopard Slug? Objective:
Objective: Teach students about the relationship between predator and prey relative to the interaction between slugs of different species and to reinforce the understanding of slugs' use of chemicals in their slime to both be tracked by and to deter predators.

Image courtesy of Erica vanRavenhorst via flickr

Materials:

- Slug ID cards, printed
- Any type of rope/yarn/string/ribbon/old ties/etc of a length anywhere between 3-4 feet long, as desired, to imitate the slime trails left behind by slugs
- Spray bottles with water
- Essential oils of any scent

Background Information: The relationship between predator and prey is an age-old struggle in nature. Animals have evolved over time to either hunt, hide from, or directly defend against each other by always adapting to the adaptations of the other. In the food web, slugs are securely at the base, providing a slow-moving and nutritious meal for predators such as mice and other small mammals, amphibians such as frogs and salamanders, and birds of all types. Most slugs are detritovores, eating mostly decaying plant material and even dead animals or scat, but some have evolved to become cannibalistic predators. In response to their place in the food chain, some have adapted their already slimy skin to be a defense against being eaten.

Slugs produce two types of slime: one that coats their bodies - which in some cases can contain chemicals that are bitter tasting - and another more viscous one that allows them to move and to climb vertical surfaces. This bitterness comes from chemicals that they produce and excrete with the mucus, which can be toxic at varying levels ranging from causing the predator to vomit or even become comatose. The thicker slime used for locomotion also contains chemicals that can be used by other slugs to identify the one that left the slime trail. It can also be produced more readily when threatened and cause the slug to become less appealing to the predator.

Leopard slug image courtesy of Lawrence Wright via Flickr

This activity centers around the relationship between the invasive European Leopard Slug, *Limax maximus*, and 3 species of slugs native to the North Eastern US (see photos below): seadow slugs (*Deroceras leave*), Carolina mantleslugs (*Philomycus carolinianus*), and the winding mantleslug (*Philomycus flexuolaris*). The leopard slug is rather large (4-8 inches long) with distinct black spots on a grey body. They move fairly quickly at about 6 inches per minute and they use this ability to hunt down and eat other slugs by following their chemical slime

trails, though they are also detritivores that clean up dead plants and fungi. No one is sure when they were introduced from Europe to the United States, but they have become very common, especially in the North East.

Procedure: Explain to the students about the relationship between predators and prey, then introduce the idea of defense mechanisms. Explain the history and behavior of the leopard slug and its adaptation to follow the chemical trails left by prey slug species in order to hunt them. Explain the defense mechanisms used by the prey slugs: bitter tasting chemicals and viscous slime.

Winding mantleslug image courtesy of Kevin Ripka via LeafLitterCritters

Meadow slug image courtesy of Wikipedia

Leopard slug image courtesy of Wikpedia

Carolina mantleslug image courtesy of jaxshells.org

Have the students randomly choose a card from the deck, which will decide who is the Leopard Slug and who are the other species. Then distribute the "slime trails" to the students who are not Leopard Slugs by rolling them up partway and either tucking them into their belts or the back of their outfits. Also give these prey slugs the spray bottles with water and a small amount of essential oils; these will mimic the bitter chemical deterrents. The objective of the game is for the Leopard Slugs to chase the prey slugs and pull out their slime trails until only one slug is left, but the prey slugs are given the chance to spray the Leopard Slug in order to deter them. If they successfully spray the predator before it takes away their slime trail, then the predatory slug must stop chasing that prey slug and find another one then try again later. The game can be changed as appropriate to allow different numbers of sprays, different lengths of slime trail, and different numbers of predators and prey.

See the next page for printable slug ID cards.

You are a: Meadow Slug!

You are a: Winding Mantleslug!

You are a: Leopard Slug!

You are a: Carolina Mantleslug!

What Makes a Caddisfly and Its House?

In this lesson, participants will learn about the anatomy of caddisflies and how they build their mobile shelters. Educators, caregivers, and parents are encouraged to read the information along with or to participating children and then allow them to complete the labeling activity. The answer key can be found on the third page of this packet. Part 2 prompts further hands-on exploration of these innovative critters by first learning about how they build their own homes and then creating your own caddisfly case using whatever materials you have available! Have fun!

Case-Building Caddisfly Anatomy

Read Along - Part 1

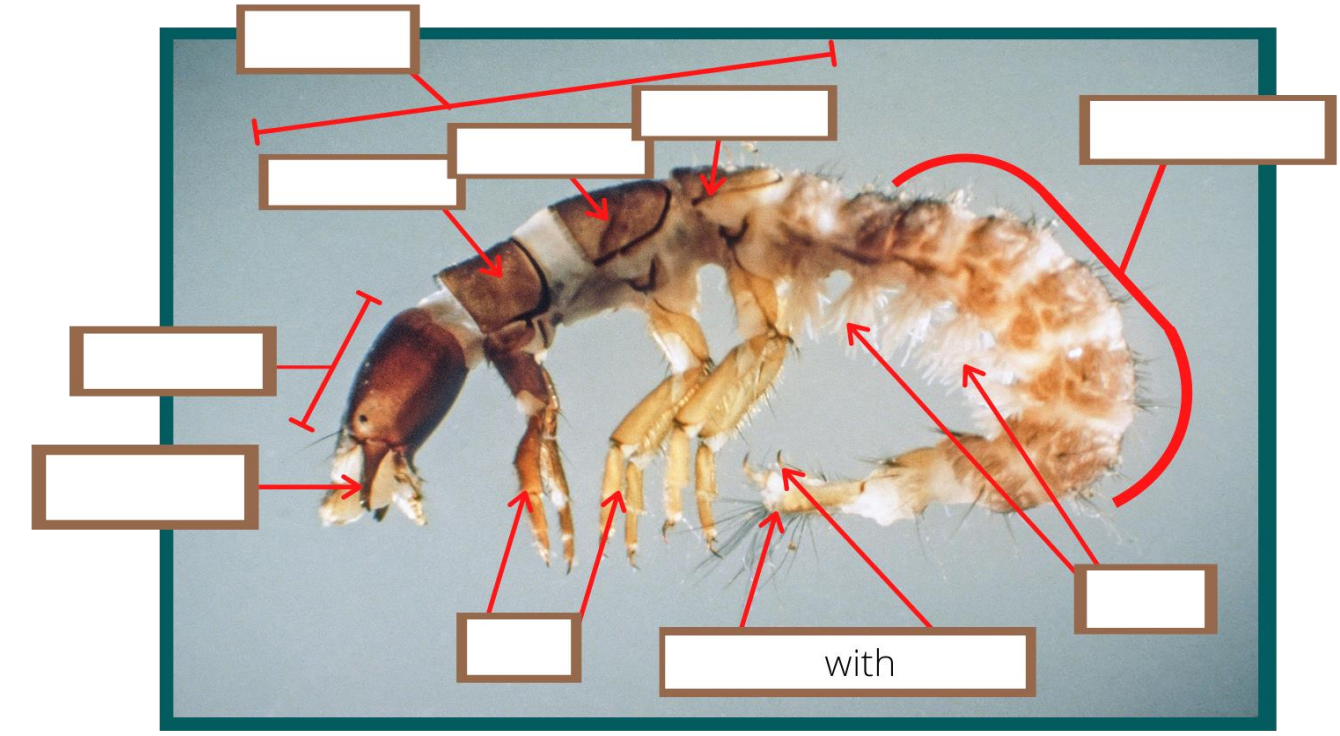
Adult caddisfly image courtesy of Gordon Ramel

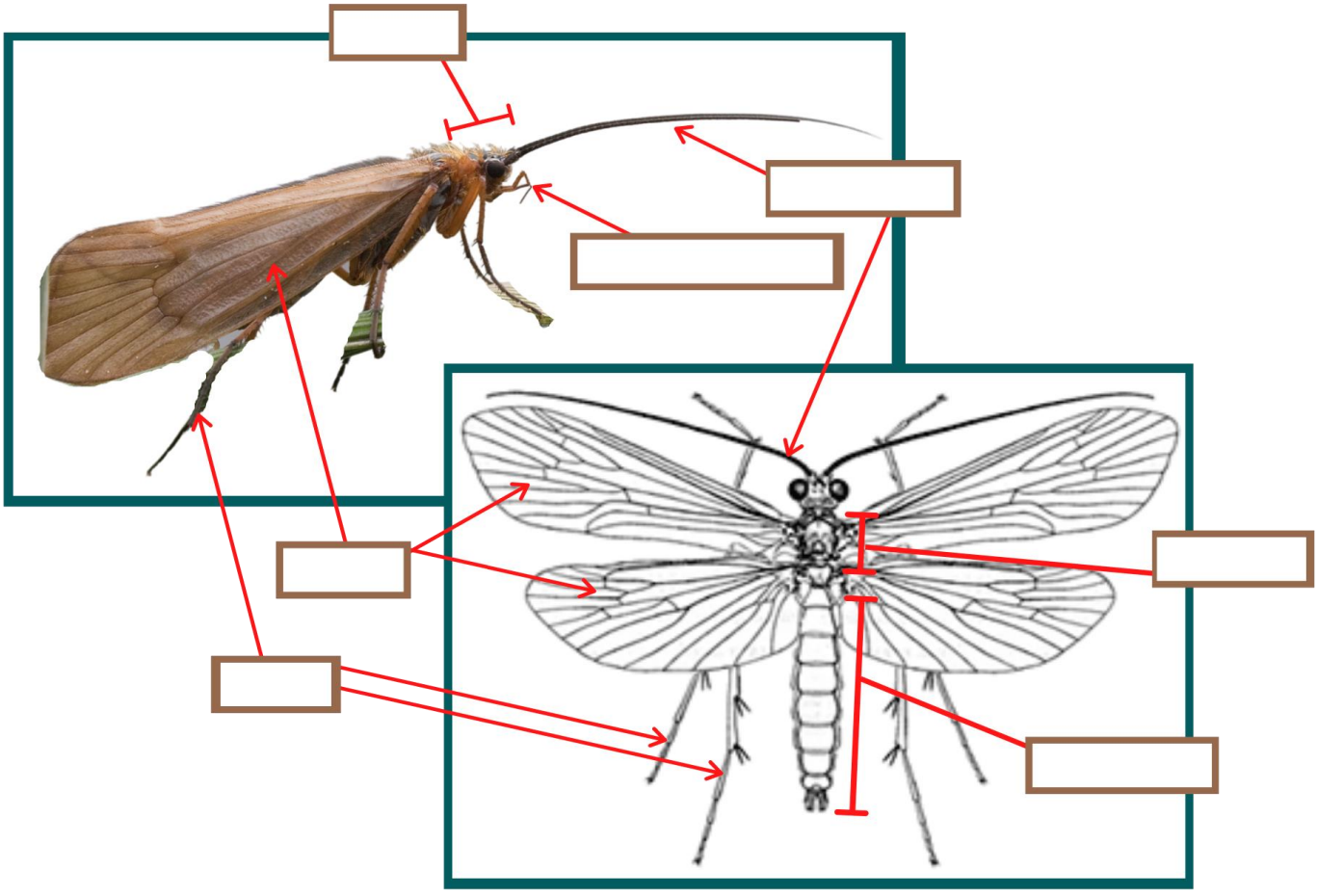
Caddisflies are *insects* in the taxonomic Order **Trichoptera**, which means "hairy wing". These insects are closely related to moths, but you can tell the differences starting with their **heads**; while moths have a mouth like a straw, called a proboscis, larval (baby) caddisflies have chewing **mandibles** and adults have **maxillary palps** instead of actual mouths because they do not eat! Another way to tell a moth from an adult caddisfly is by looking at their **antennae**: moths have two fluffy antennae sticking out from their heads while caddisflies have long, skinny ones, but both animals use these sensory organs to smell and feel vibrations in the air! Both adult and larval caddisflies have body segments, which include a **thorax** with 6 **legs** and an **abdomen**, but there are some differences that develop as a larvae *metamorphoses* into an adult. A caddisfly larva's thorax is divided into 3 pieces: **pronotum** ("pro" = first and "notum" = back) **mesonotum** ("meso" = middle), and **metanotum** ("meta" = end), and they have **prolegs** at the end of their abdomen with **hooks** to help them hold on to the inside of the case that they build around themselves (see the second part of this activity to learn more about this!). The other huge difference between an adult caddisfly and their larvae is that larvae have **gills** on their abdomens which they use to breathe underwater like fish! Adult caddisflies do not live underwater like their babies, and instead they have large **wings** attached to their thoraxes that allow them to fly through the air!

Caddisfly larva in its case image courtesy of Jan Hamrsky

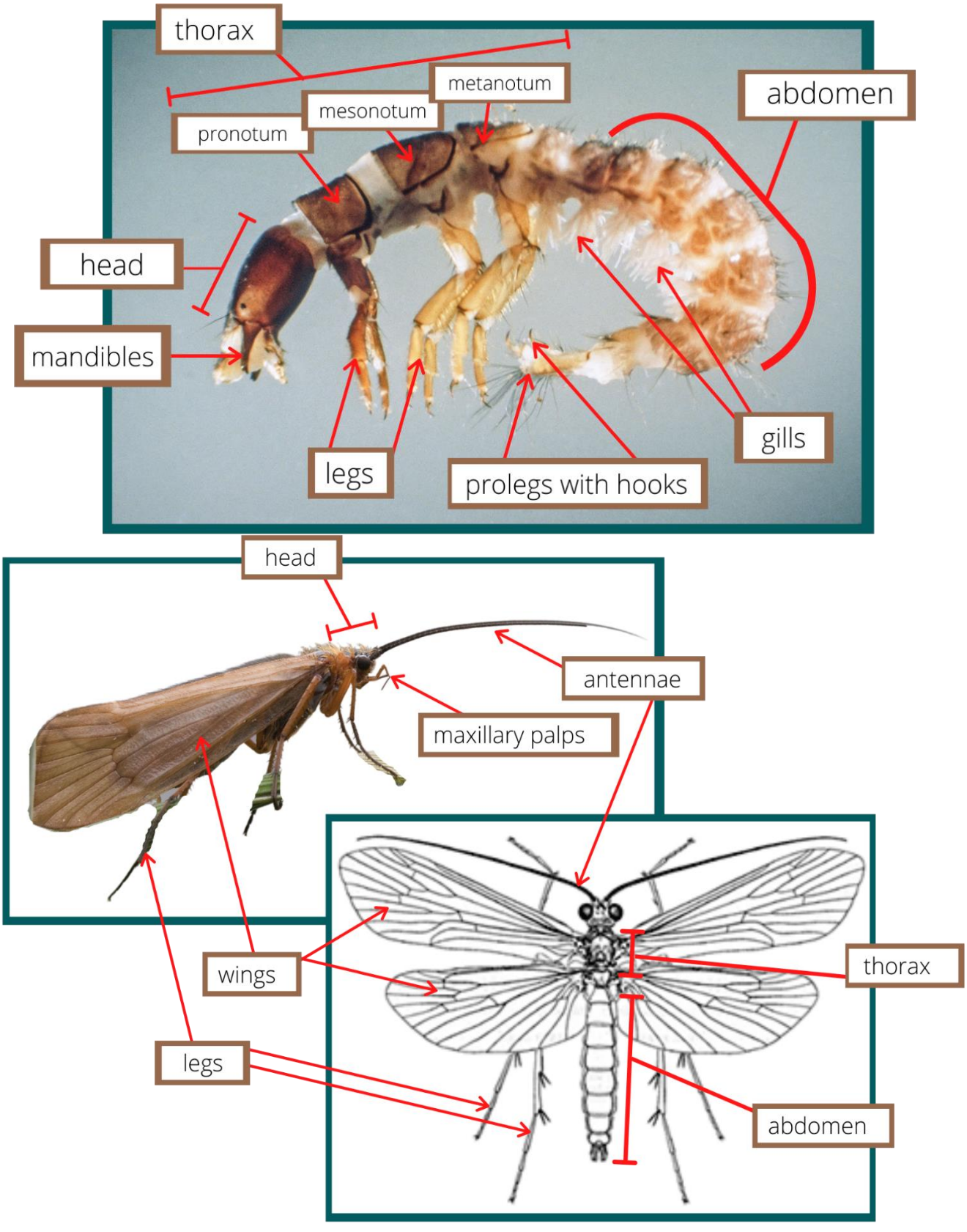
Continue to the next page to test your new knowledge by labeling the caddisflies!

Case-building Caddisfly Anatomy Labeling Activity





Case-building Caddisfly Anatomy Answer Key



Home for a Caddisfly Build-Along

There are about 7,000 species of Trichoptera, or caddisflies, around the globe, and many of them are what we call **case-building caddisflies**. As their name implies, they are amazing tiny architects of the animal world! Both terrestrial and aquatic species exist and can be found in many different habitats and climates. While in their *larval*, or young, life stage, they are vulnerable to being eaten by bigger animals (because they form a main base for the global food web!) and are pummeled by wind and rushing water. So, what is a tiny, defenseless critter supposed to do to protect itself? Why, build their own mobile house of course! Caddisflies have evolved the incredible ability to produce a silk that is sticky and stretchy even underwater that they use to glue objects together to form a sleeve that they stick their abdomens into, kind of like a hermit crab. They use tiny hooks on their two *prolegs* (small limbs that are similar to legs but are not fully developed) to hold onto it while they use their 6 true legs to crawl across the forest floor or clamber between rocks on the bottom of a stream, in search of decaying leaves and other plant material to munch on. Different species of caddisflies prefer to build their cases out of different materials, which makes for some beautiful structures! In this activity, you can study images and videos of different species of caddisfly larvae and the many ways that they protect themselves…in style! Then, you can try your hand at building your own caddisfly model by doing what a caddisfly does and "upcycling" the materials you already have around you at home!

Resources:

- **Life in Freshwater** is a fantastic and visually stunning project by Jan Hamrsky, full of photos and useful information about caddisflies and many more aquatic invertebrates. The photo gallery on this page of the website alone is enough to make you fall in love with the aesthetic capabilities of these tiny beings! All images are courtesy of Jan Hamrsky. Jan Hamrsky is not an affiliate of Duke Farms.

- **Deep Look** is an educational channel on Youtube that is known for its lovely up-close-and-personal explorations of usually overlooked parts of nature. This video is a great way to see just how intense the construction process is for these caddisflies and offers a new appreciation for their efforts! Deep Look is not an affiliate of Duke Farms.




Materials:

- Play-dough, modeling clay, any manipulative material to make the body of the caddisfly
- Recyclable materials from home; ex. Toilet paper rolls, scrap paper, bottle caps, jars, wrappers, be creative and eco-friendly by (safely!) using whatever you can to keep items out of landfills.
- Tape, glue, sticky tack, etc.

Procedure: Begin by molding the body of the caddisfly itself (refer to the Anatomy Labeling activity in Part 1 of this packet!) using clay or whatever material you prefer. How detailed can you be? Can you add other items to make it more lifelike?

Explore your collected items and begin shaping them around your caddisfly using various adhesives. Take your time and be expressive! Study the photos and videos of caddisflies and see how the different species use different materials.

Discussion:

- Did you have more success with one type of adhesive versus another?
- If you were going to put your caddisfly in water, could you find an adhesive that still works while wet?
- What factors do you think affect a caddisfly's choice of materials?
- What would you build a case out of for yourself, if you were a caddisfly?

What Did the Owl Eat?
Materials:

- Food Web diagram and Food Web Animals worksheet (courtesy of Genesis Inc.)
- Blank paper
- Writing and coloring utensils
- Scissors
- Glue

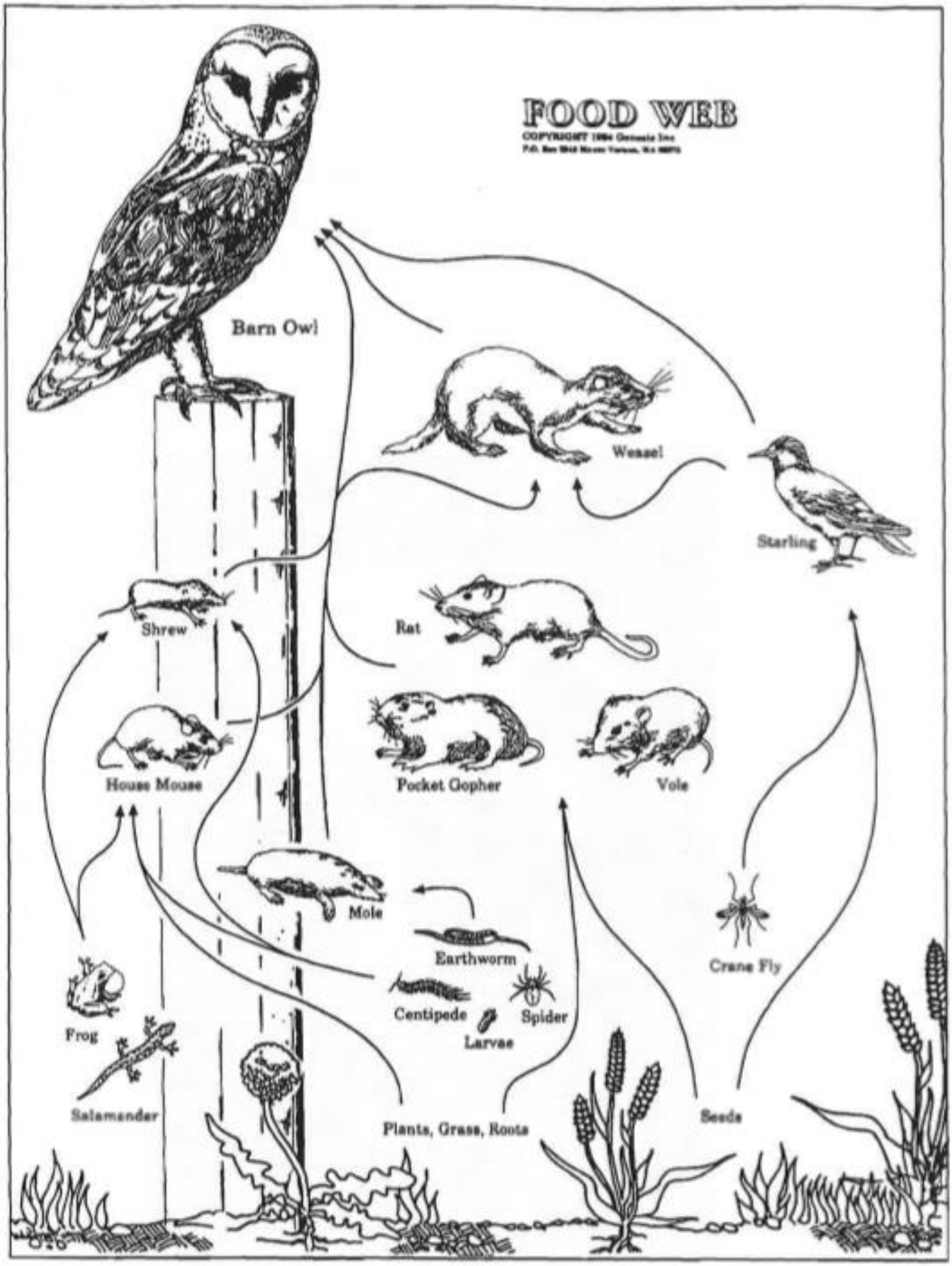
Image courtesy of Richard Lee via Unsplash

Background Information: The global food web is built on the relationships between plants and animals as they support one another and control each other's populations. At the "base level" of this web are the ***producers***, which includes the plants, grasses, and roots. These plants take carbon dioxide from the air along with nutrients and water form the soil and create oxygen which they sent back into the atmosphere. They also produce nutrients and store it within their roots, stems, leaves, flowers, and seeds. These plants provide habitat for the smallest forms of animal life, such as invertebrates (spiders, centipedes, larvae, earthworm, crane fly, and many more slimy invertebrates such as slugs and snails!) and smaller vertebrates (frogs, salamanders, etc.) which also act as ***predators*** for the invertebrates. These plants, small invertebrates, and vertebrates are ***prey*** for some small mammal ***omnivores*** such as mice, rats, voles, and pocket gophers, along with omnivorous birds such as starlings. Small ***carnivores*** such as shrews and moles also act as predators for the invertebrates and small vertebrates. All these small mammals and birds then become prey for carnivores like weasels, which are then predated upon by the owl. The owl also predates directly upon the other small mammals and birds, as well as the small vertebrates and perhaps even invertebrates depending on the species of owl in question. It is important to note the interconnectedness of all of these species and organisms. Ecological diversity of plant species in an area directly effects the available habitat to all of the baseline animal species, and even the loss of one species can mean a decline in the "higher" orders of animals; this concept is called ***trophic cascade*** and outlines the domino effect within an ecosystem after the loss and/or decline of one species of plant or animal.

Procedure: Begin by showing students the Food Web diagram and explaining the basics of ecological relationships between animals and plants. Explain the concept of trophic cascade. Provide the students with a blank piece of paper, a copy of the Web Animals worksheet, and whatever writing or coloring utensils they may want to use. Allow the students to cutout the different members of the food web and then implement their understanding of the food web relationships by arranging them on the paper and gluing them in place before drawing the different relationship lines.

Discussion:

- Is this diagram set in stone, or can you rearrange the relationship lines in different ways that are still true?
- What other animals and plants can you add to this diagram to diversify it? Is this the only option for the animals that may live in this environment?
- Can you make a food web based on your local habitats? What kind of habitats do you find locally: coastal, freshwater wetland, dry prairie, forest, desert, etc?
- If you live in an urban environment, do food webs still exist in your area? What animals and plants can you find in your area and how do they relate to each other? How about if you are in a suburban or rural area?
- How might this food web be different if you were making it about a Saw-whet Owl versus a Great Horned Owl?
- **What would a food web about YOU look like?**


FOOD WEB
Barn Owl
Weasel
Starling
Shrew
Rat
House Mouse
Pocket Gopher
Vole
Mole
Earthworm
Crane Fly
Centipede
Spider
Larvae
Frog
Salamander
Plants, Grass, Roots
Seeds

Food Web Animals