Lesson Plan

Lesson Title	Adaptations of Mosquitoes
Grade Level	4th grade
Topic	Mosquitoes
Lesson time	45-55 minutes
Materials Required	• Digital microscope • Mosquito Life Cycle Kit • Adaptations of Mosquitoes PowerPoint (available here) • Observation journal (available here)
Standards addressed	• 4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction • LS1.D 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.

Step 1: Introduction and Expectations

Step 2: PowerPoint Lesson

Slide 1: Ask students for the definition of an adaptation. Ask if someone can think of an adaptation of their favorite animal. Inform them that all animals have many adaptations that allow them to survive in their natural habitat.

Slide 2: Click or tap through the different stages of the mosquito life cycle. Help students understand the following (asking them works):

- There are 4 stages in the mosquito life cycle (egg, larva, pupa, adult). As a side note, most insects have these same 4 stages.
- Three of the stages occur in or on the water.
- Only the adult mosquito leaves the water.
- The pupa stage cannot eat.
- Only adult females bite because they need the protein from the blood to lay eggs.
- Adult males and females sip nectar as a source of sugar (energy food).
- Adult males and females can be distinguished from one another by their antennae.
- Warm weather causes the life cycle to go quickly.

Slide 3: Egg stage adaptations

Even the eggs have adaptations. This egg raft is not held together with glue. Instead, each egg has microscopic bumps and pits (similar to Legos) that allow it to stick together. As the eggs hatch, the larvae inside the eggs wiggle, causing the raft of eggs to fall apart. Other kinds of mosquitoes lay eggs that can survive long periods of time in dry or icy conditions. Once they are flooded with water and the conditions are right, they begin to hatch.

Slide 4: Larva Stage Adaptations

This slide has a short video clip that shows some of the adaptations of the larva stage. Have students point out adaptations that allow the mosquito larvae to survive in still water (breathing tubes, they float, they filter food from water, etc.). If you have a digital microscope, instead of watching this video, switch from the PowerPoint to the microscope and have students make a list of the adaptations they observe. We have provided more information/advice on using a digital microscope in classroom to observe mosquito larvae at the end of this document.

Slide 5: Pupa stage adaptations

Have the students watch the short video clip and see if they can determine some adaptations. You can let them know that a few seconds into the video clip, the habitat was jostled, which caused the pupa to respond noticeably. Hopefully the students can figure out that because the pupa stages does not eat, it needs to conserve energy. When it dove, it almost immediately rose to the surface because it has air bubbles underneath the exoskeleton that allow it to rise to the surface without expending valuable energy. Students may need some hints to figure this one out.

Slide 6: Adaptations of Adults

For this slide, ask students what body parts could be used to accomplish certain tasks. If you click on a part of the body, the name will appear. Here are a few:

- Antennae: sensory function, especially smell (females), and hearing (males). Females are trying to find a host (they can smell us, and even sense carbon dioxide when we exhale), while males are trying to find a mate, and they listen for the sound of a female mosquito's wingbeats.
- Proboscis (mouthparts): only adapted for liquids (blood and nectar)
- Compound eyes: adult mosquitoes can locate hosts or flower by sight
- Wings: flight

Slide 7: Video Clip from "How Mosquitoes Use Six Needles to Suck Your Blood".

This is an excellent video clip that shows how the female proboscis works. You can find the video in its entirety on YouTube.

Slide 8: Life Cycle Review

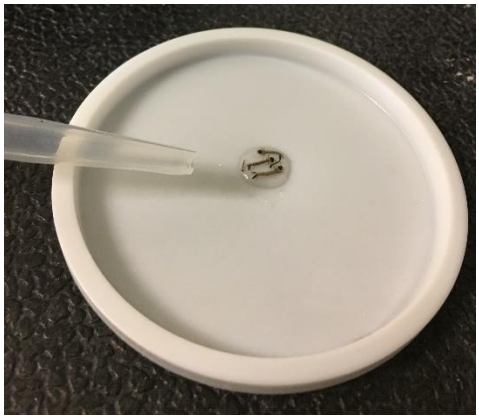
This is a convenient slide to have in the background while you answer questions

Step 3: Demonstrate how to use the life cycle kit and talk about the various tasks they will be responsible for (observing, activity sheets, feeding fish, making nectar, etc.)

Visit the Mosquito School website for more information or email erice@msmosquito.com

Notes about Using a Digital Microscope in the Classroom

Digital microscopes are a profoundly powerful tool for enhancing classroom presentations. There are a wide variety of relatively inexpensive digital microscopes available, and we currently use a ProScope Micro Mobile made by Bodelin technologies. This particular microscope attaches directly to an iPad (no cords) and uses the camera application that comes preinstalled on iPads. The iPad is either wirelessly connected to an Apple TV (if the classroom is equipped with one) or connected to a projector. Either way enables the entire classroom to study live mosquito larvae at the same time. This can be used to a quick introduction to the main lesson, as a means of generating interest and discussion during a question/answer portion of a lesson, or even as the focus of the lesson (as in our 4th grade "Adaptations of Mosquitoes" lesson). Here are a few suggestions if you plan to utilize this technology:



- Do not attempt to place the microscope directly over a dish of water. Even if there are large numbers of larvae present, they will tend to swim away from the light produced by the microscope. Instead, use a pipette to capture a small number of early-instar larvae in a drop of water, and place the drop on a flat, white surface (we use a plastic lid). If the bubble of water remains intact, you can place the microscope over the drop without displacing it, focus on the larvae, and they will not be able to wiggle away (see photo).

- It is imperative that you prepare students for this exercise prior to showing them a live magnified mosquito larvae. If you suddenly turn on the microscope and students see large, strange-looking creatures wiggling about, you will have an instant classroom management nightmare. Students will giggle, blurt out comments, and you will have to spend valuable and uncomfortable time regaining their focus. Preparing the students for this activity simply involves gaining their attention, informing them what is going to happen, and how they are expected to behave. Hold up the jar with the tiny wiggling larvae, and explain that a microscope will be used to magnify a few of them. Be very clear that when the microscope is turned on, everyone needs to observe silently. If students forget the expectations and are disruptive as soon as you turn it on, simply turn it back off and re-explain the expectations. After a short time of silent observation (30 seconds is more than enough), invite the students to raise their hand if they have a question or observation about what they see on the screen. This exercise can be an extremely valuable tool for generating interest and stimulating conversation about the topic.

- Prior to leading this activity in a classroom, spend a little time observing the mosquitoes on your own, so that you are prepared to help students understand what they are observing. The following list includes some of the behaviors that you are likely to observe:

    - **Feeding**: usually, after the larvae have been under the microscope for a few minutes, they will begin feeding. If small particles of food are present, they will be sucked in.

Some larger particles will get sucked in and then "spit out" the side of the head. You can ask if anyone knows of another animal that feeds in a similar manner (many students are familiar with other filter-feeding animals, especially baleen whales).

- **Thrashing movements**: typically, when the microscope is first turned on, the mosquitoes respond with a flurry of movement. They bump into one another, and students often describe this as "fighting" or "dancing". You can mention that mosquito larvae have very thin, flexible exoskeletons, and they move by flexing their entire bodies. You can also point out that they have sensory hairs that help them sense what is around them.

- **Breathing**: When the mosquitoes move, their breathing tubes are often visible from the side. Once they calm down, they tend to begin breathing, and the tip of the tube breaks the surface of the water. You can explain how mosquitoes do not have gills, and instead breathe at the surface. For older students you can ask/explore this adaptation and see if they can figure out why it is so important (they can survive in oxygen poor conditions where predators that depend on gills, especially fis, cannot survive).

- **Grooming**: sometimes students will observe mosquitoes bending around, so that their head is touching their "tail". You can inform the students that this is how mosquitoes clean their mouthparts.

- **Molting**: Occasionally, students will observe a mosquito larva that is in the process of splitting open and escaping from its older exoskeleton. This is a great time to talk about metamorphosis.

- **Defecating**: Fortunately, the mosquito larvae *usually* do not defecate "on camera", but it does occasionally happen, and there is probably nothing much you can do to prevent a heightened and intense student response. Good luck swiftly regaining the collective focus of the classroom if this happens.