PREVENT & PROTECT

Middle School and High School Curriculum

UNIT GUIDE FOR TEACHERS

PREVENT & PROTECT

PREVENT & PROTECT

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These lesson plans and other supplemental materials – including videos, social media, information sheets, and graphics – can be found at the *Prevent & Protect* website:

PREVENTMOSQUITOES.ORG

OBJECTIVES

Unit Objectives:

1. Describe the mosquito life cycle.
2. Describe the environment in which the different mosquito life stages live.
3. List the major arboviruses that have been transmitted in Florida
4. List the pathogens that have been transmitted in Florida.
5. Summarize the symptoms associated with mosquito-borne pathogens.
6. Summarize the health outcomes associated with mosquito-borne pathogens.
7. Prepare an action plan for your household on reducing container mosquito populations in the area.
8. Assess the role of mosquito control in Florida.

LP 1 Mosquito Biology Objectives:

1. Draw the mosquito life cycle.
2. Describe the habitat of each mosquito life stage.
3. Describe the behavior of each mosquito life stage.
4. Identify the types of Florida mosquitoes.
5. Compare and contrast the types of Florida mosquitoes.
6. Describe the characteristics of container mosquitoes.
7. Describe the behavior of container mosquitoes.

LP 2 Source Reduction Objectives:

1. Identify containers that are developing mosquito larvae.
2. Describe the actions necessary to eliminate mosquito-producing containers.
3. Create a household action plan to reduce container mosquito populations around their home.

LP 3 Mosquito-Borne Illness Objectives:

1. List the major mosquito vectors in Florida.
2. List disease-causing pathogens mosquitoes transmit.
3. Match the mosquito-borne pathogens to their associated symptoms.
4. Describe health outcomes associated with mosquito-borne pathogens.
5. Evaluate the burden of mosquito-borne illness in Florida.

LP 4 Mosquito Control Practices Objectives:

1. Describe the categories of an integrated pest management plan.
2. List the mosquito control practices currently used in Florida.
3. Describe the mosquito control practices currently used in Florida.
4. Discuss the advantages of mosquito control measures.
5. Discuss the disadvantages of mosquito control measures.
6. Create a solution to a mosquito control problem.

MOSQUITO UNIT OVERVIEW

	Lesson 1	Lesson 2	Lesson 3	Lesson 4
Topic	**Mosquito Biology**	**Source Reduction**	**Mosquito-borne Illnesses**	**Mosquito Control Practices**
Interest Approach	Draw a mosquito on tear sheets	Identify mosquito habitats within picture provided	Unscramble Lesson Topic	Review students' top 2 control methods submitted in previous lesson
Application Activity	Station Rotation	Household Action Plan	Mosquito-borne Illness Case Diagnosis	Mosquito Control Unit Manual
Closure	Exit ticket: life cycle illustration	Question and answer for clarification	Exit ticket: students' top 2 preferred mosquito control methods	Question and answer for clarification
Documents	• Lesson plan • PowerPoint • Guided Notes • Mosquito ID Station PowerPoint	• Lesson plan • PowerPoint • Guided Notes	• Lesson plan • PowerPoint • Guided Notes	• Lesson plan • PowerPoint • Guided Notes • Cover Page • Pronunciations
Videos	Mosquito Biology	Personal Responsibility	Mosquito-Borne Illnesses	Application Methods
Supplies	• Markers • Tear sheets • Mosquito life cycle models • Mosquito microscope slides			• Stapler
Evaluation	Question and Answer Handouts Exit tickets Mosquito Control Unit Manual **Unit Exam**			

LESSON 1: MOSQUITO BIOLOGY

INSTRUCTIONAL PLAN	
Lesson Title:	Mosquito Biology
Estimated Time:	100 minutes

Objectives:

At the end of this lesson, students will be able to:

1. Draw the mosquito life cycle.
2. Describe the habitat of each mosquito life stage.
3. Describe the behavior of each mosquito life stage.
4. Identify the types of Florida mosquitoes.
5. Compare and contrast the types of Florida mosquitoes.
6. Describe the characteristics of container mosquitoes.
7. Describe the behavior of container mosquitoes.

Equipment, Supplies, References, and Other Resources:

Documents

- Mosquito Biology PowerPoint presentation
- Mosquito Biology Guided Notes
- Mosquito Identification Station PowerPoint presentation

Video

- https://www.youtube.com/watch?v=Sa7HpTX0FZQ&feature=youtu.be
- Can also be found at https://preventmosquitoes.org/mosquito-control-toolkit/videos/ (click video link called “Mosquito Biology”)

Supplies

- Tear sheets (about 6)
- Markers (10)
- Mosquito Life Cycle models
  - https://www.amazon.com/Safari-662616-Life-Cycle-Mosquito/dp/B00IZ07KJQ/ref=sr_1_1?keywords=mosquito+life+cycle&qid=1552052202&s=office-products&sr=8-1
- Microscope
- Mosquito Life Cycle Microscope Slides
  - https://www.amazon.com/Mosquito-Life-Cycle-Microscope-Slide/dp/B005XCWNY6/ref=sr_1_fkmrnull_1?keywords=mosquito+life+cycle+slides&qid=1552239347&s=gateway&sr=8-1-fkmrnull

LESSON 1: MOSQUITO BIOLOGY

Situation:
25 Middle or High School students in a classroom The Mosquito Biology Guided Notes handout will not be passed out until after the interest approach. The mosquito models are out of sight, but can be used throughout the presentation when referring to egg, larval, pupal, and adult mosquitoes. A microscope is set up on a table with the microscope slide in the protective box.

Preparation (including overview, link, and interest approach)

Link

Mosquitoes are vectors of dangerous pathogens that cause disease, threatening human and animal health. Florida has a hot and humid climate ideal for insects, like mosquitoes, to thrive. There is a need to understand mosquito biology in order to mitigate the harmful diseases mosquitoes can transmit. This lesson about mosquito biology lays the foundation for the remainder of the unit focused on preventing and protecting against mosquito-borne illnesses.

- During the interest approach, students will work in small groups to draw an illustration of a mosquito.
- Throughout the PowerPoint presentation, students will take notes and participate in class discussion.
- Following the presentation, students will complete the Mosquito Key Worksheet.
- At the end of class, students will turn in an exit slip illustrating the mosquito life cycle.

Interest Approach

Students will work in groups of four to draw a mosquito on a tear sheet using the markers provided. Students should try to make the drawing as life-like as they know how, except on a large scale.

"We are starting a new unit today, and to kick it off, we are going to have a competition. You will draw your best illustration of the word given to you, using a tear sheet and markers. The goal is to make this drawing as realistic as you can, but on a larger scale. You will be working in groups of four with two minutes to draw. Once you are in your groups with a tear sheet and marker, I will announce the word and start the timer."

"Alright, each group will be drawing a mosquito! You have two minutes."

[Start two-minute timer]

"Time's up! Let's take a look at these drawings."

LESSON 1: MOSQUITO BIOLOGY

[Facilitate short class discussion reviewing each group's mosquito illustration, and then ask students to return to their seats.]

Pass out Mosquito Biology Guided Notes Handout.

Overview
Slide 1
"Over the next few days, we will be learning about mosquito biology, source reduction, mosquito-borne illnesses, and mosquito control practices."

Slide 2
"Today, specifically, we will be discussing mosquito biology, and we have three goals for this lesson:

1. Illustrate the mosquito life cycle.
2. Identify common Florida mosquitoes.
3. Distinguish characteristics of container mosquitoes."

"As we go through the lesson, I expect you to take notes on the Guided Notes handout and ask questions that will help your understanding of the topics."

Teacher Directions / Methods	Content Outline / Key Points

Slide 3
Question – Answer – Discussion (QAD)
	Mosquitoes are Insects
	What makes an insect an insect?
	• All insects have six legs. Spiders are not insects (eight legs). Ticks are not insects (eight legs).
	• Insects have an exoskeleton. When insects want to grow and/or change, they must molt. This is because their skeleton is on the outside of their body ("exo" means outside).
	• Insects have three major body segments. This is broken down into the head, thorax and abdomen.
	  ○ The head is where the mouthparts, eyes, and antennae are located.
	  ○ The thorax is where the appendages of the insect are

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Teacher Directions / Methods	Content Outline / Key Points
	located. This includes wings (if the insect has any) and legs. o The abdomen is where the food the insect consumes is stored and digested.
Slide 4	***Mosquito Morphology*** All adult mosquitoes have only two wings. • This is in contrast to things like butterflies, beetles, grasshoppers, and other insects with four wings. • Mosquitoes have two wings, and instead of a second pair of wings, they have specialized structures called halters that help with orientation in flight. The piercing-sucking mouthpart mosquitoes have is called a **proboscis**. • This is composed of multiple parts that allow blood feeding. The female mosquito lays her eggs on or near the water or in areas that are likely to flood. The immature stages of the mosquito lives in the water. The larvae and pupae must develop in the water or they will die. Only adult females need to feed on blood. The females feed on blood to mature their eggs. • To get energy resources, both males and females will feed on plant nectar. Only female mosquitoes feed on blood!
Slide 5	***Taxonomic Classification*** Before we talk about mosquitoes and their biology, we are going to discuss the taxonomic classification for this group. • Mosquitoes are in the Kingdom Animalia where Animals fall.

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Teacher Directions / Methods	Content Outline / Key Points
	• The Phylum is Arthropoda which includes insects, but also non-insect arthropods such as ticks, or millipedes. • Class Insecta includes all of the insects. • The order Diptera includes all of the "true flies" meaning that they have 2 wings and compound eyes. • And all mosquitoes are in the family Culicidae. ○ From here, there are many genera and species of mosquitoes that have their own unique biology, behavior, habitat, feeding preference, etc. From this point forward we will talk about some mosquito genera and maybe some species as well, but all mosquitoes are in the family Culicidae.
Slide 6	***Mosquito Diversity*** There are thousands of mosquito species in the world. • More than 150 in the United States. • ~80 species in Florida. Mosquitoes come in various sizes, colors, and behavioral types. • There are mosquitoes as big as *Toxorhynchites* (elephant mosquito) in the top picture and as small as *Uranotaenia* in the bottom picture. • Some mosquitoes are plain and brown while others have iridescent scales. Some have black and white scales. There are mosquitoes that feed on fish. Some feed on puddle jumpers (a type of fish) when they move from one pond to another. Other mosquitoes feed on worms (annelids) and leeches. Some mosquitoes feed on humans.

LESSON 1: MOSQUITO BIOLOGY

Slide 7 **Use mosquito models to refer to egg, larva, pupa, and adult.** **QAD** **Ask the question:**	***Mosquito Life Cycle*** Mosquitoes have a complete life cycle. • This is also known as a holometabolous life cycle. There are four major life stages: 1. An adult female mosquito lays **eggs** on or near the water. 2. Those eggs hatch in the water and **larvae** emerge. 3. Larvae feed on nutrients in the water, grow, and eventually become **pupae**. a. This is the transformation phase of the mosquito. 4. The pupae will become **adult** mosquitoes. **Can you think of another insect with a holometabolous life cycle? (looking for butterfly – this example is used again later)** We will go into more detail about each life stage in the following slides.
Slide 8 **The egg model displays a raft of eggs.**	***Different Types of Mosquito Eggs*** Different mosquito species lay different types of eggs. The eggs pictured on the left are laid by some *Aedes* mosquitoes. • They are laid **singly**. • These eggs are laid near the water or in containers where the water will flood. • Once the eggs are eventually flooded, the eggs will hatch. Other mosquitoes lay their eggs in **rafts** (photo in the center of the screen). • These are laid by some *Culex* mosquitoes and there can be hundreds of eggs in one raft. Some *Anopheles* species lay eggs that have **floats** on them (photo on the right).

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Slide 9	***Where are eggs laid?*** These eggs are laid **on or near the water** or in areas where there will eventually be flooding. • This can include anything from water-holding **containers** to permanent bodies of water like **lakes**. • Areas that flood, such as **ditches**, can also have mosquitoes. • Mosquitoes can also inhabit **salt marshes** despite the salinity of the water.

Slide 10
 	
Use larva model
	Larval Habitat and Behavior
	What do larvae eat?
	• Most larvae eat organic matter in the water.
	How long does it take for larvae to develop?
	• Larvae can develop in as little as four days. However, this can be longer based on various factors.
	  ○ Different mosquito **species** develop at different rates.
	  ○ Generally, colder **temperatures** slow mosquito development.
	  ○ The **availability of food** as well as **how many** larvae are in the same habitat can influence how long it takes mosquitoes to develop.
	When larvae (and pupae) sense a predator, they will leave the surface of the water, where they may be resting and breathing, and disperse throughout the water.

Slide 11	***Larval Habitat and Behavior*** **The major goal of a mosquito larvae is to eat and grow**. Thinking back to the butterfly example, the mosquito larvae would be similar to a caterpillar. • During this stage, larvae are looking to eat and progress through their **four** larval instars before becoming pupae – four

	larval instars, indicating the mosquito larvae grow and shed their skin four times. ○ **Instars** are the different **growth stages** of the larvae. They breathe using a siphon which is located at the opposite end of the body from their head. • They can pierce the surface of the water to obtain oxygen. This stage is known as a wiggler or a wriggler because of the way they move through the water.
Slide 12	***Mansonia and Coquillettidia Larvae*** Some mosquitoes have specialized siphons, or no siphon at all. • For example, *Mansonia* and *Coquillettidia* larvae have modified siphons (like saws) that allow them to pierce into plants. • This means that these larvae do not have to come to the surface of the water to obtain oxygen. • They get the oxygen they need from the plant.
Slide 13	***Toxorhynchites Larvae*** Other unique mosquito larvae are *Toxorhynchites* mosquito larvae. • *Toxorhynchites* are predaceous on other mosquito species. • While most mosquito species are feeding on organic matter in the water, the *Toxorhynchites* are feeding on the other mosquito larvae. • They have been used for **biological control** and may be considered a "**good**" mosquito.
Slide 14 **Use pupa model**	***Pupal Habitat and Behavior*** After progressing through the four larval instars, the mosquito larva will molt one more time to become a pupa. • This means that the pupa is found in the same aquatic

	environment as the larvae. • At this stage, the **goal is transforming** (similar to the cocoon or chrysalis of a butterfly or moth). ○ Adults will develop wings, different mouthparts and become reproductive. They are no longer just eating and growing. • When looking at a profile view of the pupae, different morphological characteristics of the adult mosquito start to become visible. • The large black dot is the compound eye. Mosquito pupae breathe using trumpets, which are projections off the pupa that penetrate the surface of the water. This is a non-feeding stage. This stage is also referred to as "tumblers" because of the way they bounce through the water when disturbed. Pupae have two major body parts: the cephalothorax and the abdomen. • The cephalothorax is simply the combined head and thorax where the abdomen is the tail you see above.
Slide 15	***Mansonia and Coquillettidia Pupae*** Similar to the larval stage, *Mansonia* and *Coquillettidia* pupae have pointed trumpets that allow them to continue to get their oxygen from aquatic plants.
Slide 16 **Use adult model**	***Adult Habitat and Behavior*** We are all most likely familiar with the adult stage because they inhabit the terrestrial environment like we do. • In some cases, they are also trying to get a bloodmeal from us. • After the pupa becomes an adult mosquito, it will go find a mate. • After mating, the female mosquito needs to take a bloodmeal

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	before she can develop her eggs. • Female mosquitoes consume blood so their **eggs** can **mature** prior to laying. ○ It serves no nourishment function. • Males do not take blood meals at all. • In order to obtain energy, both male and female mosquitoes feed upon plant nectars - much in the same manner as butterflies. The lifespan of mosquitoes varies by species. • Most adult female mosquitoes live two to three weeks. • Some species that over-winter in garages, culverts and attics can live as long as six months.
Slide 17 **QAD** **"How do mosquitoes find hosts?"** **Next Slide 18**	***How do mosquitoes find hosts?*** According to the American Mosquito Control Association, there are a number of mosquito attractants. **Carbon dioxide** is the most widely recognized attractant, and it can draw mosquitoes from up to 35 meters away – that's over 100 feet! • When females sense carbon dioxide, they fly in a zig-zag pattern to zero in on their target. Once the mosquito is close to a potential host, other cues predominate, including **body odor** and **heat**. • Some odors repel mosquitoes, too. **Visual cues**, such as movement, also factor in choosing a host.
Half-way Point	Depending on class length, this may be a nice stopping place. Continue on with the following video as interest approach.
Slide 19 **VIDEO**	Youtube link: https://www.youtube.com/watch?v=Sa7HpTX0FZQ&feature=youtu.be

	OR visit Prevent and Protect website: https://preventmosquitoes.org/mosquito-control-toolkit/videos/ (click video link called "Mosquito Biology")
Slide 20 **Think-Pair-Share "Should mosquitoes be eradicated?"**	***Should mosquitoes be eradicated?*** Think about your answer to this question for a moment, considering the positive and negative consequences. Now turn to your neighbor and share your thoughts with them. [If time permits, invite students to share their paired discussion with the rest of the class.]

Slide 21	***What if we got rid of all mosquitoes?***
	While mosquitoes can be a nuisance and may also transmit pathogens, they play a certain role in the environment.
	• They occupy a niche.
	• If mosquitoes no longer occupied that niche, it is not clear what would come after.
	  ○ What comes after may be worse than the mosquitoes were.
	• Realistically, it would be nearly impossible to eradicate mosquitoes because they occupy such diverse habitats.
	  ○ It would be hard for us to kill every last mosquito.
	
	This piece below is from the American Mosquito Control Association: "If mosquitoes were eradicated, how would this affect the ecosystem? Given that Nature abhors a vacuum, other species will fill the niches vacated by the mosquitoes after an initial shuffling period of variable length. Be advised, though, that species replacing mosquitoes may be even worse - it's extremely difficult to predict. Mosquitoes' ability to

	adapt to changing environments would make them all but impossible to eradicate."

Slide 22	***Habitat Types***
	Mosquitoes can often be distinguished or grouped by the types of habitats that they occupy.
	• Floodwater mosquitoes will lay their eggs in the soil or areas where water is likely to pool and flood after a rain event.
	  ○ These eggs can survive drying out before the flooding occurs.
	  ○ This may be in swamps, ditches (like drainage ditches) or floodplains.
	• Permanent water mosquitoes lay their eggs on the surface of the water.
	  ○ These eggs can't afford to dry out because they will die.
	  ○ They are laid directly on the surface of the water and hatch into the water.
	• Water-holding containers often have mosquitoes that lay eggs singly visit them.
	• Eggs are laid just at or right above the water line.
	• Once the container gets more water, the eggs are able to hatch into the water.
	Different mosquito species prefer different larval habitats.
	
	Examples of mosquito species in these different habitats
	Floodwater – *Aedes vexans, Psorophora columbiae, Aedes taenorhynchus*
	Permanent - *Anopheles quadrimaculatus, Culex quinquefasciatus*
	Containers – *Aedes aegypti, Aedes albopictus*

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Slide 23	***Picture of species at different stages*** Left shows mosquito egg with floats. *Anopheles* larvae don't have a siphon so they rest parallel to the surface of the water to get oxygen. They have maxillary palps that are about in length to their proboscis. When they are resting, they rest at an angle. Middle: *Aedes* eggs are laid singly by the female. The siphon of Aedes larvae is shorter compared to *Culex* larvae. The maxillary palps are not as long as the proboscis (for FEMALES). Adults do not rest at an angle. Right: *Culex* eggs are often laid in a raft. The larvae tend to have longer siphons compared to other mosquito species. The maxillary palps are not as long as the proboscis (for FEMALES). Adults do not rest at an angle.
Slide 24	***Anopheles*** *Anopheles* larvae don't have a siphon, so they rest parallel to the surface of the water to get oxygen. (Shown in image of larva) *Anopheles* may inhabit floodwater and permanent water sources. *Anopheles* eggs have floats on the sides. When they are resting, they rest at an angle. Another distinguishing characteristic is that they have maxillary palps about equal in length to their proboscis.
Slide 25	***Culex*** *Culex* may also inhabit floodwater and permanent water sources. *Culex* lay eggs in rafts. Adults do not rest at an angle. The maxillary palps are not as long as the proboscis (for FEMALES). These mosquitoes are usually brown/ plain looking mosquitoes.

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Slide 26	***Aedes*** *Aedes* inhabit containers. *Aedes* lay eggs singly. Adults do not rest at an angle. The maxillary palps are not as long as the proboscis (for FEMALES). These mosquitoes are usually black or brown with white striped legs.
Slide 27	***Yellow Fever Mosquito*** Within the genus *Aedes*, there are two species that have received a lot of attention recently: *Aedes aegypti* and *Aedes albopictus* • Pictured here is *Aedes aegypti*. This mosquito is referred to as a container mosquito because it develops in containers close to human habitation. • It is common around residential areas. • It also prefers human bloodmeals over other bloodmeals. ○ They are seeking a bloodmeal during the day when humans are most active. • These mosquitoes are brown and white in coloration have a distinctive lyre shape on their thorax. They also have striped legs.
Slide 28	***Asian Tiger Mosquito*** *Aedes albopictus*, also known as the Asian tiger mosquito is also a container mosquito. • They will usually occupy residential and suburban areas. • They feed on various mammals, including humans, but are also looking for a bloodmeal during the day. • This species is an aggressive daytime biter and easily distinguishable by its single black stripe on the thorax and striped legs. • They are vividly black and white.

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Slide 29	***Toxorhynchites*** There are some special cases of mosquitoes, like *Toxorhynchites*, that do not feed on blood at all. • These mosquitoes are the same ones that feed on other mosquito larvae when they are in the larval stage. • They get all of the protein that they need to mature their eggs from the protein they obtained as a larva. • Adult *Toxorhynchites* do not feed on blood, only nectar. • This is another reason why these mosquitoes could be considered "good" mosquitoes.
Slide 30	***Uranotaenia*** Some mosquitoes feeding behavior is very interesting. • For example, *Uranotaenia lowii* feeds on frogs and toads. • Even more interesting, *Uranotaenia sapphirina* feed on worms and leeches. • The reason this is so interesting is because, up until 2018, mosquitoes had only been documented as specializing on vertebrate hosts (things with a spine). ○ The discovery that this *Uranotaenia* species was specializing on non-vertebrate hosts was a new and interesting finding.
Slide 31	***Why do we care about mosquitoes?*** Mosquitoes can be a nuisance. No one likes being bit by a hungry female mosquito. They also transmit pathogens such as dengue virus, West Nile virus, Zika virus, and dog heartworm.

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Slide 32	***Are all mosquitoes bad?*** Mosquitos also function as food for other animals in the ecosystem. • Mosquitoes may be consumed by birds, insects, frogs, and fish. *Toxorhynchites* aren't bad mosquitoes. Some species don't bother humans or our pets, so are they really all that "bad"?
Application: **Slide 33** **Open Mosquito Identification Station PowerPoint**	There will be three stations for the application, and students will be guided by the Mosquito Biology Stations handout. 1. Mosquito Identification Key 2. Mosquito Life Cycle Models 3. Mosquito Life Cycle Microscope Slides Divide the class into three groups. At the **Mosquito Identification Key** station, students will use their mosquito identification key to identify the mosquito genera/species from the Mosquito Identification PowerPoint. At the **Mosquito Life Cycle Model** station, students will match anatomical terms with the correct model parts. At the **Mosquito Life Cycle Microscope Slide** station, students will use a microscope to view slides of an actual mosquito egg, larva, pupa, and adult. The station time length may be adjusted according to the time available.
Closure/Summary:	**Exit Slip** Students will turn in Station 3, which is the last page of the Mosquito Biology Guided Notes handout. They will draw the four stages of the mosquito life cycle in the correct box of the diagram. The exit slip is turned in as they leave.

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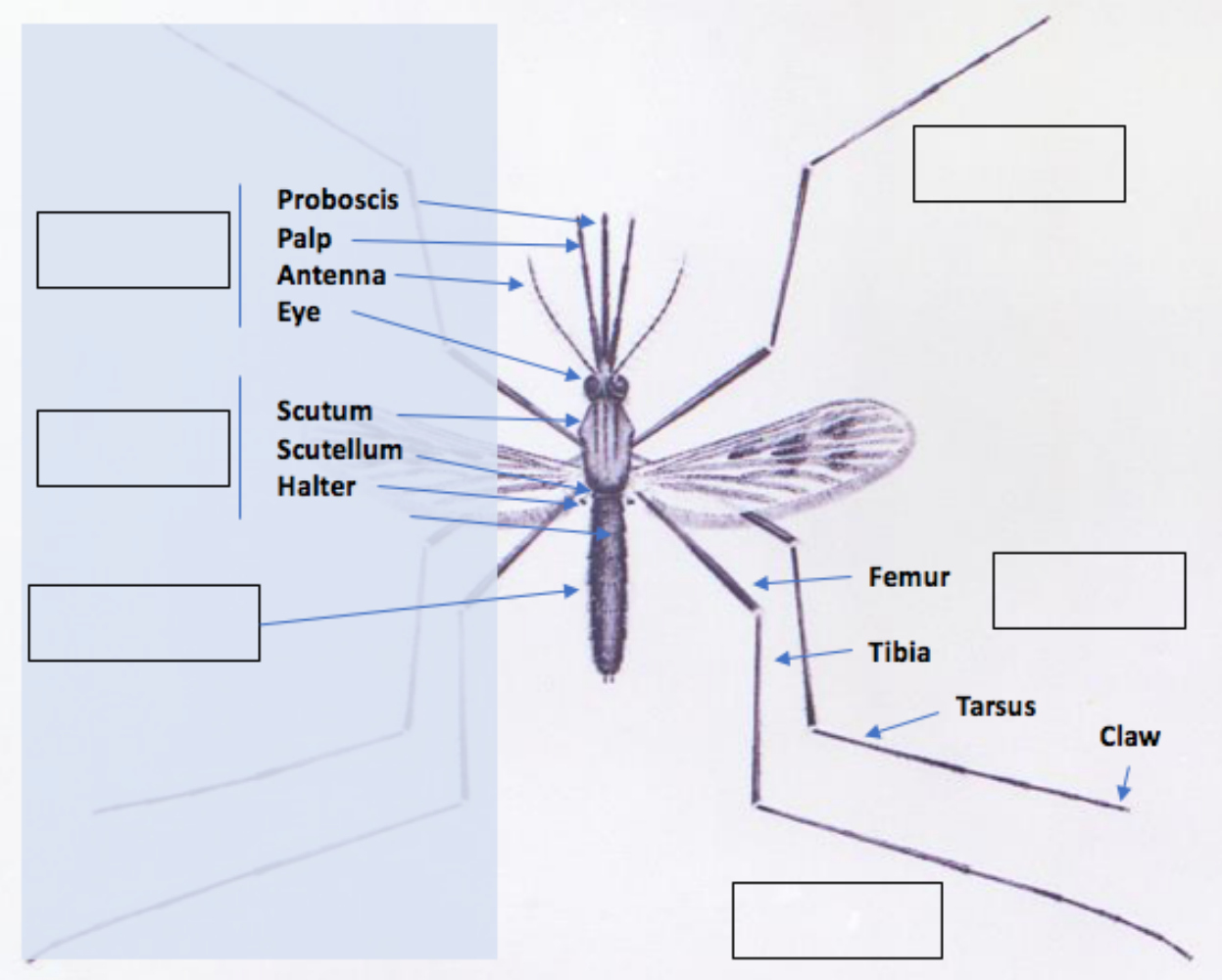
Evaluation:	**Formative:** Q&A throughout lesson Mosquito Biology Guided Notes Mosquito Life Cycle Exit Slip **Summative**: Unit Test – later in unit

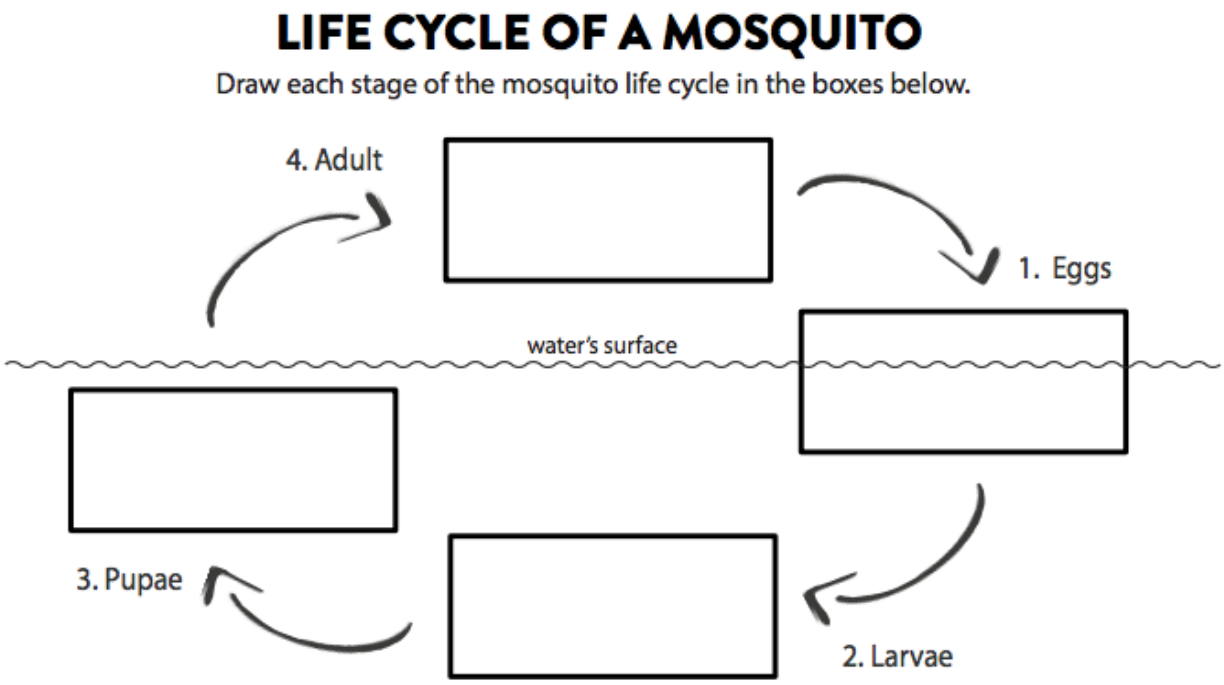
Mosquito Biology Guided Notes

Mosquito Anatomy
Fill in the boxes with the correct anatomical part.



Mosquito Life Cycle

1. Mosquitoes have a _____ life cycle – also known as _____.



2. Eggs are laid _____ or in areas where there will eventually be flooding.
   - Examples:

3. Larva can develop in as little as _____.

4. The major goal of the larval stage is to _____ and _____.

5. There are _____ larval instars. Instars are _____ stages.

6. *Toxorhynchites* larvae have been used for _____ and may be considered a "_____" mosquito.

7. The major goal of the pupal stage is _____.

8. Pupae have two major body parts: the _____ and the _____.

9. Only _____ consume blood.
    a. The primary purpose for this is to _____ their _____ prior to laying.
10. _____ is the most universally recognized mosquito attractant.
    a. Other attractants:

Habitat Types

1. _____
    a. Examples:
2. _____
    a. Examples:
3. _____
    a. Examples:

Mosquito Identification

Construct a key to differentiate between common Florida mosquito genera and species.

Genus: *Anopheles*

Habitat Type:

Egg type:

Resting Position:

Distinguishing characteristics:

Genus: *Culex*

Habitat Type:

Egg type:

Resting Position:

Distinguishing characteristics:

Genus and species: *Aedes aegypti*

Habitat Type:

Egg type:

Resting Position:

Distinguishing characteristics:

Genus and species: *Aedes albopictus*

Habitat Type:

Egg type:

Resting Position:

Distinguishing characteristics:

Genus: *Toxorhynchites*

Resting position:

Distinguishing characteristics:

Genus: *Uranotaenia*

Resting Position:

Distinguishing characteristics:

Station Rotation

Directions: Rotate through the following stations to reinforce the topics discussed in the lesson.

Station 1: Mosquito Identification

Using your Mosquito Identification Key, identify the mosquito genera/species in the Mosquito Identification PowerPoint.

1. **_____**
2. **_____**
3. **_____**
4. **_____**
5. **_____**
6. **_____**

Station 2: Mosquito Life Cycle Model

Identify the following anatomical parts on the models.

Egg

- Type of egg?

Larva

- Head
- Siphon

Pupa

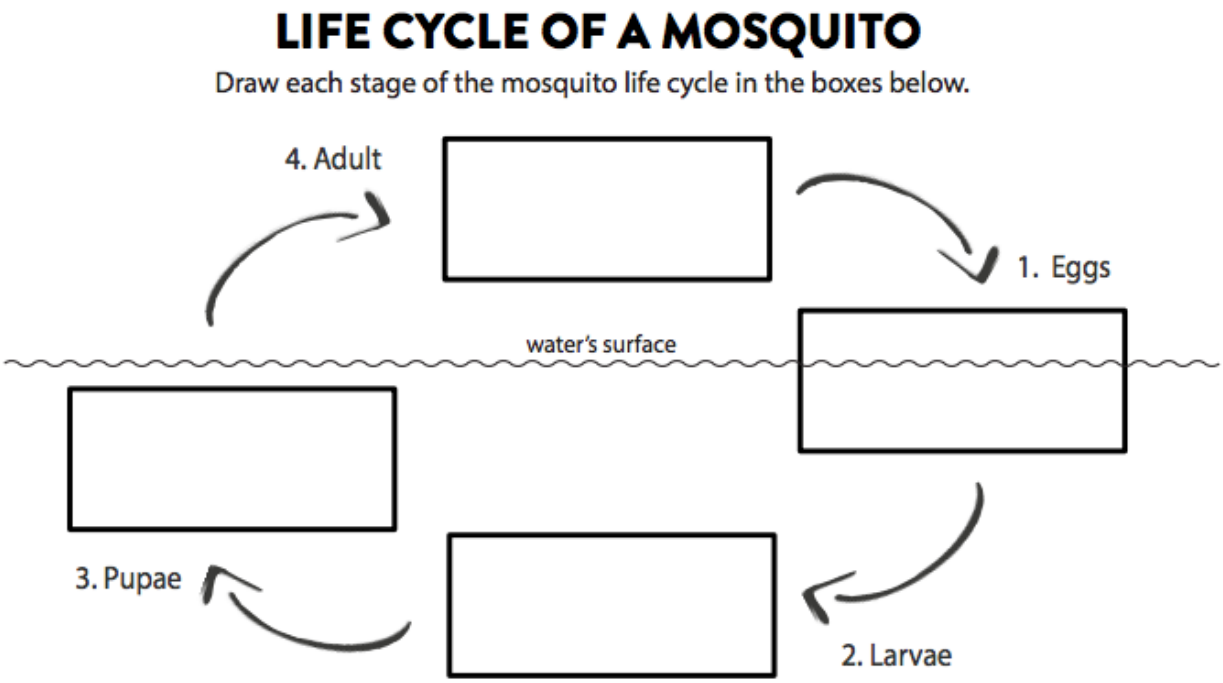
- Cephalothorax
- Abdomen
- Is there a trumpet?

Adult

- Head
  - Proboscis
  - Antenna
  - Maxillary palps
- Thorax
  - Wings
- Abdomen

Station 3: Mosquito Life Cycle Microscope Slide

Take turns viewing a mosquito in each of the four life cycle stages under the microscope, zooming in to see each stage magnified. Complete the life cycle diagram by sketching what a mosquito looks like at each stage in the correct box.



Station 3 is also your ticket to leave when class is over. Detach this page from the rest of the handout and turn it in as you leave.

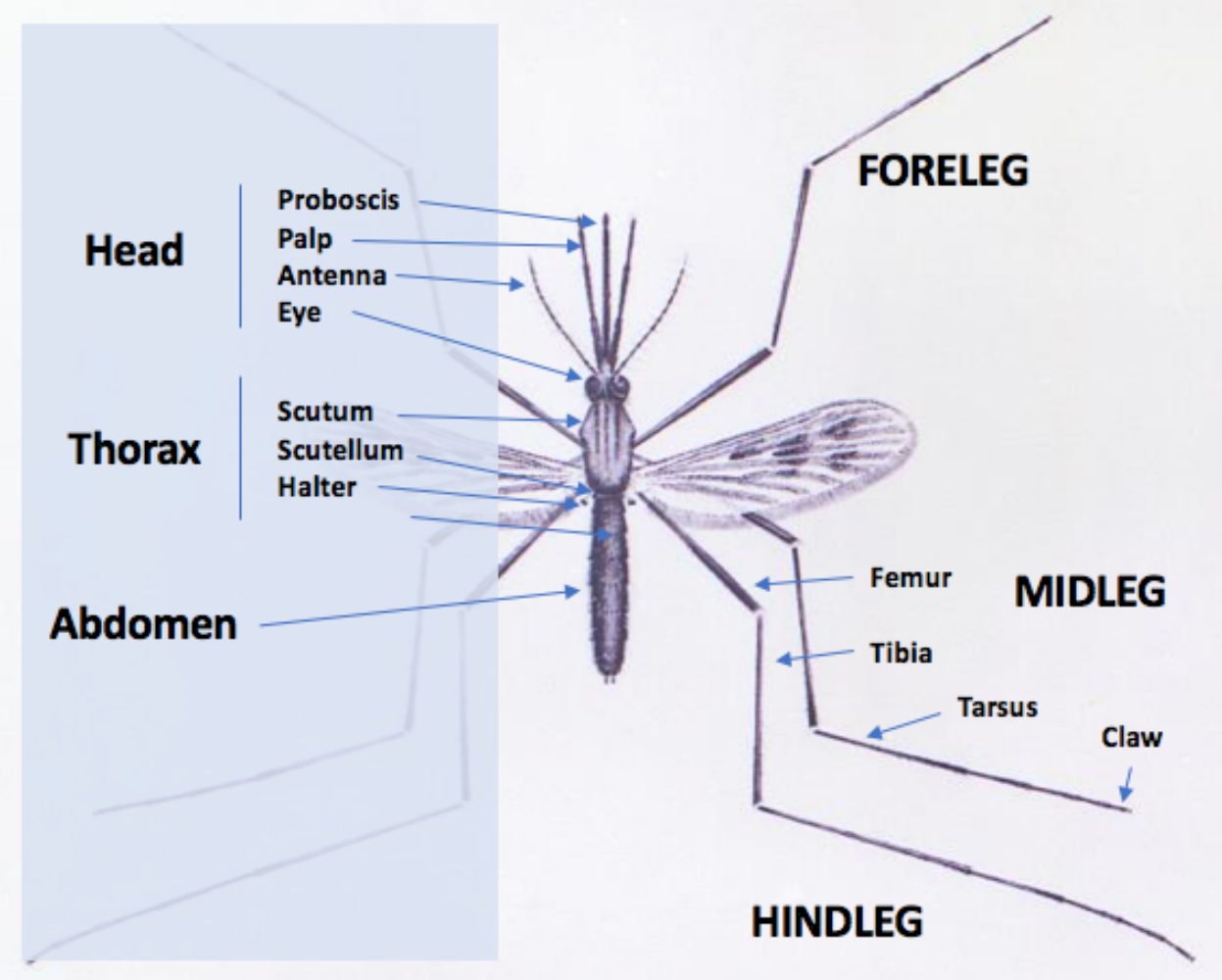
Name: _____

Class: _____

Date: _____

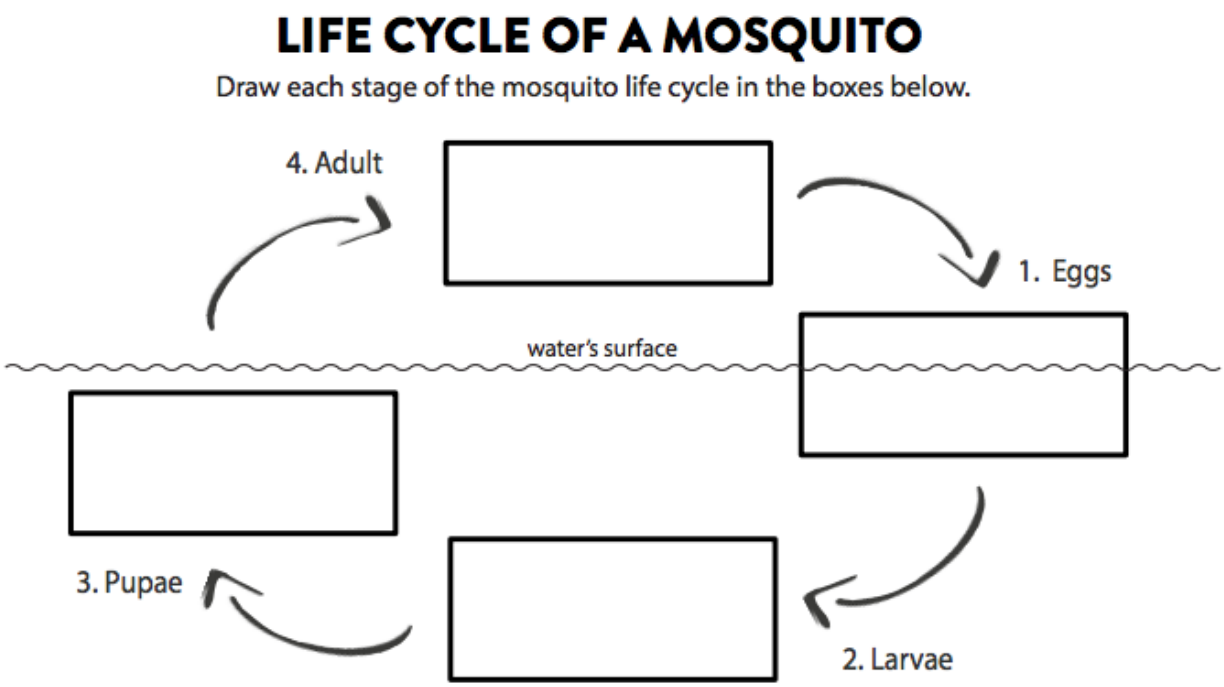
Mosquito Biology Guided Notes

Mosquito Anatomy
Fill in the boxes with the correct anatomical part.



Mosquito Life Cycle

1. Mosquitoes have a **complete** life cycle – also known as **holometabolous**.



2. Eggs are laid **on or near the water** or in areas where there will eventually be flooding.
   - Examples: **containers, lakes, ditches, salt marshes**

3. Larva can develop in as little as **4 days**.

4. The major goal of the larval stage is to **eat** and **grow**.

5. There are **4** larval instars. Instars are **growth** stages.

6. *Toxorhynchites* larvae have been used for **biological control** and may be considered a "**good**" mosquito.

7. The major goal of the pupal stage is **transformation**

8. Pupae have two major body parts: the **cephalothorax** and the **abdomen**.

9. Only **females** consume blood.

    a. The primary purpose for this is to **mature** their **eggs** prior to laying.

10. **Carbon dioxide** is the most universally recognized mosquito attractant.
    a. Other attractants: **body odors, heat, visual cues**

Habitat Types

1. **Floodwater**
    a. Examples: **ditches, floodplains**

2. **Permanent**
    a. Examples: **lakes**

3. **Containers**
    a. Examples: **bird bath, recycling bin, any container that can hold water**

Mosquito Identification Worksheet

Using your lesson notes and additional research, construct a key to differentiate between common Florida mosquito genera and species.

Genus: *Anopheles*

Habitat Type: floodwater and permanent

Egg type: with floats

Resting Position: angled

Distinguishing characteristics: long maxillary palps

Genus: *Culex*

Habitat Type: floodwater and permanent

Egg type: rafts

Resting Position: not angled

Distinguishing characteristics: usually brown and plain looking

Genus and species: *Aedes aegypti*

Habitat Type: container

Egg type: laid singly

Resting Position: not angled

Distinguishing characteristics: lyre shape on thorax, striped legs

Genus and species: *Aedes albopictus*

Habitat Type: container

Egg type: singly laid

Resting Position: not angled

Distinguishing characteristics: black and white, single white stripe on thorax

very large mosquito
with brilliantly colored scales

Genus: *Toxorhynchites*

Resting position: not angled

Distinguishing characteristics: Very large, eats other mosquito larvae, doesn't take a bloodmeal

Genus: *Uranotaenia*

Resting Position: not angled

Distinguishing characteristics: Very small, iridescent blue/ purple scales on body

very small mosquito

Station Rotation

Directions: Rotate through the following stations to reinforce the topics discussed in the lesson.

Station 1: Mosquito Identification

Using your Mosquito Identification Key, identify the mosquito genera/species in the Mosquito Identification PowerPoint.

1. ***Culex***
2. ***Aedes albopictus***
3. ***Uranotaenia***
4. ***Anopheles***
5. ***Aedes aegypti***
6. ***Toxorhynchites***

Station 2: Mosquito Life Cycle Model

Identify the following anatomical parts on the models.

Egg

- Type of egg? **raft**

Larva

- Head
- Siphon

Pupa

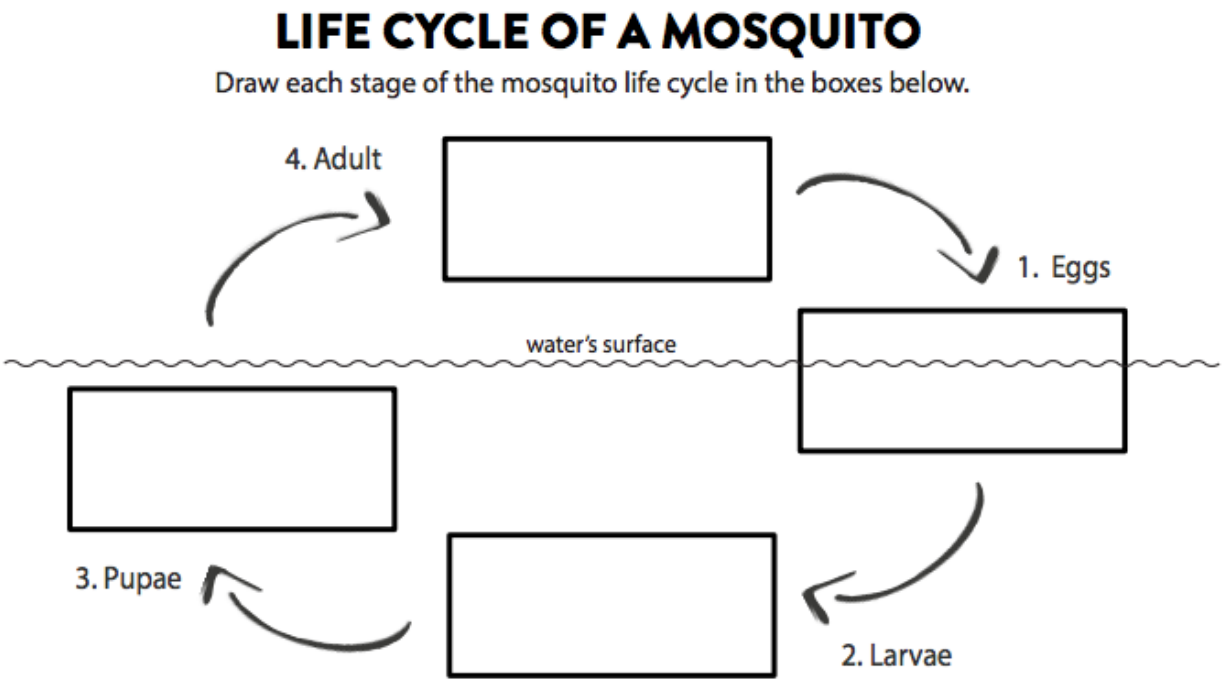
- Cephalothorax
- Abdomen
- Is there a trumpet? **Not on this model**

Adult

- Head
  - Proboscis
  - Antenna
  - Maxillary palps
- Thorax
  - Wings
- Abdomen

Station 3: Mosquito Life Cycle Microscope Slide

Take turns viewing a mosquito in each of the four life cycle stages under the microscope, zooming in to see each stage magnified. Complete the life cycle diagram by sketching what a mosquito looks like at each stage in the correct box.



Station 3 is also your ticket to leave when class is over. Detach this page from the rest of the handout and turn it in as you leave.

Name: _____

Class: _____

Date: _____

LESSON 2: SOURCE REDUCTION

INSTRUCTIONAL PLAN	
Lesson Title:	Source Reduction
Estimated Time:	100 Minutes

Objectives

At the end of this lesson, students will be able to:

1. Identify containers that are developing mosquito larvae.
2. Describe the actions necessary to eliminate mosquito-producing containers.
3. Create a household action plan to reduce container mosquito populations around their home.

Equipment, Supplies, References, and Other Resources:

Documents

- Source Reduction PowerPoint presentation
- Source Reduction Guided Notes (1 copy per student)

Video

- https://www.youtube.com/watch?v=5AVJ-zcg_MQ&feature=youtu.be
- Can also be found at https://preventmosquitoes.org/mosquito-control-toolkit/videos/ (click video link called “Mosquito Biology”)

Situation:

25 middle school or high school students

Student Preparation (including overview, link, and interest approach)

Link

Mosquitoes are vectors of dangerous pathogens that cause disease, threatening human and animal health. Florida has a hot and humid climate ideal for insects, like mosquitoes, to thrive. There is a need to understand where mosquitoes live and how to remove these habitats in order to mitigate the harmful diseases mosquitoes can transmit. This lesson about source reduction will focus on identifying mosquito-producing containers and actions needed to eliminate those containers.

- During the interest approach, students will identify all possible mosquito larval habitats within the photo provided.

- Throughout the PowerPoint presentation, students will follow along with the guided notes and participate in class discussion.
- Following the presentation, students will complete the Household Action Plan homework assignment.
- At the end of class, students will have the opportunity to ask questions or bring up a topic they would like to be clarified.

Interest Approach
Students will work independently to identify as many mosquito-producing habitats as they can from the picture provided on slide 1 in the PowerPoint presentation.

Slide 1
"On a scratch piece of paper, write down as many potential locations as you see in the picture for mosquitoes to lay eggs – which would mature into larvae, pupae, and adults. Keep in mind one of the key components eggs need to grow and develop."

"So what is the key component mosquito eggs need to grow and develop?"

"So where could we potentially find mosquito larvae in this photo?"

Slide 2

From picture:

- Rain barrel
- Bird bath
- Rain gutter
- Bird feeder
- Flower pots
- Anywhere else that can hold standing water

Overview
Slide 3
"Today's lesson will center around source reduction as it relates to mosquito control."

Slide 4
"We have three goals for this lesson:

1. Identify containers that are developing mosquito larvae.

2. Describe the actions necessary to eliminate mosquito-producing containers.
3. Create a household action plan to reduce container mosquito populations."

"As we go through the slides, you will take notes by following the Guided Notes handout."

Teacher Directions / Methods	Content Outline / Key Points
Slide 5 **Question-Answer-Discussion (QAD)** **Ask:**	***Source Reduction*** When we talk about reduction, we are referring to the removal of something, whatever that object may be. • Source reduction = **the removal or permanent destruction of mosquito development sites**. • Dumping out and destroying artificial containers that hold water is one way to reduce larval habitats for mosquitos. • If there are containers that we can't eliminate, we can manipulate the habitat in a way that does not allow for larval development. ○ This is a specific type of source reduction and the one we will focus on in this lesson because you can do this in your own home! **Why do we remove water-holding containers to prevent mosquito development? (Think about the life cycle and corresponding habitats.)**
Slide 6	***Container Mosquitoes*** In the last lesson, we talked about the biology of mosquitoes and also talked about two species in particular. ***Aedes aegypti***, the yellow fever mosquito, and ***Aedes albopictus***, the Asian tiger mosquito, are container mosquitoes. • They get this name because they develop in both

LESSON 2: SOURCE REDUCTION

Teacher Directions / Methods	Content Outline / Key Points
	natural and artificial containers around our homes. • These containers can be anything as small as a bottle cap or larger like the base of a basketball hoop or a construction barricade. • The places these mosquitoes can develop is virtually endless. • Container mosquito larvae may develop in **any container** that has the potential to hold **water**.
Slide 7 **QAD** **Ask:**	***Container Mosquitoes*** The containers that container mosquitoes have adapted to utilize as larval habitats can be extremely numerous around a home. • This has to do with the fact that the containers that they can occupy are so diverse. • **Can we possibly get rid of everything around our home that holds water?** It's pretty hard, but it takes training your eyes to know what kinds of things to look for. But that's one of the purposes of this lesson. A lot of the containers may be hard to find or something you wouldn't usually think about holding water. • These types of containers are considered cryptic.
Slide 8 **VIDEO**	Youtube Link: https://www.youtube.com/watch?v=5AVJ-zcg_MQ&feature=youtu.be Can also be found at https://preventmosquitoes.org/mosquito-control-toolkit/videos/ (click video link called "Personal Responsibility")

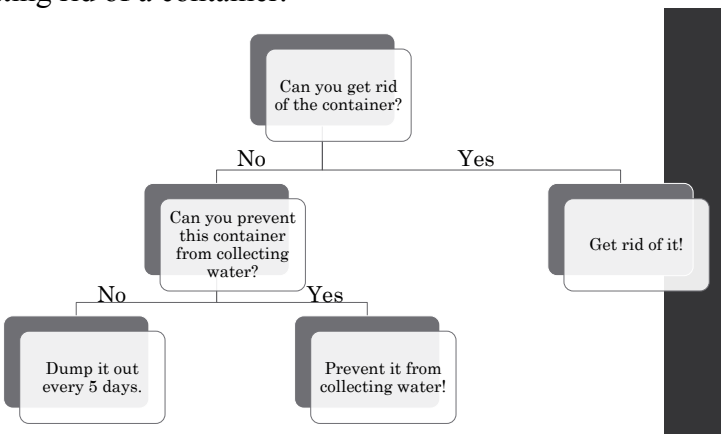
LESSON 2: SOURCE REDUCTION

Teacher Directions / Methods	Content Outline / Key Points
Slide 9	***Source Reduction Steps*** The steps of source reduction are to: 1. **Inspect** and identify containers that are holding water or could collect water in the future. 2. **Eliminate the containers or prevent them from holding water** in the future. a. This may also mean that the container should be treated. 3. If a container can't be eliminated or be manipulated so it can't hold water anymore, the containers should be **dumped** out. 4. **Identify water-holding plants** and develop an action plan for them. 5. Once you have done all of this, the next step is to **educate** the other people living in your home about how to prevent mosquito development around your home. a. You can even share this information with your neighbors, so they know how to prevent mosquitoes from developing around their homes as well.
Slide 10	***Step 1: Inspection*** The first step in the source reduction process is inspection of your property. • When inspecting the house, you need to make sure you inspect very closely for any container that is holding water or could potentially collect water. • Just because it doesn't have water in it now doesn't mean that it won't eventually have water in it.

LESSON 2: SOURCE REDUCTION

Teacher Directions / Methods	Content Outline / Key Points

	• You should also make sure that you look up when doing your inspection because rain gutters are located above you.
	  ○ While you might not be able to tell from the ground, you should make sure that rain gutters are not clogged and holding water because mosquitoes can develop there.
	  ○ Also, things like tarped carports may be above your head and could be holding water as well.
	When you find containers, ask yourself these questions. Can I get rid of this container? Can I prevent this container from collecting water? If not, we will need to dump the container every five days.

Slide 11 **QAD** **Practice going through the flow chart using the examples**	***Flowchart*** Use this flow chart to determine how you should handle getting rid of a container.  Use examples to practice with students: **Clogged rain gutter**: • Can you get rid of the container? No → Can you prevent this container from collecting water? Yes.

Teacher Directions / Methods	Content Outline / Key Points
provided.	→ How can this container be prevented from collecting water? The leaves can be removed so the water can drain off the roof properly. **Dog water bowl**: • Can you get rid of this container? No → Can you prevent this container from collecting water? No. We need to make sure the dog's water bowl is dumped out at least every five days. **Kids' outdoor toys**: • Can you get rid of the containers? Answers to this could vary. If they are old toys, they could be discarded or donated. If the toys are still in use, they could be moved to a covered area or dumped out every five days. **Wheelbarrow**: • Can you get rid of this container? No. Can you prevent this container from collecting water? Yes. Either move it to a covered area like a garage or shed or turn it upside down. If you turn it upside down, make sure the lip of the wheelbarrow is not collecting water.
Slide 12 **QAD** **Ask:**	***Step 2: Elimination*** First, can you get rid of the container completely? This would apply to things like garbage or something else that you are no longer using (maybe some old toys)? • If you can get rid of the container, great! Go ahead and throw it away. **What other containers can be discarded?**

LESSON 2: SOURCE REDUCTION

Teacher Directions / Methods	Content Outline / Key Points
Slide 13 **QAD** **Ask:**	***Step 2: Manipulation*** If it is something that you can't throw away, is there a way that you can modify it to prevent water from collecting and allowing mosquitoes to develop? • For example, if you have a tire swing, drilling a hole in the bottom will prevent the swing from collecting water. • If there is a bucket or recycling bin that is collecting water, turning them upside down will prevent water from collecting in them. Another option is to move containers to a location where they can't collect water. • If it is possible, buckets and recycling bins can be stored in a garage or under a car port where water can't collect in the container. • As long as there is no water in the container, mosquito larvae cannot develop there. **What other examples can you think of for containers that can be manipulated to prevent larval development?**
Slide 14	***Step 3: Dumping Out Containers*** If you can't change the container to prevent it from collecting water, you will have to add it to your list of items to dump out every five days. • Making sure to dump out the containers every five days will ensure that any larvae developing in the container do not have the time they need to make it to the adult stage. • Dumping the water in the container out into the grass or dirt will kill the larvae in the container. ○ This may include containers like an animal

Teacher Directions / Methods	Content Outline / Key Points
	water bowl. By providing the animal with fresh water at most every five days, you will prevent mosquito development. o If you have a bird bath, dumping it and filling it with fresh water every five days will also prevent mosquito development.
Slide 15	***Other Options*** Sometimes there will be containers that are too large to dump out and there is a solution for that as well! • For something like a pond, we can add mosquito fish to the water. o Mosquito fish eat mosquito larvae and can be effective in small bodies of water like ponds (including ornamental ponds). • For the large drums or buckets that are too big to dump out, mosquito bits or mosquito dunks can be used. o These have something called Bti in them which is a naturally occurring soil bacterium. o When the mosquito larvae consume the Bti, it causes their stomach to rupture, resulting in death. ▪ This is insect specific and will not affect you or your pets. • If you have a pool, keeping it chlorinated will ensure that larvae cannot develop in it. • Also, if your family collects rain for different purposes, simply fitting the openings to the rain barrel with mesh will prevent female mosquitoes

LESSON 2: SOURCE REDUCTION

Teacher Directions / Methods	Content Outline / Key Points
	from entering the container and laying their eggs. o When using this kind of strategy, make sure to keep an eye out for holes in the mesh.
Slide 16	***Step 4: Water-holding Plants*** You may also have bromeliads or tree holes somewhere on your property. • Both of these can develop mosquito larvae. • To prevent these places from being a larval habitat, you can either use a hose to flush out all the water in the plant every five days, OR you can treat these habitats with mosquito bits as well.
Slide 17 **QAD** **Ask:**	***Educate Others*** The last step of the source reduction plan is to educate others. **What are some ways you can educate friends and family members?** Many people do not know how many different places around our home mosquitoes can live and develop. • Once you find all the containers you can around your home, you can share the information with the rest of your family so they can help you in the effort to prevent mosquitoes from developing around the home. • Sharing the action plan that you have developed can be helpful, but it may also be helpful to go and show them all the places you detected that are developing mosquitoes outside. o This is also useful information to share with

LESSON 2: SOURCE REDUCTION

Teacher Directions / Methods	Content Outline / Key Points
	your neighbors. o Even if you get rid of every mosquito development site around your home, if your neighbors do not do the same, you may continue to experience a lot of biting from container mosquitoes.
Slide 18	***Importance of Source Reduction*** Controlling container mosquitoes can be extremely difficult because of the number of containers they will develop in and how hard those containers are to find. • Source reduction is the first step in reducing those mosquito populations. • Source reduction becomes very important if there are outbreaks of diseases like dengue, Zika, or chikungunya. o While this does not happen a lot in the U.S., it has happened in the past and could happen again. • By practicing source reduction, we are reducing the number of mosquitoes in an area. o This means that there is a smaller population of mosquitoes that could be flying around, biting infected people, and surviving to bite a healthy person.
Slide 19	***Source Reduction Steps*** Repeat source reduction steps. The steps of source reduction are to: 1. **Inspect** and identify containers that are holding water or could collect water in the future.

LESSON 2: SOURCE REDUCTION

Teacher Directions / Methods	Content Outline / Key Points
	2. **Eliminate the containers or prevent them from holding water** in the future. 3. **Dump** out containers that can't be eliminated. 4. **Identify water-holding plants** and develop an action plan for them. 5. **Educate** those around you on how to prevent mosquito development.
Slides 20-22 **Students will use the "Source Reduction Reference Sheet" to complete this activity.**	***Let's Practice*** On the next couple of slides, we are going to list some common containers that might be found around the home. To complete this, you may raise your hand to share your answer. You will also want to record the answers on the "Source Reduction Reference Sheet" that was passed out at the beginning of class. [Go through the eighteen potential mosquito habitats. Answers will be revealed on the slide with each mouse click, and they are included in the comments.]
Application: **Slide 23**	***Homework: Develop a Household Action Plan*** Now that we know how to identify containers around our home and how to eliminate them, we are going to develop an action plan for the mosquito habitats around our home. • This will be a homework assignment. • The Source Reduction Reference Sheet we just completed will help you as you develop a household action plan. You will notice it has two parts. • In the first part, you will draw a map of your house

LESSON 2: SOURCE REDUCTION

Teacher Directions / Methods	Content Outline / Key Points
	from an aerial view. ○ This map will include potential mosquito-producing containers like what we have been talking about during this lesson. ○ You will also include a legend for the map. ○ An example map and legend is provided. • The second part will ask you to identify 1. The type of container 2. If it can hold water 3. If it contains mosquito larvae 4. Your action to prevent the container from collecting water in the future Assign due date. [Depending on the amount of time left in class, students may be able to get started on their homework.] ***This may also be adapted to fit the school campus instead of students' houses.
Closure/Summary: **Class Discussion**	In today's lesson, we had three goals: 1. Identify containers that are developing mosquito larvae. 2. Describe the actions necessary to eliminate mosquito-producing containers. 3. Create a household action plan to reduce container mosquito populations. What do you have questions on so far in the unit, related to mosquito biology or source reduction?
Evaluation:	**Formative:** Q&A throughout lesson Source Reduction Guided Notes Question/Clarification Discussion **Summative**: Unit Test – later in unit

Source Reduction Guided Notes

Source Reduction:

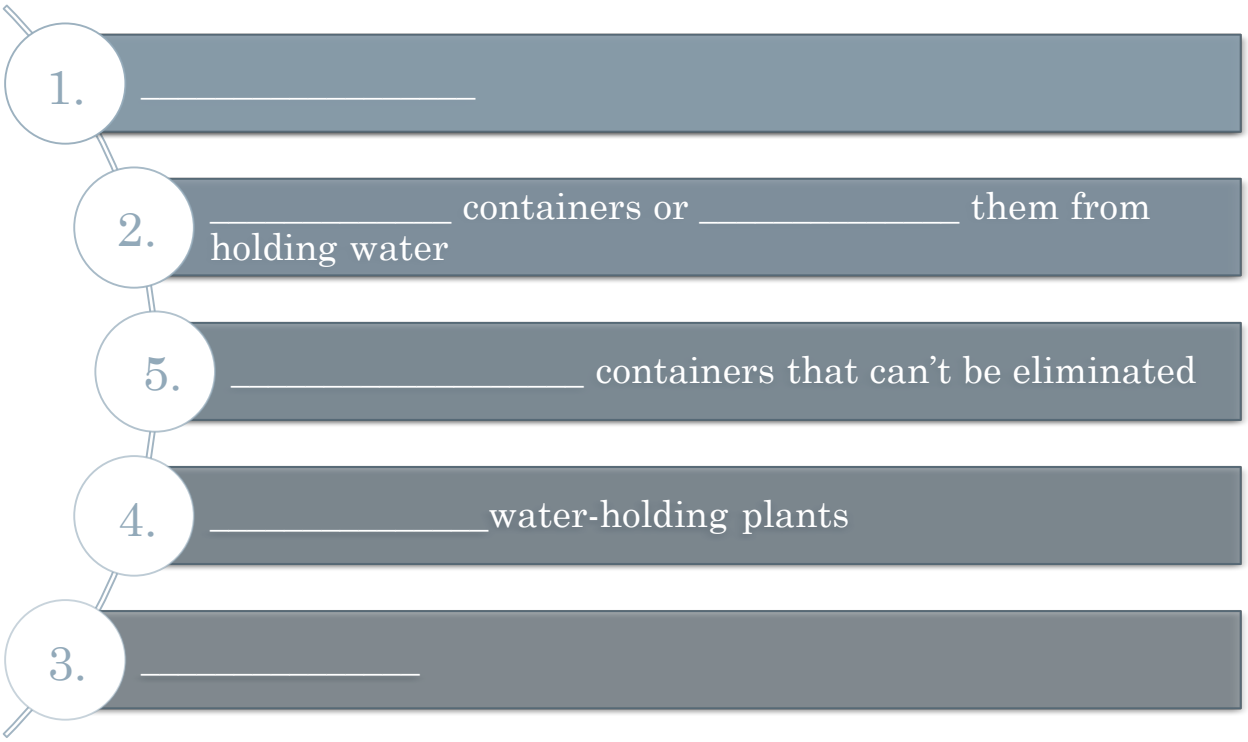
_____

Container Mosquitoes

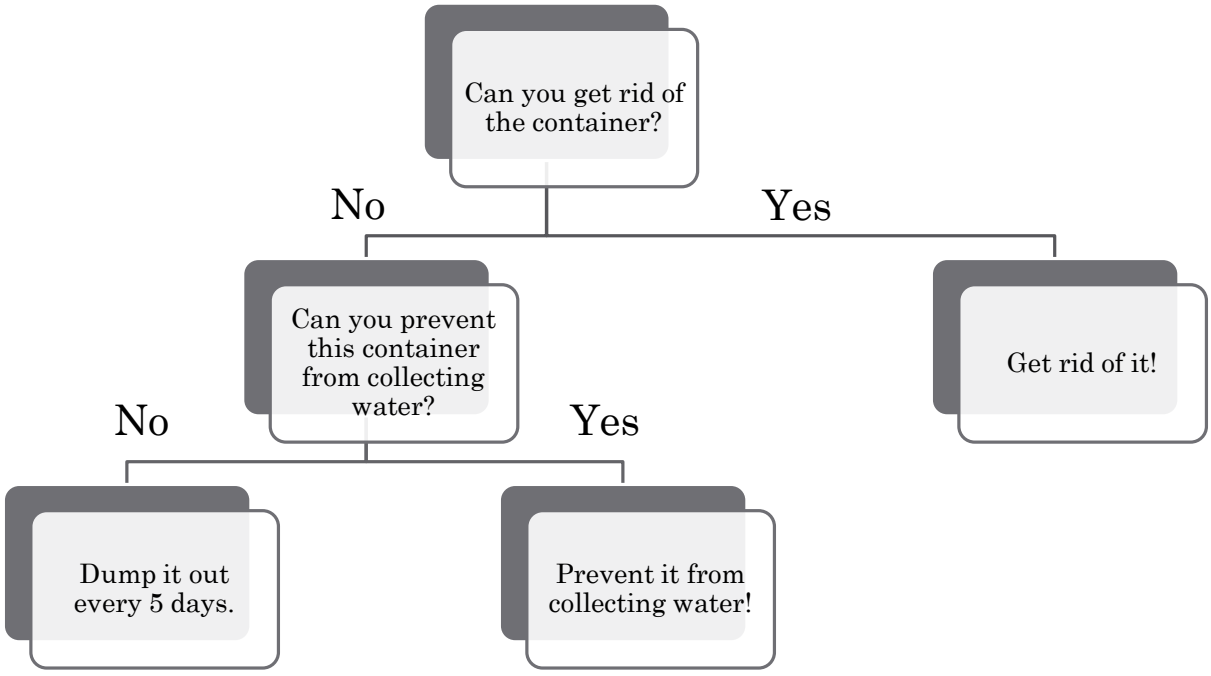
1. _____ - yellow fever mosquito
2. _____ - Asian tiger mosquito

Container mosquito larvae may develop in _____ that has the potential to hold _____.

Source Reduction Steps



Use this flow chart to determine how you should handle getting rid of a container



Source Reduction Reference Sheet

Mosquito Habitat	How to get rid of it
Clogged rain gutter	
Corrugated Pipes	
Buckets, watering cans, trash	
Old tires	
Bird baths	
Ponds	
Potted plants & bases	
Water-holding plants	
Leaking outdoor faucets	

Pools	
Children's toys/play equipment	
Tarps	
Wheelbarrows	
Portable basketball goals	
Pet dishes	
Garbage can/recycling bin	
Abandoned cars/boats	
Air conditioner drip	

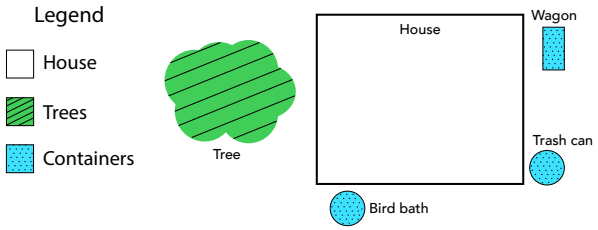
PREVENT & PROTECT HOMEWORK

NAME _____ DATE _____

DIRECTIONS

- Draw your house and yard in the box below as it would look from the sky.
- Add any containers* around your home that are holding water (ex. buckets, wagons). Color them blue.
- Label each container.
- Make a legend (key) for the map (see example).

EXAMPLE



MY HOUSE

***REMINDER:** Be careful when dumping out containers of water you find outside. You may startle a snake or harmful insect!

Directions: Fill out the following chart according to the type of containers you have outside your house.

Type of Container	**Could it hold water?**	**Are there larvae in the container?**	**How will you prevent this container from collecting water in the future?**
Ex. Bird bath	*Yes*	*Yes*	*Dump/flush out the bird bath every five days.*

Source Reduction Guided Notes Answer Key

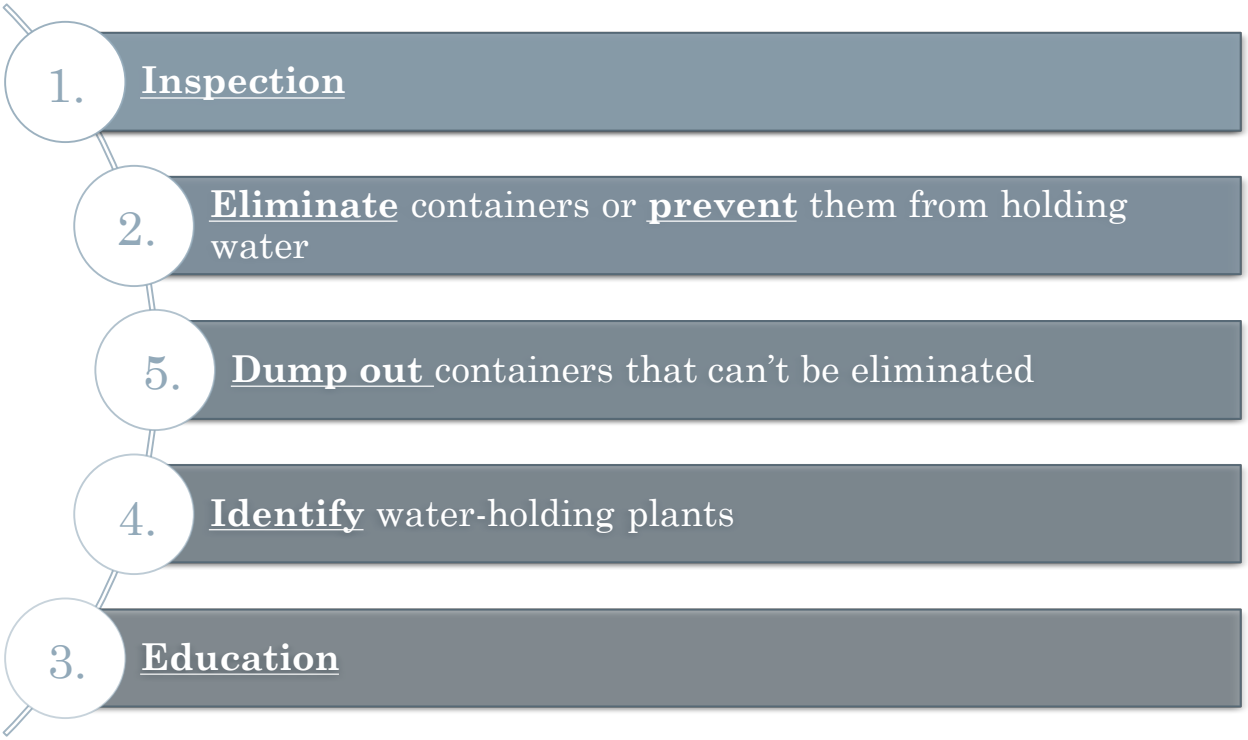
Source Reduction:
The removal or permanent destruction of mosquito development sites.

Container Mosquitoes

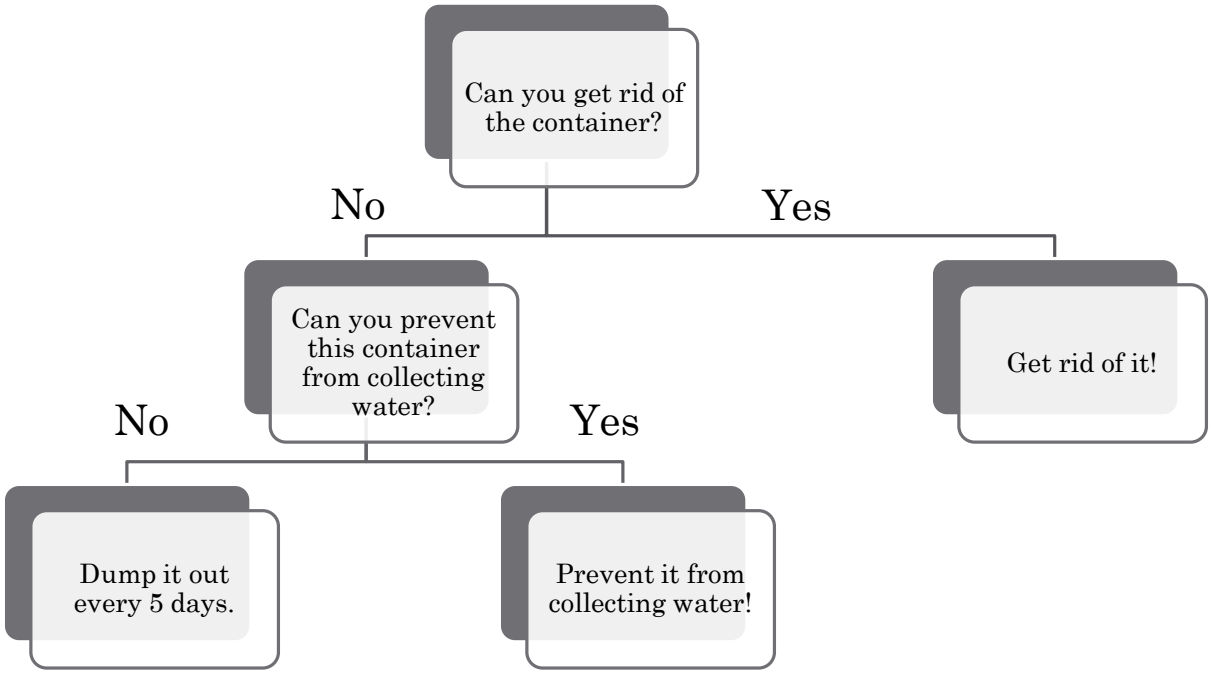
1. ***Aedes aegypti*** - yellow fever mosquito
2. ***Aedes albopictus*** - Asian tiger mosquito

Container mosquito larvae may develop in **any container** that has the potential to hold **water**.

Source Reduction Steps



Use this flow chart to determine how you should handle getting rid of a container



Source Reduction Reference Sheet

Mosquito Habitat	How to get rid of it
Clogged rain gutter	Clean out any debris frequently to ensure water is able to flow through the gutter.
Corrugated Pipes	The grooves can hold water and allow mosquitoes to develop. Treat with mosquito bits regularly.
Buckets, watering cans, trash	Turn over or empty water on a weekly basis. Dispose of all trash.
Old tires	Recycle, store where they will not collect water, or fill with sand. For tire swings, drill holes in the bottom of the tire so it won't hold water.
Bird baths	Change the water on a weekly basis.
Ponds	Stock with fish or aerate the pond with a recirculation pump.
Potted plants & bases	Empty water from saucers on a weekly basis.
Water-holding plants	Remove or treat with mosquito bits regularly.
Leaking outdoor faucets	Repair any faucets to prevent small pools of water from forming.

Pools	For wading pools, change the water weekly. For abandoned pools, treat with mosquito bits regularly.
Children's toys/play equipment	Store indoors or in a way that does not allow for water collection.
Tarps	Tighten or straighten the tarp so that it does not hold water.
Wheelbarrows	Turn over when not in use.
Portable basketball goals	Fill with sand instead of water or be sure that the plug is tightly secured.
Pet dishes	Give pets fresh water regularly and rinse bowls weekly.
Garbage can/recycling bin	Keep covered or drill drainage holes in the bottom.
Abandoned cars/boats	Cover with a tight-fitting tarp.
Air conditioner drip	Place rocks underneath so small puddles do not form.

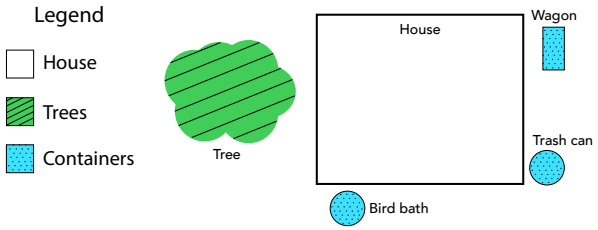
PREVENT & PROTECT HOMEWORK

NAME _____ DATE _____

DIRECTIONS

- Draw your house and yard in the box below as it would look from the sky.
- Add any containers* around your home that are holding water (ex. buckets, wagons). Color them blue.
- Label each container.
- Make a legend (key) for the map (see example).

EXAMPLE



MY HOUSE

***REMINDER:** Be careful when dumping out containers of water you find outside. You may startle a snake or harmful insect!

Directions: Fill out the following chart according to the type of containers you have outside your house.

Type of Container	**Could it hold water?**	**Are there larvae in the container?**	**How will you prevent this container from collecting water in the future?**
Ex. Bird bath	*Yes*	*Yes*	*Dump/flush out the bird bath every five days.*

LESSON 3: MOSQUITO-BORNE ILLNESS

INSTRUCTIONAL PLAN	
Lesson Title:	Mosquito-Borne Illness
Estimated Time:	100 Minutes

Objectives

At the end of this lesson, students will be able to:

1. List the major mosquito vectors in Florida.
2. List disease-causing pathogens mosquitoes transmit.
3. Match the mosquito-borne pathogens to their associated symptoms.
4. Describe health outcomes associated with mosquito-borne pathogens.
5. Evaluate the burden of mosquito-borne illness in Florida.

Equipment, Supplies, References, and Other Resources:

Documents

- Mosquito-Borne Illness PowerPoint presentation
- Mosquito-Borne Illness Guided Notes (1 copy per student)

Video

- https://www.youtube.com/watch?v=qW252a2a2k0&feature=youtu.be
- OR visit Prevent and Protect website: https://preventmosquitoes.org/mosquito-control-toolkit/videos/ (click video link called “Mosquito-Borne Illnesses”)

Student Preparation (including overview, link, and interest approach)

Link

Mosquitoes are vectors of dangerous pathogens that cause disease, threatening human and animal health. Florida has a hot and humid climate ideal for insects, like mosquitoes, to thrive. There is a need to understand mosquito-borne illnesses in order to mitigate these harmful diseases. This lesson is focused on the disease components, cycle, symptoms, and distribution for six mosquito-borne illnesses relevant in Florida.

- During the interest approach, students will unscramble the phrase “mosquito-borne illness,” which is the title of the lesson.
- Throughout the PowerPoint presentation, students will take notes and participate in class discussion.
- Following the presentation, students will diagnose three patients with the correct mosquito-borne illness according to their symptoms and patient history.

- At the end of class, students will submit their current mosquito control methods.

Interest Approach – Word Unscramble
The lesson will start with slide 1 of the PowerPoint presentation, which has the phrase "Mosquito-Borne Illness" scrambled.

"In a moment, a scrambled phrase will be projected on the screen, and you will decipher the phrase to discover the topic of today's lesson. Once you have deciphered the phrase, shout it out!" (or students may raise their hand).

Slide 1

The correct phrase: "Mosquito-Borne Illness"

Slide 2

(Optional prize for the student that deciphers the phrase first)

[Teacher passes out guided notes for each student to take notes on and use later for the application activity]

Overview
Slide 3
Today we will continue our Mosquito Control unit by discussing Mosquito-Borne Illnesses. We have five goals for today:

1. List the major mosquito vectors in Florida.
2. List disease-causing pathogens mosquitoes transmit.
3. Match the mosquito-borne pathogens to their associated symptoms.
4. Describe health outcomes associated with mosquito-borne pathogens.
5. Evaluate the burden of mosquito-borne illness in Florida.

As we talk about different diseases, you may take notes using the guided notes handout, and this will be helpful for you later in the lesson.

Teacher Directions / Methods	Content Outline / Key Points

LESSON 3: MOSQUITO-BORNE ILLNESS

Teacher Directions / Methods	Content Outline / Key Points
Slide 4 **Question-Answer-Discussion** **(QAD)**	**Ask the students *"What mosquito-borne illnesses have you heard of?"*** List for reference: (bolded are the diseases covered in this lesson) **West Nile Virus** **St. Louis Encephalitis** **Eastern Equine Encephalitis** **Dengue** **Chikungunya** **Zika** Dog heartworms Malaria Yellow Fever We will discuss many of these diseases throughout this lesson.

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Slide 5	***What is a mosquito-borne disease?*** It is a disease transmitted by a mosquito, which is the **vector**. When it comes to mosquito-borne disease transmission, three things are necessary in order for there to be disease manifestation. If any of these components are missing, there will be no transmission. These three components are 1. A **vector** that can transmit the pathogen from one host to another. This vector must be a competent vector, meaning the vector can successfully pick up the pathogen, maintain it, and eventually pass it to a susceptible host. a. The vector we will be talking about today is a mosquito. 2. The susceptible **host** is another part of the mosquito-borne disease triad. a. The hosts we will often refer to are humans or animals. 3. The third and final component is the **pathogen** that can cause disease in the susceptible host. a. The pathogen can be a virus, bacteria, parasite, etc. All three parts of the triad are necessary to cause disease manifestation. If you have a mosquito vector that is infected with a virus, but the mosquito never feeds on a susceptible host, there will be no disease. Not all hosts are susceptible to the pathogen, so even if an infected mosquito bites an animal that is not susceptible, that animal will not experience disease. We will use this triad throughout the lesson when talking about each disease.

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Slide 6 **VIDEO**	Youtube link: https://www.youtube.com/watch?v=qW252a2a2k0&feature=youtu.be OR visit Prevent and Protect website: https://preventmosquitoes.org/mosquito-control-toolkit/videos/ (click video link called "Mosquito-Borne Illnesses")
Slide 7	***Mosquito-borne Disease in Florida*** So now that we know what components are necessary for there to be disease, let's discuss what diseases Florida has dealt with. Historically, Florida has dealt with transmission of a variety of mosquito-borne diseases. • Going back to the 1800s, Florida had transmission of Dengue, Malaria, and Yellow Fever. • In the 1900s, we stopped seeing yellow fever and started seeing some new diseases such as dog heartworms, Eastern Equine Encephalitis, also known as triple E, and St. Louis Encephalitis, also known as SLE. • In recent decades, the 2000s, we also added Chikungunya, West Nile, and Zika to that list. We are going to talk about some of these diseases in more detail, but with increased travel and globalization came the introduction of new pathogens as well as new mosquito species. Florida is a very hospitable environment for different mosquito species and pathogens, so as time has progressed, we see the introduction of new mosquito-borne diseases.

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Slide 8	***Outline***
	For all of the diseases that we will cover today, we will talk about
	• the three components of the **mosquito-borne disease triad**:
	  ○ the vector
	  ○ the host
	  ○ the pathogen.
	• Then we will look at the **disease cycle** and how that contributes to the transmission of the pathogen.
	• We will also talk about the **symptoms** of the disease
	• And finally, the global **distribution** of the disease.

Slide 9	***Two Major Groups*** We will go through the major mosquito-borne diseases in two groups: encephalitic viruses and other viruses.

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Teacher Directions / Methods	Content Outline / Key Points
Slide 10	***West Nile Virus*** We will cover the encephalitic viruses first. • You will understand why they are considered encephalitic viruses when we get into the symptoms. The pathogen, West Nile virus, is transmitted by mosquitoes in the genus *Culex*. The mosquito is the vector. • There are multiple species that can transmit West Nile, including *Culex quinquefasciatus, Culex nigripalpus,* and *Culex tarsalis*. • You don't need to know those species, but you should know there are multiple species of *Culex* mosquitoes that can transmit West Nile virus to hosts. Susceptible hosts are primarily birds. *Introduce a new term here – dead end host.* Dead end hosts are hosts that can become infected with the virus, may show symptoms, but the virus can't replicate at high enough levels inside this host. This means it is unlikely for another mosquito to pick up the virus from this dead end host. • In this case, horses and humans are dead-end hosts.

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Teacher Directions / Methods	Content Outline / Key Points
Slide 11	***West Nile Disease Cycle*** The text below is from the graphic made by the CDC. "In nature, West Nile virus cycles between mosquitoes (especially *Culex* species) and birds. Some infected birds, can develop high levels of the virus in their bloodstream and mosquitoes can become infected by biting these infected birds. After about a week, infected mosquitoes can pass the virus to more birds when they bite. Mosquitoes with West Nile virus also bite and infect people, horses and other mammals. However, humans, horses and other mammals are 'dead end' hosts. This means that they do not develop high levels of virus in their bloodstream, and cannot pass the virus on to other biting mosquitoes."
Slide 12	***Symptoms – West Nile*** Of those that are infected, 80%, or four out of five people do not develop symptoms. For the one out of five people that do develop symptoms, they may experience fever, headache, body aches, joint pains, vomiting, diarrhea, and rash.

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Teacher Directions / Methods	Content Outline / Key Points
Slide 13	***Severe Symptoms – West Nile*** 1 out of 150 people, or less than 1%, develop severe symptoms from infection. This can affect the central nervous system by causing encephalitis or meningitis. • This is why we call West Nile along with some of the other diseases, encephalitic diseases. Other symptoms of severe illness include high fever, headache, neck stiffness, disorientation, coma, paralysis, and others. Of those that develop severe symptoms, 10% will die. This can be a very severe disease in a small percentage of cases. • Although certain populations are more susceptible – those that are immunocompromised or elderly.
Slide 14	***Distribution – West Nile*** West Nile has a scattered distribution but can be found in many regions of the world including North America, Europe, Africa, Asia, and Australia. • In the United States, you can see that a majority of the transmission occurs in the Eastern half of the country.
Slide 15	***St. Louis Encephalitis*** St. Louis Encephalitis is another encephalitic disease. It is also transmitted by a few species of mosquitoes in the genus *Culex*. The pathogen is St. Louis Encephalitis virus. Birds are the primary host for the mosquitoes, but humans and domestic animals can also be dead end hosts.

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Teacher Directions / Methods	Content Outline / Key Points
Slide 16	***St. Louis Encephalitis Disease Cycle*** Text below is from the Centers for Disease Control and Prevention. "St. Louis encephalitis virus (SLEV) also functions in a cycle between peridomestic birds (birds that live around human habitation) and Culex species mosquitoes. Wild birds are the primary vertebrate hosts. Birds sustain inapparent infections but develop the virus in their blood sufficient enough to infect the mosquito vectors. Humans and domestic mammals can acquire SLEV infection, but they are dead-end hosts, so they do not pass it on."
Slide 17	***Symptoms – St. Louis Encephalitis*** Less than 1% of people exhibit symptoms of infection when infected with St. Louis Encephalitis virus. • For those who do have symptoms, it may include fever, headache, dizziness, and nausea. Just as with West Nile, there can be severe symptoms associated with St. Louis Encephalitis infection. • As the name suggests, there can be swelling in the brain, or **encephalitis**, stiff neck, coma, or even death in some cases.
Slide 18	***St. Louis Encephalitis Distribution*** St. Louis Encephalitis is primarily found in the Americas with the greatest burden occurring in the United States. Historically, there have been substantial outbreaks of the disease in the United States, and it is still present in Florida today.

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Teacher Directions / Methods	Content Outline / Key Points
Slide 19	***Eastern Equine Encephalitis*** The final encephalitic virus we will discuss is Eastern Equine Encephalitis. We are going to introduce a new term here which is **bridge vector**. The primary mosquito vector of EEEV is *Culiseta melanura*. However, this mosquito primarily transmits this pathogen between birds. In order for the pathogen to make its way into humans or horses, there has to be a **bridge vector**. • Bridge vectors are feeding on the infected animals and then later transmitting the pathogen to a dead-end host. They are referred to as bridge vectors because they link the major transmission cycle (between birds and mosquitoes) to humans (dead-end host). • For EEEV, these bridge vectors include some mosquitoes in the genus *Aedes, Coquillettidia,* and *Culex*. The pathogen is Eastern Equine Encephalitis virus, and the primary host is birds. Humans and horses are dead end hosts.
Slide 20	***EEE Disease Cycle*** This graphic displays the role of bridge vectors a little more clearly. *Culiseta melanura* is maintaining transmission between mosquitoes and birds. However, an *Aedes, Culex,* or *Coquillettidia* mosquito can come in and feed on that infected bird, and later feed on a human or horse dead-end host.

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Teacher Directions / Methods	Content Outline / Key Points
Slide 21	***Symptoms – Eastern Equine Encephalitis*** Symptoms of infection with Eastern Equine Encephalitis include chills, fever, joint pain, muscle pain. For those who develop encephalitic symptoms, they may experience fever, headache, vomiting, diarrhea, and coma. Of all individuals infected with EEEV, approximately 1/3 of those cases result in death. • This is the highest mortality of the mosquito-borne encephalitic diseases in humans.
Slide 22 **QAD** **Ask question:**	***Distribution – Eastern Equine Encephalitis*** In the United States, most of the cases of Eastern Equine Encephalitis occur in Florida, but other areas, primarily in the Eastern half of the country, have cases as well. "**Why might Florida have a higher number of cases compared to the rest of the country?"** Florida is home to over 380,000 horses, ranking third nationally in the number of horses (Texas is first and California is second). In addition, Ocala, Florida is the Horse Capital of the world.
Slide 23	***Distribution – Eastern Equine Encephalitis*** The global distribution of EEEV is confined primarily to the Americas. Note with this map that it is on the country level. So, if there is any case in the entire country, the whole country is highlighted.
Slide 24	Other Mosquito-Borne Diseases

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Teacher Directions / Methods	Content Outline / Key Points
Slide 25	***Dengue, Chikungunya, & Zika*** Dengue, Chikungunya, and Zika are three different diseases that have similarities so we are going to cover them together. • There are some characteristics that make them different from each other, but for the mosquito-borne disease triad, we will talk about them in the same way. The vectors of dengue, chikungunya, and Zika are *Aedes aegypti* and *Aedes albopictus*. The pathogen is Dengue virus, Chikungunya virus, or Zika virus and these viruses are transmitted to humans.
Slide 26	***Dengue, Chikungunya, & Zika Disease Cycle*** Dengue, Chikungunya, and Zika are maintained in a cycle between humans and the *Aedes aegypti* and *Aedes albopictus* mosquitoes. These two mosquito species are invasive in North America. • Unlike the other diseases that we have covered up to this point, humans are NOT the dead-end host. • The virus is able to replicate inside the human and reach a concentration high enough to transmit back to another mosquito that feeds on that person.

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Teacher Directions / Methods	Content Outline / Key Points
Slide 27	***Symptoms - Dengue*** The symptoms for these diseases are similar, but can manifest in slightly different ways. For Dengue, symptoms usually include a high fever, headache, eye pain, rash, flu-like symptoms, nausea and vomiting and severe joint or muscle pain. • Dengue is sometimes referred to as break bone fever. • This is because the joint and muscle pain that is experienced can be very severe, hence the name break bone fever. Some individuals can develop dengue hemorrhagic fever, but this usually occurs in people that have been infected with dengue multiple times. In these severe cases, internal bleeding occurs and this can be fatal.
Slide 28	***Symptoms - Chikungunya*** Symptoms of Chikungunya infection include headache, fever, rash, muscle pain as well as significant swelling in the joints and severe joint pain.
Slide 29	***Symptoms - Zika*** Symptoms of Zika infection include fever, headache, rash, red eyes, and joint and muscle pain. While the symptoms are generally mild, more severe outcomes, such as microcephaly, are possible. • Women infected with Zika while pregnant have an increased likelihood of giving birth to children with microcephaly. • Babies with microcephaly are born with abnormally small heads.

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Teacher Directions / Methods	Content Outline / Key Points
Slide 30	***Distribution*** The map pictured here shows the global distribution of Dengue, but it highlights an important point. Dengue, Chikungunya, and Zika, can occur in a variety of tropical and subtropical areas. • If the mosquitoes are present, the pathogen is present, and there are susceptible hosts, then transmission of these pathogens can occur in many tropical and subtropical areas. While there isn't any local transmission of these pathogens in Florida right now, all three diseases have been locally transmitted in Florida previously!
Application: **Slide 31**	***Mosquito-borne illness case diagnosis*** It is now your turn to play the doctor! Using the information discussed in this lesson and your Mosquito Identification Key, you will read through three scenarios to properly diagnose the patients with the most likely mosquito-borne illness. Students will fill out the patient records according to the scenario explanation, supporting their diagnosis.

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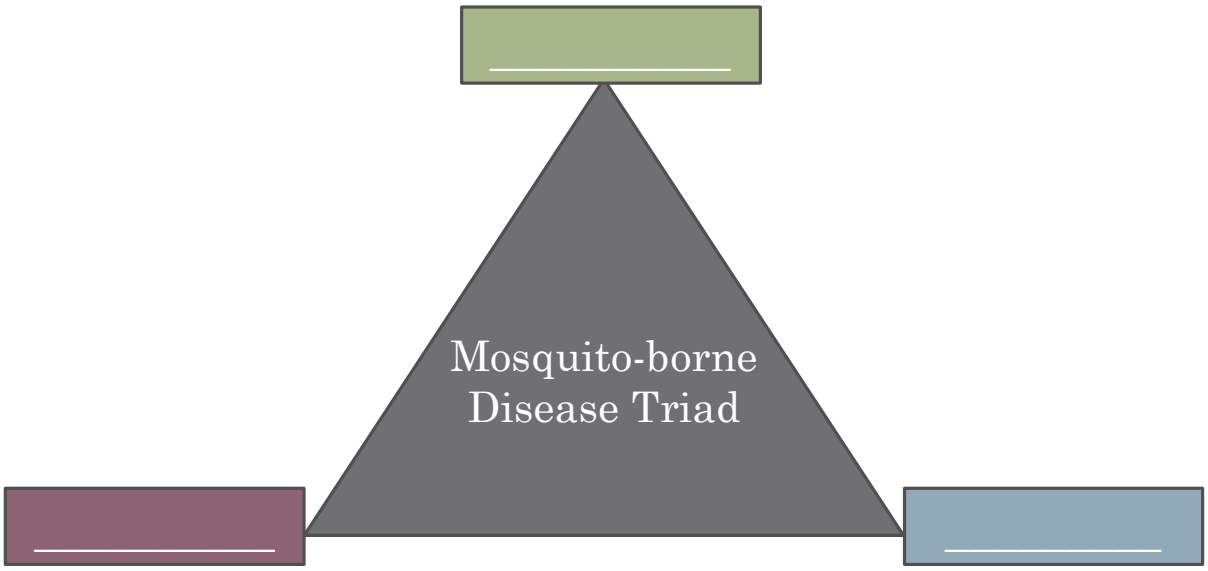
Teacher Directions / Methods	Content Outline / Key Points
Closure/Summary: **Exit Slip:** **Students' preferred mosquito control methods**	In this lesson, we have met five goals relating to mosquito-borne illnesses: 1. List the major mosquito vectors in Florida. 2. List disease-causing pathogens mosquitoes transmit. 3. Match the mosquito-borne pathogens to their associated symptoms. 4. Describe health outcomes associated with mosquito-borne pathogens. 5. Evaluate the burden of mosquito-borne illness in Florida. In preparation for the next lesson, we will survey our class right now to determine mosquito control methods common to this group. On a scratch piece of paper, please list your top two mosquito prevention methods. (e.g. bug spray, long sleeves, citronella candles, nothing…) We will talk about these again during the first part of the next lesson. [Teacher collects pieces of paper, divides them up into their respective methods/categories, and determines percentages of the class that prefer certain control methods over others.]
Evaluation:	**Formative:** Q&A throughout lesson Mosquito-borne Illness Guided Notes **Summative**: Unit Test – later in unit

Mosquito-borne Illness Guided Notes

What is a mosquito-borne illness?

_____



Two Major Groups of Viruses:

Encephalitic

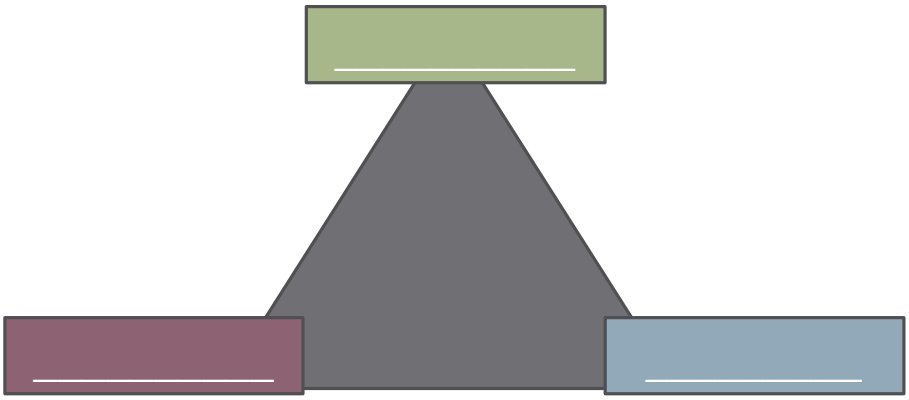
1. _____
2. _____
3. _____

Other

4. _____
5. _____
6. _____

West Nile

Symptoms:

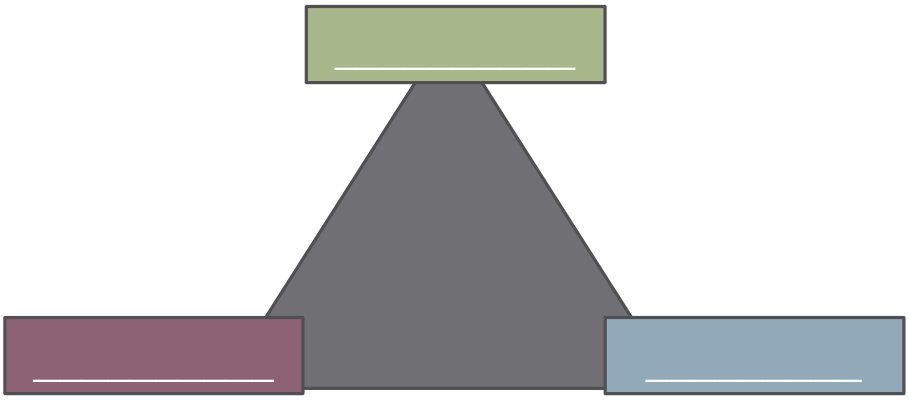


Severe Symptoms:

Global Distribution:

St. Louis Encephalitis

Symptoms:

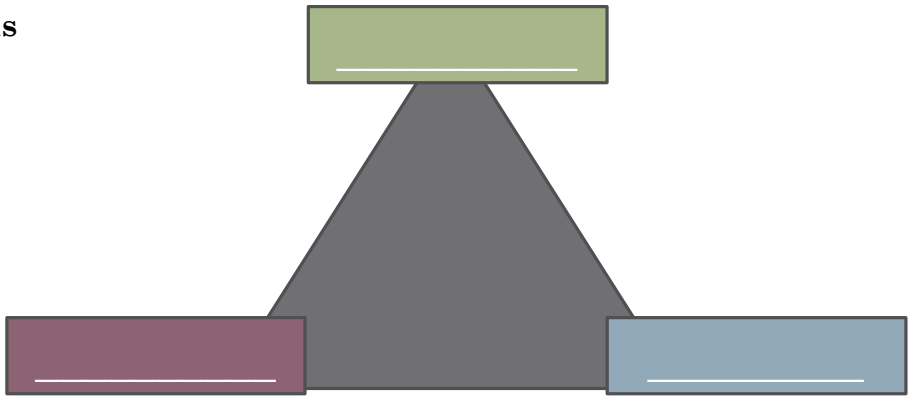


Severe Symptoms:

Global Distribution:

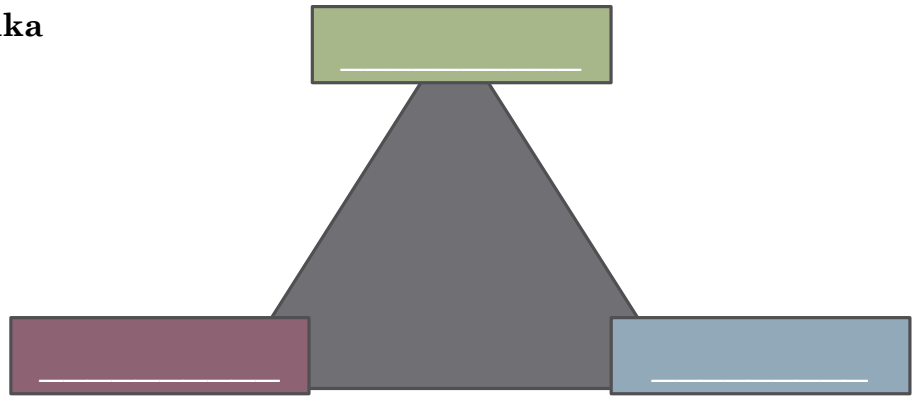
Eastern Equine Encephalitis

Symptoms:



Global Distribution:

Dengue, Chikungunya, & Zika



Dengue Symptoms:

Chikungunya Symptoms:

Zika Symptoms:

Global Distribution:

Mosquito-Borne Illness Case Diagnosis

Directions: It is now your turn to play the doctor! Read the following three scenarios to make the best diagnosis from the mosquito-borne illnesses we discussed in the lesson. **You must fill out the patient charts to support your diagnosis according to their explanation.**

Patient 1: You are a doctor in Virginia. Courtney Baker, a 21-year-old female college student comes in to your office complaining of severe pain throughout her entire body. She has a 102F fever, a rash on her abdomen and appears fatigued. She has not traveled outside of the United States, but was recently in Florida (within the last couple of weeks) for a summer vacation. She says that the symptoms began a couple of days ago and have progressively gotten worse. While in Florida, she says she did not wear insect repellant and recalls being bitten by mosquitoes, although she can't recall what they looked like. She is fairly certain the mosquitoes had stripes on their legs. When you ask her to describe the pains throughout her body, she says it feels like all the bones in her body have broken and that even the feeling of clothes on her skin is uncomfortable. Based on the information provided, what mosquito-borne illness do you believe this individual has been infected with?

Patient 2: You are a doctor in an emergency hospital in Florida. Robert Taylor, a 65-year-old man comes in with severe pain. He has a headache, 101F fever, and is extremely disoriented. Luckily, his partner is there to provide information the onset and progression of illness. They inform you that about a week ago, they were doing yard work until shortly after dusk. They remember being bitten by a lot of "normal" looking mosquitoes. When you ask what they mean by this, they say that they were just plain brown mosquitoes. You consult with an entomologist friend who says based on the time the mosquitoes were feeding and the general description of the mosquito, it was probably a *Culex* species. After doing a CT scan on the infected patient, you discover that the individual has inflammation of the brain and in the tissues surrounding the brain and spinal cord (encephalitis and meningitis). The partner points out that even though they were out at the same time and both were fed on by mosquitoes, the partner appears to be perfectly healthy. Based on the information provided, what mosquito-borne illness do you believe this individual has been infected with?

Patient 3: Sarah Price, a 35-year-old woman, has just returned home to Florida five days ago from a vacation in Brazil. While in Brazil, she visited and stayed with family. Shortly after returning home, she started to feel ill and thought she had the flu. She thought this was unlikely because she had the flu shot earlier that year, so she decided to go see you, her primary care physician. She says that she has muscle and joint pain, a low fever, and her eyes are really red. She has been pretty tired

and sleeping a lot since she started to feel ill. When you ask her about her trip to Brazil, she informs you that her family does not have screens on the windows, which were frequently left open so there would be a breeze in the house. She remembers having coffee in the morning with her family after the sun had risen and swatting mosquitoes away while drinking her coffee. When you ask if she was bitten by any mosquitoes while she was there, she says she doesn't remember, but it was certainly possible. She didn't wear insect repellant or long sleeves nearly as much as she should have. Based on this information, you decide you need to utilize further diagnostic tests to narrow down what virus this individual is infected with. Based on the information presented (without the diagnostic test), which mosquito-borne illness(es) could this woman be infected with?

Patient Record #1

Patient Name:					
Age:	**Sex: M / F**	**Home Address:**			
Temperature:		**When did the symptoms start?**			
Symptoms:					
Fever		Joint pain		Fatigue	
Sneezing		Back pain		Headache	
Coughing		Stomach pain		Other:	
Sore throat		Chest pain			
Nausea		Muscle pain			
Vomiting		Fainting			
Rash		Dizziness			
Red eyes		Mental confusion			
Recent Travel:					
Was the patient exposed to mosquitoes? Y / N		**Did the patient use any mosquito control practices? Y / N**			
If yes, what did the mosquitoes look like?		**If yes, what practices?**			
Probable mosquito genera:					
Further testing needed? Y / N					
Diagnosis:					
Doctor Name:			Signature:		

Patient Record #2

Patient Name:					
Age:	**Sex: M / F**	**Home Address:**			
Temperature:		**When did the symptoms start?**			
Symptoms:					
Fever		Joint pain		Fatigue	
Sneezing		Back pain		Headache	
Coughing		Stomach pain		Other:	
Sore throat		Chest pain			
Nausea		Muscle pain			
Vomiting		Fainting			
Rash		Dizziness			
Red eyes		Mental confusion			
Recent Travel:					
Was the patient exposed to mosquitoes? Y / N		**Did the patient use any mosquito control practices? Y / N**			
If yes, what did the mosquitoes look like?		**If yes, what practices?**			
Probable mosquito genera:					
Further testing needed? Y / N					
Diagnosis:					
Doctor Name:			Signature:		

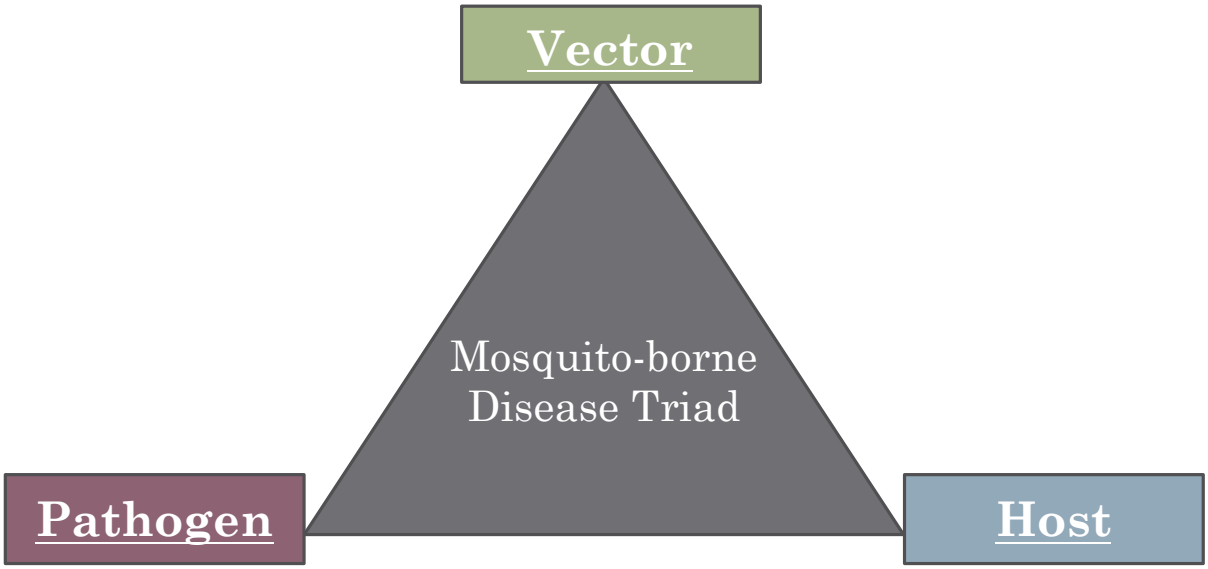
Patient Record #3

Patient Name:					
Age:	**Sex: M / F**	**Home Address:**			
Temperature:		**When did the symptoms start?**			
Symptoms:					
Fever		Joint pain		Fatigue	
Sneezing		Back pain		Headache	
Coughing		Stomach pain		Other:	
Sore throat		Chest pain			
Nausea		Muscle pain			
Vomiting		Fainting			
Rash		Dizziness			
Red eyes		Mental confusion			
Recent Travel:					
Was the patient exposed to mosquitoes? Y / N		**Did the patient use any mosquito control practices? Y / N**			
If yes, what did the mosquitoes look like?		**If yes, what practices?**			
Probable mosquito genera:					
Further testing needed? Y / N					
Diagnosis:					
Doctor Name:			Signature:		

Mosquito-borne Illness Guided Notes

What is a mosquito-borne illness?

It is a disease transmitted by a mosquito, which is the vector.



Two Major Groups of Viruses:

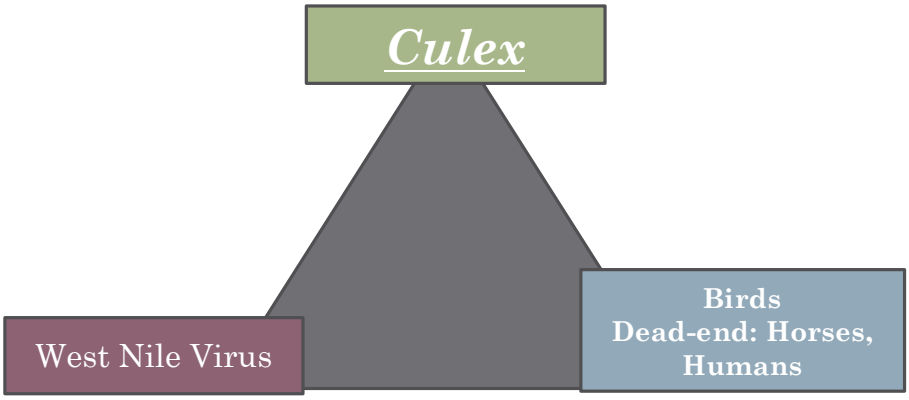
Encephalitic

1. **West Nile**
2. **St. Louis Encephalitis**
3. **Eastern Equine Encephalitis**

Other

4. **Dengue**
5. **Chikungunya**
6. **Zika**

West Nile



Symptoms:

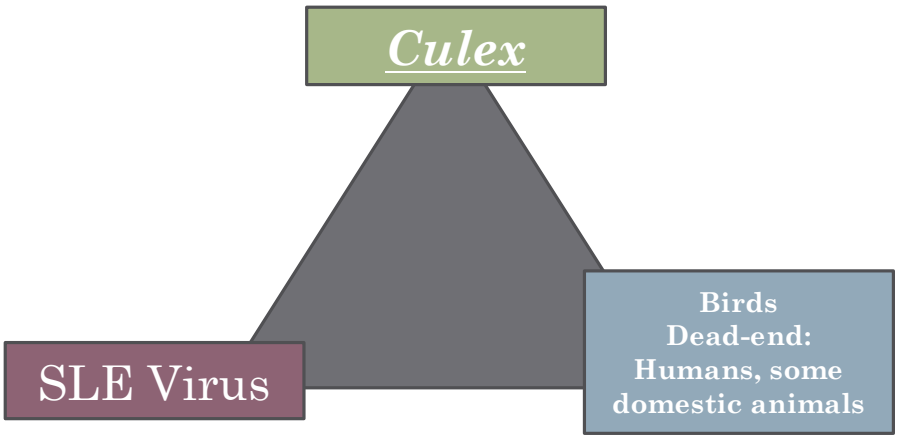
- Fever
- Headache
- Body aches
- Joint pains
- Vomiting
- Diarrhea
- Rash

Severe Symptoms

- Inflammation of the brain
- Inflammation of the spinal cord
- High fever
- Headache
- Neck stiffness
- Disorientation
- Coma
- Paralysis
- Death in 10% of people with severe illness

Global Distribution:
North America, Europe, Africa, Asia, and Australia. In the U.S. the majority of the transmission occurs in the eastern half of the country.

St. Louis Encephalitis



Symptoms:

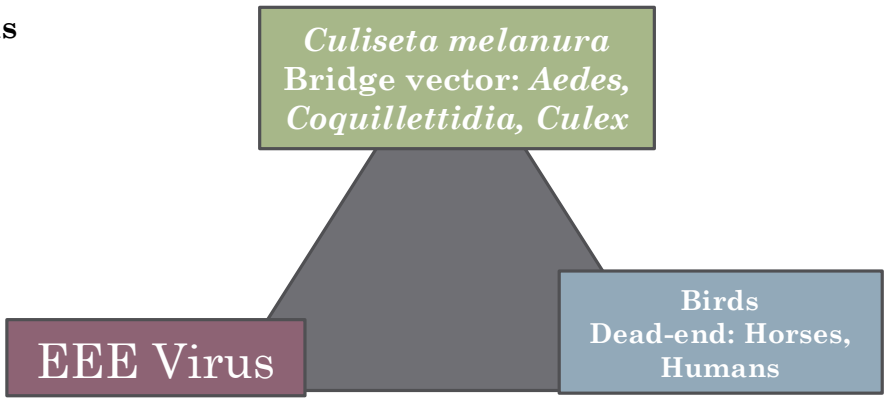
- Fever
- Headache
- Dizziness
- Nausea

Severe symptoms:

- Encephalitis
- Stiff neck
- Coma
- Death

Global Distribution: The Americas with the greatest burden in the U.S.

Eastern Equine Encephalitis



Symptoms:

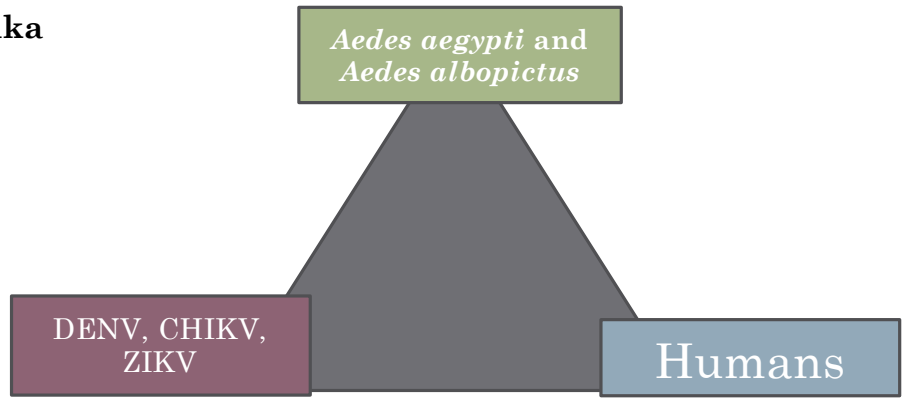
- Chills
- Fever
- Joint pain
- Muscle pain

Severe symptoms:

- Fever
- Headache
- Vomiting
- Diarrhea
- Coma

Global Distribution: Within the U.S., Florida has experienced most of the cases. But EEE also occurs in other countries in the Americas.

Dengue, Chikungunya, & Zika



Symptoms:

Dengue	Chikungunya	Zika
High fever	Fever	Fever
Headache	Headache	Headache
Eye pain	Rash	Rash
Rash	Severe joint pain	Joint and muscle pain
Flu-like symptoms	Swelling in joints	
Nausea		Pregnant woman could give birth to a child with microcephaly
Vomiting		
Joint and muscle pain		
Hemorrhagic fever (severe cases)		

Global Distribution: tropical and subtropical areas across the world

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Mosquito-Borne Illness Case Diagnosis KEY

Directions: It is now your turn to play the doctor! Read the following three scenarios to make the best diagnosis from the mosquito-borne illnesses we discussed in the lesson. **You must fill out the patient charts to support your diagnosis according to their explanation.**

Patient 1: You are a doctor in Virginia. A 21-year-old female college student comes in to your office complaining of severe pain throughout her entire body. She has a 102F fever, a rash on her abdomen and appears fatigued. She has not traveled outside of the United States, but was recently in Florida (within the last couple of weeks) for a summer vacation. She says that the symptoms began a couple of days ago and have progressively gotten worse. While in Florida, she says she did not wear insect repellant and recalls being bitten by mosquitoes, although she can't recall what they looked like. She is fairly certain the mosquitoes had stripes on their legs. When you ask her to describe the pains throughout her body, she says it feels like all the bones in her body have broken and that even the feeling of clothes on her skin is uncomfortable. Based on the information provided, what mosquito-borne illness do you believe this individual has been infected with?

Answer: Dengue

Patient 2: You are a doctor in an emergency hospital in Florida. A 65-year-old man comes in with severe pain. He has a headache, 101F fever, and is extremely disoriented. Luckily, his partner is there to provide information about the onset and progression of the illness. They inform you that about a week ago, they were doing yard work until shortly after dusk. They remember being bitten by a lot of "normal" looking mosquitoes. When you ask what they mean by this, they say that they were just plain brown mosquitoes. You consult with an entomologist friend who says based on the time the mosquitoes were feeding and the general description of the mosquito, it was probably a *Culex* species. After doing a CT scan on the infected patient, you discover that the individual has inflammation of the brain and in the tissues surrounding the brain and spinal cord (encephalitis and meningitis). The partner points out that even though they were out at the same time and both were fed on by mosquitoes, the partner appears to be perfectly healthy. Based on the information provided, what mosquito-borne illness do you believe this individual has been infected with?

Answer: West Nile virus – severe symptoms

Patient 3: A 35-year-old woman has just returned home to Florida from a vacation in Brazil. While in Brazil, she visited and stayed with family. Shortly after

returning home, she started to feel ill and thought she had the flu. She thought this was unlikely because she had the flu shot earlier that year, so she decided to go see you, her primary care physician. She says that she has muscle and joint pain, a low fever, and her eyes are really red. She has been pretty tired and sleeping a lot since she started to feel ill. When you ask her about her trip to Brazil, she informs you that her family does not have screens on the windows, which were frequently left open so there would be a breeze in the house. She remembers having coffee in the morning with her family after the sun had risen and swatting mosquitoes away while drinking her coffee. When you ask if she was bitten by any mosquitoes while she was there, she says she doesn't remember, but it was certainly possible. She didn't wear insect repellant or long sleeves nearly as much as she should have. Based on this information, you decide you need to utilize further diagnostic tests to narrow down what virus this individual is infected with. Based on the information presented (without the diagnostic test), which mosquito-borne illness(es) could this woman be infected with?

Answers: Zika, dengue, or chikungunya

(For this one, the student will only be able to narrow it down to Zika, dengue, or chikungunya because the symptoms for these 3 are so similar. Diagnostic testing done at the end will confirm Zika virus infection.)

Patient Record # 1 KEY

Patient Name: Courtney Baker					
Age: 21	**Sex: M / <u>F</u>**	**Home Address:** Virginia			
Temperature: 102F		**When did the symptoms start? A few days ago**			
Symptoms:					
Fever	x	Joint pain	x	Fatigue	x
Sneezing		Back pain	x	Headache	
Coughing		Stomach pain	x	Other:	
Sore throat		Chest pain	x		
Nausea		Muscle pain	x		
Vomiting		Fainting			
Rash	x	Dizziness			
Red eyes		Mental confusion			
Recent Travel: Florida					
Was the patient exposed to mosquitoes? <u>Yes</u>		**Did the patient use any mosquito control practices? No**			
If yes, what did the mosquitoes look like? Stripes on legs		**If yes, what practices?**			
Probable mosquito genera: *Aedes*					
Further testing needed? No					
Diagnosis: Dengue					
Doctor Name:			Signature:		

Patient Record #2 Key

Patient Name: Robert Taylor					
Age: 65	**Sex: M / F**	**Home Address: Florida**			
Temperature: 101F		**When did the symptoms start? About a week ago**			
Symptoms:					
Fever	x	Joint pain	x	Fatigue	
Sneezing		Back pain	x	Headache	x
Coughing		Stomach pain	x	Other: CT scan revealed inflammation of brain and spinal cord	
Sore throat		Chest pain	x		
Nausea		Muscle pain	x		
Vomiting		Fainting			
Rash		Dizziness	x		
Red eyes		Mental confusion	x		
Recent Travel: none, the patient was working outside in his yard.					
Was the patient exposed to mosquitoes? Y / N		**Did the patient use any mosquito control practices? Left unsaid**			
If yes, what did the mosquitoes look like? Plain and brown		**If yes, what practices?**			
Probable mosquito genera: *Culex*					
Further testing needed? No					
Diagnosis: West Nile – severe symptoms					
Doctor Name:		Signature:			

Patient Record #3 Key

Patient Name: Sarah Price					
Age: 35	**Sex: M / <u>F</u>**	**Home Address: Florida**			
Temperature: low fever		**When did the symptoms start? In the last 5 days**			
Symptoms:					
Fever	x	Joint pain	x	Fatigue	x
Sneezing		Back pain		Headache	
Coughing		Stomach pain		Other:	
Sore throat		Chest pain		Flu-like	
Nausea		Muscle pain	x		
Vomiting		Fainting			
Rash		Dizziness			
Red eyes	x	Mental confusion			
Recent Travel: Brazil					
Was the patient exposed to mosquitoes? Yes		**Did the patient use any mosquito control practices? No**			
If yes, what did the mosquitoes look like? Not enough information		**If yes, what practices?**			
Probable mosquito genera: *Aedes*, but not enough information					
Further testing needed? Yes					
Diagnosis: Dengue, Chikungunya, or Zika					
Doctor Name:			Signature:		

(For this one, the student will only be able to narrow it down to Zika, dengue, or chikungunya because the symptoms for these 3 are so similar. Hypothetical diagnostic testing done at the end will confirm Zika virus infection.)

LESSON 4: MOSQUITO CONTROL PRACTICES

INSTRUCTIONAL PLAN	
Lesson Title:	Mosquito Control Practices
Estimated Time:	100 Minutes

Objectives

At the end of this lesson, students will be able to:

1. Describe the categories of an integrated pest management plan.
2. List the mosquito control practices currently used in Florida.
3. Describe the mosquito control practices currently used in Florida.
4. Discuss the advantages of mosquito control measures.
5. Discuss the disadvantages of mosquito control measures.
6. Create a solution to a mosquito control problem.

Equipment, Supplies, References, and Other Resources:

Documents

- Mosquito Control Practices PowerPoint presentation
- Previous lesson's exit ticket – students' top mosquito control methods
- Mosquito Control Practices Guided Notes (1 copy per student)
- Remaining Mosquito Control Unit Manual pages (1 copy per student)
    - Cover Page
    - Pronunciations

Video

- https://www.youtube.com/watch?v=5QH2d0ZDLI0&feature=youtu.be
- OR visit Prevent and Protect website: https://preventmosquitoes.org/mosquito-control-toolkit/videos/ (click video link called "Application Methods")

Supplies

- Stapler

Situation:

25 middle school or high school students

LESSON 4: MOSQUITO CONTROL PRACTICES

Student Preparation (including overview, link, and interest approach)
Link The Mosquito Control Practices lesson is the culmination of the unit, and it will allow students to apply what they have learned so far, preparing them to play an active role in mosquito control practices. **Interest Approach** Review previous lesson's exit tickets of current mosquito control methods. It would be helpful to have already put together a summary of the responses prior to class starting (e.g. In this class, 40% preferred bug spray, 30% preferred nothing, and 30% preferred mosquito nets). The results may even be posted on the board as students walk in. **Overview** **Slide 1** Today, we are finishing up the Mosquito Control unit by discussing mosquito control methods. **Slide 2** We have six goals for today. 1. Describe the categories of an integrated pest management plan. 2. List the mosquito control practices currently used in Florida. 3. Describe the mosquito control practices currently used in Florida. 4. Discuss the advantages of mosquito control measures. 5. Discuss the disadvantages of mosquito control measures. 6. Create a solution to a mosquito control problem. As we go through the lesson, I expect you to take notes and ask questions that will help your understanding of the topics.

LESSON 4: MOSQUITO CONTROL PRACTICES

Teacher Directions / Methods	Content Outline / Key Points

Slide 3	***Integrated Pest Management (IPM)***
	IPM based on CDC document found here https://www.cdc.gov/nceh/ehs/docs/factsheets/what_is_integrated_pest_management.pdf
	For our purposes, we will define **integrated pest management**, or IPM, as a science-based, common-sense approach for reducing populations of disease vectors and public health pests.
	• IPM uses a **variety of management techniques** and this is where the "integrated" part comes from.
	  ○ Controlling pests is not just chemical spraying.
	  ○ On the contrary, IPM aims to reduce the amount of chemicals that are used to control an insect pest.
	• By **focusing on preventative** strategies, we can reduce the amount of chemical control that is needed to adequately control mosquito populations.
	  ○ This also involves denying access to the things they need to survive including **food, water, and harborage**.
	  ○ Harborage is places where the mosquitoes can rest or hid when they are not seeking a bloodmeal, looking for a place to lay eggs, or mating.
	About the picture:
	Roxanne Rutledge, extension medical entomologist with the University of Florida's Institute of Food and Agricultural Sciences, installs a mosquito trap in a wooded area near Monticello in Jefferson County, Thursday 8/9. The device, known as the Roske-2 modified Trinidad trap, collects mosquitoes that will be tested for West Nile virus at UF's Florida Medical Entomology Laboratory in Vero Beach. Rutledge said, that by baitin with dry ice, the trap emits carbon dioxide to attract mosquitoes. West Nile virus is transmitted by mosquitoes to humans and animals, and it can be life-threatening, particularly for elderly.

LESSON 4: MOSQUITO CONTROL PRACTICES

Teacher Directions / Methods	Content Outline / Key Points
Slide 4	***Integrated Pest Management Steps*** There are five major steps to an IPM program. 1. It starts with **inspection and monitoring**. a. At this stage, we can use different kinds of traps to collect adult mosquitoes. b. We can also actively go out and look for places in the environment where mosquitoes may be laying their eggs and the larvae are developing. 2. Next, we must **identify** the mosquito species. a. Knowing the species is useful in determining their impact and where they are developing and living. This information will help us later. 3. At this point, it's also good to **establish threshold levels**. a. We are not going to be able to get rid of all the mosquitoes on the planet. b. When we do our inspection and monitoring, we will probably find some mosquitoes, but are they at a tolerable level? c. In other words, <u>is the population at a low enough level that it will not cause a major concern from a nuisance standpoint or a public health standpoint</u>? 4. The next step is developing and **implementing a control strategy** to reduce the mosquito populations. a. This will be tailored to the biology and behavior of the mosquito species that you are dealing with and that's why step 2, identifying the mosquito, is so important. 5. And finally, we want to know if the control measures we implemented actually worked. a. To do this, we can use different measurement and

Teacher Directions / Methods	Content Outline / Key Points
	evaluation tools. b. One way of monitoring success of control is through continuing surveillance using things like traps. c. During mosquito season, if we see that our trap numbers are steadily declining, we know that our control measures are working. d. This brings us back to step 1 and the cycle begins all over again.

LESSON 4: MOSQUITO CONTROL PRACTICES

Teacher Directions / Methods	Content Outline / Key Points
Slide 5	***IPM Approaches*** When we implement control measures, there are different types of control that we can use. The types of control can be separated into three categories and these include physical and cultural control, biological control, and finally, chemical control. 1. **Physical/ cultural control** – these are things that you can do to prevent mosquito development and invasion into your home. 2. **Biological control** – this is control of a pest (here, a mosquito) by introducing a natural enemy or predator. 3. **Chemical control** – finally, we can use chemicals to control mosquitoes that we did not successfully control with the other two methods. The whole point of the triangle is that you should be starting at the bottom and working your way up the triangle. • Here, the goal is to reduce the amount of chemicals that go into the environment. o The chemicals that are used in mosquito control are EPA (Environmental Protection Agency) registered and have undergone rigorous testing to ensure their impact on the environment is minimal. o However, it is best to reduce use of chemicals by implementing other control strategies to minimize the amount of chemicals used. o Also, when chemicals are overused, mosquitoes can develop resistance to the insecticides and they are no longer effective or don't work as well. o This is even more incentive for making sure we are using other control strategies before using chemical control.

LESSON 4: MOSQUITO CONTROL PRACTICES

Teacher Directions / Methods	Content Outline / Key Points

Slide 6	***Physical/Cultural Control***
	Physical and cultural control include methods to prevent mosquito development or invasion into your home.
	• Some areas deal with salt marshes and those salt marshes produce a specific type of mosquito: salt marsh mosquitoes.
	• Impoundments may be set up to try to address the problem of salt marsh mosquitoes.
	  ○ Impoundments are managed waterways that are flooded during the mosquito season.
	  ○ Flooding in the mosquito season prevents mosquitoes that require moist soil to lay their eggs from being able to lay those eggs.
	  ○ By controlling when the soil is flooded and when it is dry, mosquito populations can be significantly reduced.
	• Salt marsh mosquitoes lay their eggs on moist soil.
	  ○ When the water level rises, the wet soil is flooded and the eggs hatch.
	  ○ Impoundments can be used to manage the water to ensure that the moist soil is not exposed during peak mosquito season.
	  ○ This prevents salt marsh mosquitoes from laying eggs and can reduce the population

LESSON 4: MOSQUITO CONTROL PRACTICES

Teacher Directions / Methods	Content Outline / Key Points

Slide 7	***Biological Control***
	Control of a mosquitoes by introducing a natural enemy or predator.
	For mosquitoes, this is primarily done at the larval stage.
	Biological control can include things like mosquito fish and *Toxorhynchites* larvae.
	• Mosquito fish are small fish that will eat mosquitoes.
	  ○ Some mosquito control programs actually have colonies of these mosquito fish and will provide them to residents to treat small ponds or other areas appropriate for fish
	• *Toxorhynchites* larvae were also discussed in the mosquito biology lecture.
	  ○ These mosquito larvae feed on other mosquito larvae – they are predatory.
	  ○ When *Toxorhynchites* larvae are present in a container, they will eat other mosquito larvae and that can result in reductions in the population.

LESSON 4: MOSQUITO CONTROL PRACTICES

Teacher Directions / Methods	Content Outline / Key Points
Slide 8	***Chemical Control*** There are many types of chemicals available for controlling mosquitoes, and they can be aimed at controlling the larvae or controlling the adult mosquitoes. • For the mosquito larvae, we use insect growth regulators, Bti, and spinosad. o Insect growth regulators come in 2 forms: juvenile hormone analogs and chitin synthesis inhibitors. ▪ JHAs work by essentially making a hormone needed for mosquito development present when it shouldn't be present. • This causes the immature mosquito to die before it can make it to the adult stage. ▪ Chitin is an essential component of the insect exoskeleton. • What chitin synthesis inhibitors do is prevent the proper formation of the exoskeleton, which ends up killing the insects. o Bti is a naturally-occurring soil bacterium that causes toxicity in mosquitoes that eat it. ▪ Bti is commonly used to control mosquito larvae. ▪ It comes in the form of bits and dunks that can be put in mosquito larval development sites. ▪ After mosquitoes eat the Bti, they will eventually die. o Spinosad acts on the nervous of mosquito larvae

LESSON 4: MOSQUITO CONTROL PRACTICES

Teacher Directions / Methods	Content Outline / Key Points
	and causes over-excitation of their nervous system and eventually death • For adult chemical control, pyrethroid and organophosphate insecticides can be used. o Both of these chemical classes affect the nervous system of the mosquito eventually causing death. o The activity of these insecticides can be enhanced by something called synergists. o Synergists are not toxic on their own, but instead, can enhance the activity of the chemical that they are paired with.
Slide 9 **VIDEO**	Youtube Link: https://www.youtube.com/watch?v=5QH2d0ZDLI0&feature=youtu.be OR visit Prevent and Protect website: https://preventmosquitoes.org/mosquito-control-toolkit/videos/ (click video link called "Application Methods")

LESSON 4: MOSQUITO CONTROL PRACTICES

Teacher Directions / Methods	Content Outline / Key Points
Slide 10	***Mosquito Control Practices*** Knowing that information, we can talk specifically about what mosquito control does. ○ This is largely the same as an integrated pest management program, but we will discuss specific things that mosquito control does. • First mosquito control will look for mosquitoes (**surveillance**) and **identify** the mosquitoes that they find. Depending on the mosquitoes they find and the abundance at which they find them, they will **build a control plan** and eventually **implement that control**. Ideally, using control strategies from at least two of the IPM control categories (physical/cultural, biological, or chemical) is ideal. After this, the **success of the control strategy is evaluated.** • Community education also plays an important role throughout this process.

LESSON 4: MOSQUITO CONTROL PRACTICES

Teacher Directions / Methods	Content Outline / Key Points
Slide 11	***Surveillance*** Surveillance of mosquitoes can be done using a variety of traps and methods. o CDC light traps and BG sentinel traps are two traps used for surveillance of HOST-SEEKING mosquitoes. o These are mosquitoes that are actively looking for a bloodmeal. o The way that the trap is designed biases it towards collecting hungry mosquitoes instead of mosquitoes that are looking to lay their eggs, for example. The CDC light trap has a light and this can serve as an initial attractant for the mosquitoes.
Question-Answer-Discussion QAD **Ask:**	Think back to the first lesson when we talked about how mosquitoes find hosts. **What is the most universally recognized mosquito attractant?** Carbon dioxide o CDC LTs are also often baited with carbon dioxide. o Carbon dioxide is also an attractant for mosquitoes that are looking to get a bloodmeal. o When the mosquitoes get close enough to the trap, they are drawn down into a collection bag by a fan. o These traps usually run overnight and are picked up after that for identification. o BG Sentinel traps also incorporate a lure and draw in host-seeking females. o These traps were designed specifically for

Teacher Directions / Methods	Content Outline / Key Points
	container mosquitoes and usually run for 24 hours. o The contrasting colors are attractive as well as the BG lure that comes with the trap. Again, these populations attract host-seeking mosquitoes (those looking for a bloodmeal).

LESSON 4: MOSQUITO CONTROL PRACTICES

Teacher Directions / Methods	Content Outline / Key Points

Slide 12	***Surveillance***
	Surveillance can be done by collecting resting mosquitoes as well.
	• Resting shelters, like the one pictured, can be set out in the environment and mosquitoes will enter them to rest.
	  ○ The mosquitoes that are entering these resting shelters are far more likely to have bloodfed compared to mosquitoes collected in the CDC light trap and BG sentinel trap.
	• Aspirations can also be used to collect mosquitoes from vegetation where they are resting.
	  ○ Mosquitoes will often look for a place to rest after they have taken a bloodmeal.
	  ○ While they rest, they digest the bloodmeal.
	  ○ This is why mosquitoes in these shelters are more likely to have had a bloodmeal.

QAD **Ask:**	**Why might we want to trap mosquitoes that have bloodfed over mosquitoes that are still seeking a host to feed on?** • To collect those mosquitoes and test them for pathogens.
Ask:	And, **why might we want to trap mosquitoes that are still seeking a host to feed on rather than mosquitoes that have already bloodfed?** • Trapping host-seeking mosquitoes gives us an idea of the biting pressure and which mosquitoes are most abundant currently. • It also tells us something about which larval habitats are likely most productive. ○ Certain mosquitoes prefer certain larval habitats so

Teacher Directions / Methods	Content Outline / Key Points
	if you have a high number of a species that prefers a salt marsh, you know your salt marshes are likely very productive at that time.
Slide 13	***Surveillance*** Gravid traps are used to collect female mosquitoes as they are going to lay their eggs. • Gravid is the word used to describe a female that is ready to lay her eggs. • This trap works by filling the blue part of the trap with water. ○ This water often has things added to it like hay or other infusion to make it more attractive to female mosquitoes looking to lay their eggs. • The part suspended over the black container has a fan that will suck mosquitoes up into the netted collection chamber when they come down to the water to lay their eggs. • Almost all of the mosquitoes collected using this method will have previously bloodfed (unless the trap accidentally collected a mosquito).

LESSON 4: MOSQUITO CONTROL PRACTICES

Teacher Directions / Methods	Content Outline / Key Points

Slide 14	***Importance of Trap Type***
	The type of trap is extremely important in managing the mosquito population.
	When choosing a trap, we want to think about a few things:
	• If we are looking for a host-seeking trap, like the CDC light trap, or the BG Sentinel trap, we have to keep in mind that mosquitoes are looking for a host to consume a bloodmeal.
	  ○ So, we may attract them with a substance like carbon dioxide.
	• If we are looking to trap resting or gravid mosquitoes, we are looking to trap them after they have bloodfed but before they deposit their eggs.
	  ○ These types of traps are useful in disease surveillance because the bloodfed females can be tested for infection.
	
	This photo is of an electric bug zapper, which is NOT an effective mosquito control method.
	• Jonathan Day, associate professor of entomology with the University of Florida's Institute of Food and Agricultural Sciences, says they actually make things worse by drawing more mosquitoes into your yard, while killing thousands of beneficial insects.
	• The UF/IFAS Florida Medical Entomology Laboratory in Vero Beach completed a test where one zapper killed more than 10,000 insects but only eight mosquitoes.

LESSON 4: MOSQUITO CONTROL PRACTICES

Teacher Directions / Methods	Content Outline / Key Points
Slide 15	***Larval Surveillance*** Larval surveillance is conducted using a tool called a larval dipper. • The larval dipper is dipped into a larval habitat so a sample of water can be collected. • The inspector then looks into the sample to see if there are any larvae present in the larval dipper. The larvae can also be quantified. Larval surveillance tells us which larval habitats are productive and developing larvae and that tells us where control measures need to be implemented.
Slide 16	***Identification*** After mosquitoes have been collected, they must be **identified**. • These mosquitoes can be from any of the surveillance methods previously listed, including the larval surveillance. Identifying mosquitoes can be very challenging because there are approximately 80 species of mosquitoes in Florida. • To identify the mosquitoes that are collected, we use keys, like the one listed here to identify the mosquito. Once the mosquito has been identified, we can do research about that mosquito species to determine where it lives and what its behaviors are. • This information can then be used to build a specialized control program for that mosquito species.

LESSON 4: MOSQUITO CONTROL PRACTICES

Teacher Directions / Methods	Content Outline / Key Points
Slide 17	***Build a Control Plan*** When we are building the control plan, there are a few questions we need to ask: 1. Where do the immature mosquitoes live? a. We need to know what the preferred habitat of the mosquitoes are so we know where we need to treat if needed. 2. What is the mosquito feeding on? a. Knowing what the mosquito is feeding on helps us determine if this species is a nuisance species. 3. Does this mosquito transmit any pathogens? a. This becomes particularly important when there is a disease outbreak.
Slide 18	***Implement Control*** Once the control plan has been built, it has to be implemented. • This can be a combination of cultural/ physical controls, biological control, and chemical control. o For example, if we are dealing with the container mosquito, *Aedes aegypti*, the first thing we would want to do eliminate the containers where *Aedes aegypti* larvae are developing. o Additionally, the containers where the immature mosquitoes are developing can be treated using a larvicide. If there was an outbreak of Zika virus, it may also be necessary to treat with an adulticide chemical (chemical to kill adult mosquitoes). • When there are infected mosquitoes flying around, we need to kill those mosquitoes before they are able to transmit the virus to another susceptible host.

LESSON 4: MOSQUITO CONTROL PRACTICES

Teacher Directions / Methods	Content Outline / Key Points
Slide 19	***Evaluate Success*** After the control measure has been implemented and it has had time to work, we need to evaluate the success of the campaign. • To do this, we can continue to conduct surveillance to see if the number of mosquitoes present in the trap decreases after the control measure has been implemented. If the control measure isn't effective, the plan can be modified until an effective strategy is developed.

Slide 20	***Community Education***
	Many mosquito control programs have an active community education program.
	• As components of this, they may be participating in a combination of different community education components.
	  ○ Some go to **schools** and give presentations and present informational materials.
	  ○ Others attend **community events** where they provide educational materials, provide hands on activities and answer the questions of the community.
	  ○ Others be sure that they are present on **social media** so they can make the public aware of control measures being implemented, but also to communicate new information to community education.
	  ○ Finally, mosquito control programs often respond to many types of **public requests** to be present at a wide variety of events.

LESSON 4: MOSQUITO CONTROL PRACTICES

Teacher Directions / Methods	Content Outline / Key Points

Slide 21	***Other Mosquito Control Practices***
	Mosquito control programs may also have active arbovirus surveillance program.
	• This involved a **sentinel chicken program** where chicken flocks are strategically placed in secure locations and are exposed to biting mosquitoes.
	  ○ Blood is regularly collected from chickens and sent to the Department of Health for testing.
	  ○ A positive chicken is proof of current, local transmission and a narrow window of time of infection can be calculated.
	  ○ This lets the program know if there are mosquitoes in the area infected with different encephalitic viruses.
	
	Finally, mosquito control will take nuisance calls.
	• If mosquitoes present an extreme biting pressure, people may call and complain.
	  ○ Mosquito control will take this information into account when designing their control strategies

LESSON 4: MOSQUITO CONTROL PRACTICES

Teacher Directions / Methods	Content Outline / Key Points
Slide 22	***Advantages of Mosquito Control*** There are many advantages to mosquito control. The major, and probably the most important, advantage is that mosquito control **protects the health of humans and animals**. • Mosquitoes are capable of transmitting all kinds of pathogens that can harm us and animals. • Mosquito control aims to control mosquitoes and prevent them from transmitting those pathogens to us. This means that they are also **reducing the biting pressure** of mosquitoes. • Even if a mosquito isn't transmitting a pathogen to you, it is still annoying to get bit while you are outside. • If we didn't have mosquito control, it would probably be very hard to live in Florida because of how many mosquitoes there would be. Mosquito control also uses an **integrated approach**. • They aren't just applying chemicals. • They are modifying the environment the mosquitoes need to develop, communicating with the public and implementing control strategies that don't require chemicals whenever possible. These action plans for controlling mosquitoes are also **targeted**. • Mosquito control aims to implement treatments when the mosquitoes are most active. • They are also looking specifically for the larval habitats of those mosquitoes and targeting them. • This targeted approach means that we can reduce the number of other organisms that are impacted by mosquito control.

LESSON 4: MOSQUITO CONTROL PRACTICES

Teacher Directions / Methods	Content Outline / Key Points
Slide 23	***Disadvantages of Mosquito Control*** However, there are also disadvantages to mosquito control. When chemicals are used, there is always the possibility that **insecticide resistance** will develop. • Insecticide resistance happens when an insect is exposed to the chemical and, by a mutation, is able to survive the chemical and pass the survival genes on to its offspring. • Over time, the amount of insects in the population that can survive an insecticide application increases and this is bad. • Eventually, the product may no longer work at all. Additionally, if a **chemical control is implemented incorrectly**, it could harm insects that we are not targeting. However, good mosquito control programs keep these in mind and keep negative effects minimized while prioritizing human health.
Slide 24	***Advantages and Disadvantages*** You will notice the major advantages of mosquito control outweigh the major disadvantages.
Application: **Slide 25**	Students will create their own Mosquito Control Unit Manual, including previous notes and assignments along with a mosquito control plan, which will come from this lesson. The manual will include: • Cover page • Mosquito Biology Guided Notes • Source Reduction Guided Notes • Mosquito-borne Illness Guided Notes • Mosquito Control Practices Guided Notes • Pronunciations The manual will also serve as a study guide for the unit exam and may be turned in after taking the exam.

LESSON 4: MOSQUITO CONTROL PRACTICES

Teacher Directions / Methods	Content Outline / Key Points
Closure/Summary: **QAD** **Ask:**	Today, we finished up the Mosquito Control unit by discussing mosquito control methods. We had six goals for today. 1. Describe the categories of an integrated pest management plan. 2. List the mosquito control practices currently used in Florida. 3. Describe the mosquito control practices currently used in Florida. 4. Discuss the advantages of mosquito control measures. 5. Discuss the disadvantages of mosquito control measures. 6. Create a solution to a mosquito control problem. **After assembling the manual, what questions do you have about the material, or what topic would you like clarified?**
Evaluation:	**Formative:** Q&A throughout lesson Mosquito Control Plan Mosquito Control Unit Manual **Summative**: Unit Test – later in unit

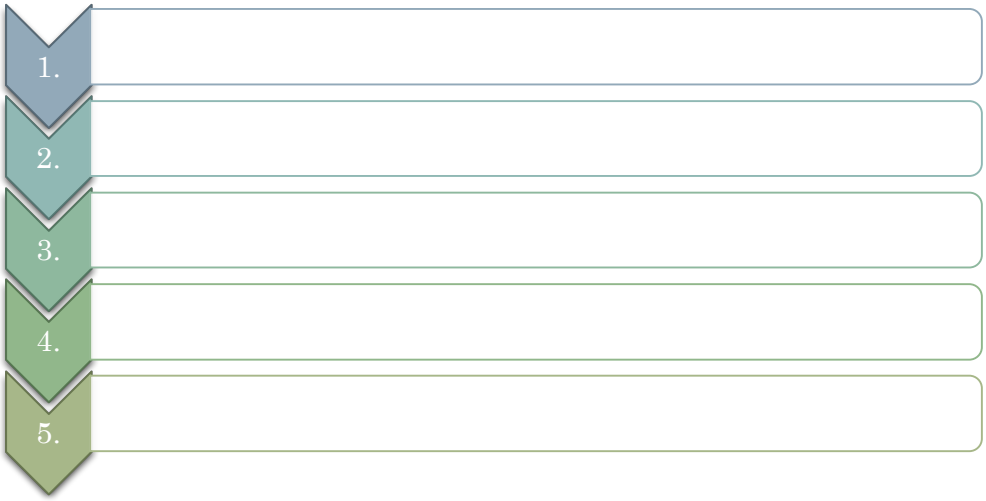
Mosquito Control Practices Guided Notes

Integrated Pest Management (IPM):

_____

_____

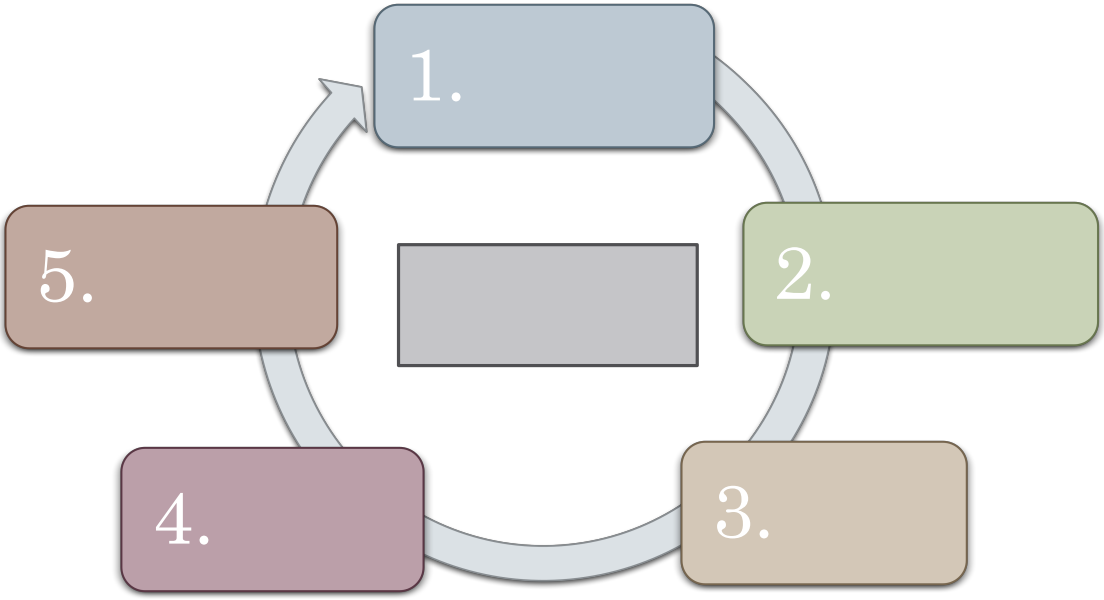
Integrated Pest Management Steps

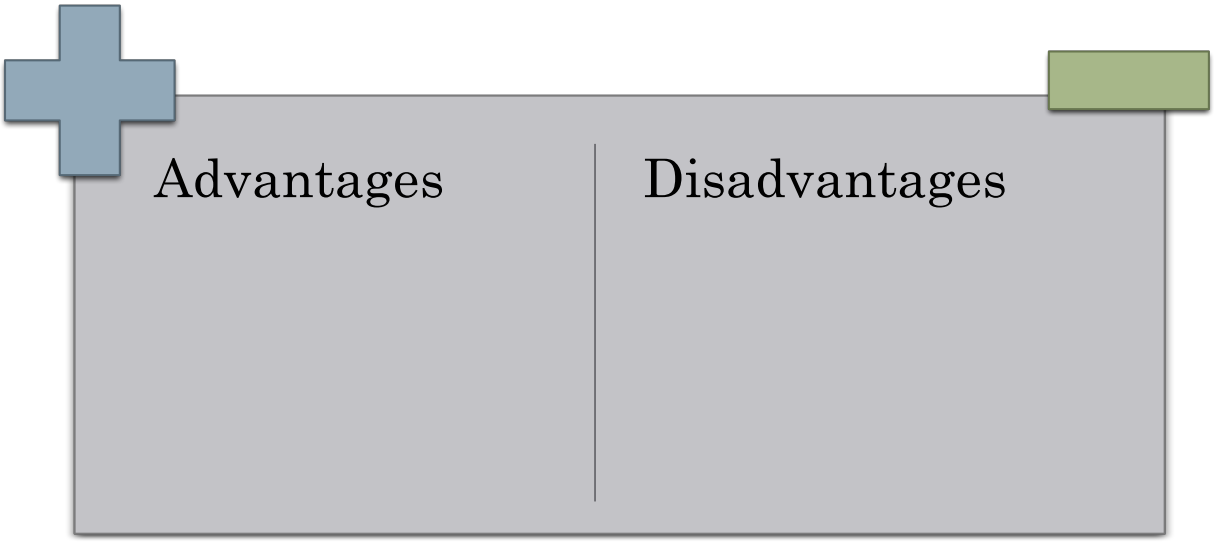


IPM Approaches

1. _____ Control
2. _____ Control
3. _____ Control

Mosquito Control Practices





Identify a mosquito control problem:

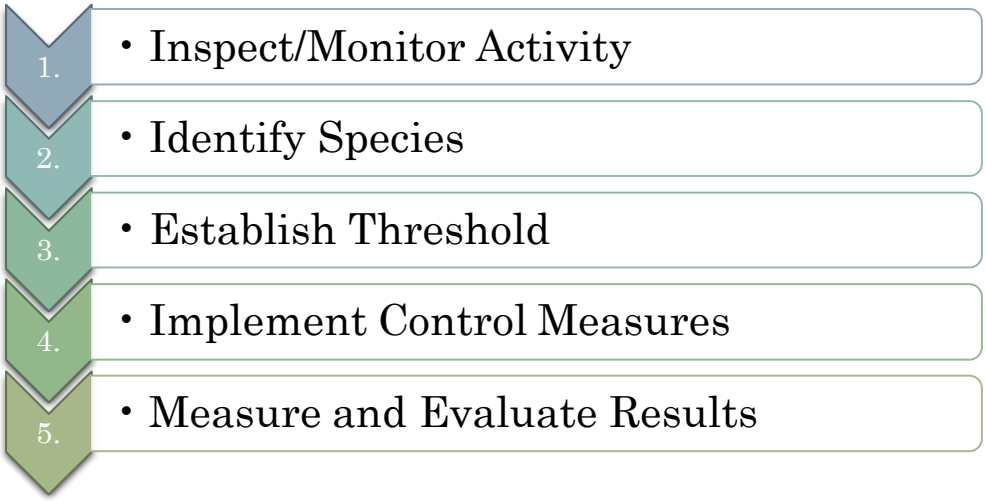
What is a solution for this problem?

Mosquito Control Practices Guided Notes KEY

Integrated Pest Management (IPM):

Science-based, common-sense approach for reducing populations of disease vectors and public health pests

Integrated Pest Management Steps



IPM Approaches

1. **Chemical** Control
2. **Biological** Control
3. **Physical** Control

Mosquito Control Practices

Advantages and Disadvantages

Protects the health of humans and animals

Reduces the biting pressure of mosquitoes

Uses an integrated approach

Targeted application

Resistance to chemical control can develop

If applied improperly, non-target organisms can be affected

Identify a mosquito control problem:

Create a solution for this problem?

MOSQUITO CONTROL PRETEST

Name: _____

Date: _____

Multiple Choice
Directions: Answer each statement by circling the best answer choice.

1. Which of the following describes the mosquito life cycle?

    A. Ametabolous

    B. Hemimetabolous

    C. Holometabolous

    D. Incomplete

2. The larval stage is the _____ stage of the mosquito life cycle.

    A. First

    B. Second

    C. Third

    D. Fourth

3. Mosquitos are highly attracted to _____.

    A. Carbon dioxide

    B. Methane

    C. Oxygen

    D. Sodium carbonate

MOSQUITO CONTROL PRETEST

4. To help control mosquitos around your home, containers that hold water, should be emptied every _____ days.

    A. 5

    B. 10

    C. 15

    D. 20

5. What the term for a host that may become infected with a virus, show symptoms of the virus, but the virus does not replicate inside the host?

    A. Carrier host

    B. Dead-end host

    C. Receiving host

    D. Vector host

MOSQUITO CONTROL PRETEST - KEY

Mosquito Control Pretest Key

1. C
2. B
3. A
4. A
5. B

MOSQUITO CONTROL UNIT EXAM

Name: _____

Date: _____

Objectives Evaluated:

1. Describe the mosquito life cycle.
2. Describe the environment in which the different mosquito life stages live.
3. List the major arboviruses that have been transmitted in Florida
4. List the pathogens that have been transmitted in Florida.
5. Summarize the symptoms associated with mosquito-borne pathogens.
6. Summarize the health outcomes associated with mosquito-borne pathogens.
7. Prepare an action plan for your household on reducing container mosquito populations in the area.

Unit Exam Matrix

	Lesson 1	Lesson 2	Lesson 3	Lesson 4
Topic	**Mosquito Biology**	**Source Reduction**	**Mosquito-borne Illnesses**	**Mosquito Control Practices**
Items	1, 2, 3, 4, 5, 6, 7	8, 9, 10, 11, 12	13, 14, 15, 16, 17, 18, 19, 20	21, 22, 23, 24, 25

MOSQUITO CONTROL UNIT EXAM

Multiple Choice (25 questions, 3 points each)

Directions: Answer the following by circling the best answer choice.

1. The primary reason mosquitoes feed on blood is to _____.
    A. get energy resources
    B. infect hosts with a disease
    C. help mature their eggs prior to oviposition
    D. nourish their bodies

2. Mosquitos have a(n) _____ life cycle.
    A. Ametabolous
    B. Hemimetabolous
    C. Holometabolous
    D. Incomplete

3. Which mosquito genera can serve as a biological control for other mosquitoes?
    A. *Aedes*
    B. *Anopheles*
    C. *Culex*
    D. *Toxorhynchites*

4. Identify the four major life stages in order from youngest to oldest.
    A. Adult, pupa, larva, egg
    B. Adult, egg, larva, pupa
    C. Egg, larva, pupa, adult
    D. Egg, pupa, larva, adult

MOSQUITO CONTROL UNIT EXAM

5. Which mosquito genera lays eggs with floats on them?
    A. *Aedes*
    B. *Anopheles*
    C. *Culex*
    D. *Toxorhynchites*

6. Transformation takes place during the _____ stage of the mosquito life cycle.
    A. adult
    B. egg
    C. larva
    D. pupa

7. The most widely recognized mosquito attractant is _____.
    A. Carbon dioxide
    B. Garlic
    C. Oxygen
    D. Sugar

8. Which mosquito genera is referred to as a container mosquito because it develops in containers close to human habitation?
    A. *Aedes*
    B. *Anopheles*
    C. *Culex*
    D. *Uranotaenia*

MOSQUITO CONTROL UNIT EXAM

9. Which of the following statements is not true?
    A. Adding mesh to the openings of rain barrels will prevent female mosquitoes from entering and laying their eggs.
    B. Keeping a pool chlorinated will ensure larvae cannot develop in it.
    C. Mosquito bits contain Bti, which is a genetically altered soil bacterium.
    D. Mosquito fish eat mosquito larvae and can be effective in small bodies of water.

10. Source reduction is the _____.
    A. decrease in available resources
    B. destruction of habitat
    C. permanent removal of something
    D. temporary removal of something

11. Scenario: Your family owns a portable basketball goal filled with water in its base. However, the cap to close the base is missing. What is the best solution to protect against mosquito development?
    A. Dump out the water every other week.
    B. Replace existing water with filtered water.
    C. Replace the water weight with sand.
    D. There is no need to worry about mosquitoes entering.

MOSQUITO CONTROL UNIT EXAM

12. Scenario: Your dog's water dish is located outdoors but underneath the porch. What is the best solution to protect against mosquito development?

    A. Dump out the water every five days
    B. Only fill the dish as the dog is thirsty
    C. Treat the water with a larvicide
    D. Use chlorinated water

13. Which of the following is <u>not</u> a component necessary to transmit a mosquito-borne illness?

    A. Host
    B. Pathogen
    C. Receiver
    D. Vector

14. Mosquitoes in the genus *Culex* are the primary vectors of which diseases?

    A. Eastern Equine Encephalitis and West Nile
    B. West Nile and St. Louis Encephalitis
    C. Zika, dengue, and chikungunya
    D. Zika and St. Louis Encephalitis

15. A host that can become infected with the virus, may show symptoms, but cannot replicate the virus internally is known as a _____.

    A. Closed-end host
    B. Dead-end host
    C. Susceptible host
    D. Terminating host

MOSQUITO CONTROL UNIT EXAM

16. Which disease is considered encephalitic?

    A. Chikungunya
    B. Dengue
    C. West Nile
    D. Zika

17. Which of the following mosquito-borne illnesses requires a bridge vector to transmit the disease?

    A. Dengue
    B. Eastern Equine Encephalitis
    C. West Nile
    D. Zika

18. *Aedes aegypti* and *Aedes albopictus* are vectors for all of the following diseases except _____.

    A. Chikungunya
    B. Dengue
    C. St. Louis Encephalitis
    D. Zika

19. What is the relationship between a vector and a pathogen?

    A. The pathogen hosts the vector.
    B. The pathogen is infected by the vector.
    C. The pathogen transmits the vector.

    The vector transmits the pathogen.

MOSQUITO CONTROL UNIT EXAM

20. You are a doctor who specializes in mosquito-borne illnesses at a small hospital in south Florida. One of your female patients is preparing for a vacation to Peru. However, because she is pregnant, you highly recommend that she cancel her trip. You know that traveling in this area could put your patient at risk of being infected with a mosquito-borne illness that could cause a birth defect in her baby. Which mosquito-borne illness are you warning against?

    A. Chikungunya
    B. Eastern Equine Encephalitis
    C. St. Louis Encephalitis
    D. Zika

21. Integrated Pest Management aims to _____.

    A. create landscape habitats for mosquitoes to safely live in
    B. eradicate pests through chemical spraying
    C. reduce the amount of chemicals that are used to control an insect pest
    D. repel insects, forcing them to migrate elsewhere

22. The IPM step that determines if the mosquito population is at a low enough level that it will not cause a major concern from a nuisance or public health standpoint is known as _____.

    A. Establishing the threshold
    B. Identifying the species
    C. Implementing a control strategy
    D. Inspecting and monitoring

MOSQUITO CONTROL UNIT EXAM

23. An example of a biological control IPM approach is the _____.

    A. CDC light trap
    B. mosquito bits
    C. mosquito fish
    D. window screens

24. Surveillance can be done by collecting resting mosquitoes with a

    A. BG Sentinel trap
    B. gravid trap
    C. larval dipper
    D. resting box

25. Raising public awareness through social media is an example of which mosquito control practice step?

    A. Build a control plan
    B. Community education
    C. Evaluate success
    D. Identification

MOSQUITO CONTROL UNIT EXAM - KEY

Mosquito Control Unit Exam Key

1. C
2. C
3. D
4. C
5. B
6. D
7. A
8. A
9. C
10. C
11. C
12. A
13. C
14. B
15. B
16. C
17. B
18. C
19. D
20. D
21. C
22. A
23. C
24. D
25. B

LESSON PLAN ASSESSMENT

Source Reduction: At-Home methods of Mosquito Control

On a scale of 1 to 5, circle number between the set of words that best represents your views. For example, for the first line, a 1 would be very bad and a 5 would be very good.

Me using at-home methods of mosquito protection and control is:

Bad	[1] [2] [3] [4] [5]	Good
Harmful	[1] [2] [3] [4] [5]	Beneficial
Ineffective	[1] [2] [3] [4] [5]	Effective
Useless	[1] [2] [3] [4] [5]	Useful
Unimportant	[1] [2] [3] [4] [5]	Important
Worthless	[1] [2] [3] [4] [5]	Valuable
Undesirable	[1] [2] [3] [4] [5]	Desirable
Unnecessary	[1] [2] [3] [4] [5]	Necessary
Not my responsibility	[1] [2] [3] [4] [5]	My responsibility

LESSON PLAN ASSESSMENT

Mosquito-Borne Illnesses:

Mosquito-borne illnesses are:

Not dangerous	[1] [2] [3] [4] [5]	Dangerous
Not a risk to me	[1] [2] [3] [4] [5]	A risk to me
Not a risk in Florida	[1] [2] [3] [4] [5]	A risk in Florida
Not prevalent	[1] [2] [3] [4] [5]	Prevalent
Unimportant	[1] [2] [3] [4] [5]	Important
Not a priority	[1] [2] [3] [4] [5]	A priority
Uncontrollable	[1] [2] [3] [4] [5]	Controllable
Unpreventable	[1] [2] [3] [4] [5]	Preventable

LESSON PLAN ASSESSMENT

Mosquito Control Practices Attitudes

Mosquito control practices currently used by mosquito control programs in Florida are:

Bad	[1] [2] [3] [4] [5]	Good
Harmful	[1] [2] [3] [4] [5]	Beneficial
Useless	[1] [2] [3] [4] [5]	Useful
Unimportant	[1] [2] [3] [4] [5]	Important
Worthless	[1] [2] [3] [4] [5]	Valuable
Unnecessary	[1] [2] [3] [4] [5]	Necessary
Not needed	[1] [2] [3] [4] [5]	Needed
Inefficient	[1] [2] [3] [4] [5]	Efficient
Unsafe	[1] [2] [3] [4] [5]	Safe

LESSON PLAN ASSESSMENT

Importance of At-Home Mosquito Control

Please indicate your agreement with the following statements about mosquito control:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Using at-home methods of mosquito control helps protect me from mosquito-borne illnesses.						
Using at-home methods of mosquito control is important to helps protect my neighbors from mosquito-borne illnesses.						
Using at-home methods of mosquito control helps protect pets from mosquito-borne diseases.						
Using at-home methods of mosquito control helps reduce the nuisance of mosquitoes when participating in outdoor activities.						

PRONUNCIATIONS

Aedes aegypti - Aye-dees uh-gyp-tie

Aedes albopictus - Aye-dees al-bow-pick-tus

Anopheles - Uh-noff-uh-lees

Chikungunya - *CHIK-ən-GUN-yə*

Coquillettidia - Coke-wa-la-tid-e-uh

Culex - Cue-lex

Culicidae - kyü-lis-ə-dē

Dengue - deng-gey, -gee

Mansonia - Man-sown-e-uh

Proboscis – proh-BOS-kiss

Siphon - sīfən

Toxorhynchites - TOX-o-rin-KITE-eez

Uranotaenia - Your-rain-ah-tay- knee-uh

Zika - zee-k*uh*

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