GETTING TOGETHER & STAYING ALIVE

1

OBJECTIVES

1. **Name and describe 5 ways insects get together to mate.**
2. **Using an example, describe each of the different ways insects protect themselves.**
3. **Define Mullerian and Batesian mimicry.**
4. **Define and give examples of aposematic coloring/behavior.**

2

INTRODUCTION

The primary goal of any organism, including insects, is to pass on it's genes through reproduction. In order to do this, an organism must, eat, grow, and protect itself so that it can reproduce. Through this unit you will learn how insects find mates and protect themselves by examining 5 reproductive strategies and 9 protective strategies.

Diptera:Bibionidae – love bugs

3

GETTING TOGETHER – REPRODUCTIVE STRATEGIES

We are going to discuss some specific mating strategies (some of the strategies are pretty racy).

The five strategies to be discussed are:

1. Looking good
2. Smelling good
3. Sounding sweet
4. Lamp light
5. Buying love

4

LOOKING GOOD

Specific insects can rely on their looks to attract a mate. Males will look for characteristics of his species and when he finds a female that matches he mates with her or vice versa. The more a potential mate looks like the "visual ideal" of the species its chances for reproduction is much greater.

At times the one seeking the potential mate may mistakenly mate with the wrong species, or "bottle", as is seen in the video clip about Jewel Beetles.

Mating pair of lovebugs, *Plecia nearctica* Hardy. Female on right. Color black with red dorsal portion of thorax.

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VIDEO – JEWEL BEETLES AND THEIR BEER MATES

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SMELLING GOOD

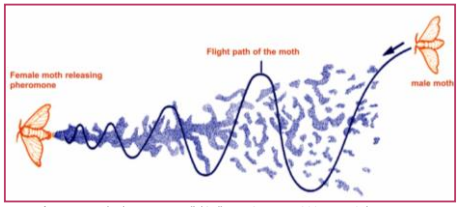

Figure 1. moth pheromone trail (Gullen & Cranston 2005, pg 101).

- One of the most efficient ways to attract a mate is pheromones.
- Insects rely heavily on sexual pheromones to get together and reproduce.

- Usually the chemicals are produced from glands located in the abdomen.

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VIDEO - SILK MOTH SEEKS MATE

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ELECTROANTENNOGRAM

Scientists have found that an isolated male silkworm moth's antenna produced an electrical signal when exposed to a chemical called bombykol, but did not respond to any other chemical.

An *electroantennogram* (EAG) (fig. 2)is what is used to test such signals. An EAG involves blowing a whiff of any material to be tested in a gentle stream of air over an isolated antenna. Any electrical signal the antenna produces is then recorded. This technique is not difficult to perform. The EAG has become standard practice today for anyone doing insect signaling research.

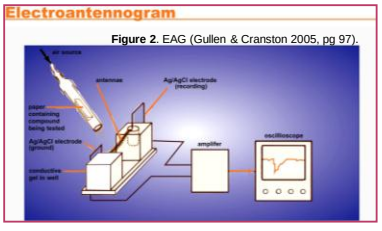

Figure 2. EAG (Gullen & Cranston 2005, pg 97).

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SOUNDING SWEET

Some insects use smell AND sound to attract mates like the Polka Dot Moth.

Other insects just use sound to entice reproductive partners. Some even employ ultrasound sent through plant stems to attract mates.

Male cicadas, crickets and grasshoppers are known for their ability to produce sound. Most of us have heard their buzz on a warm summer night. Each species has a distinct song.

Crickets rub their forewings together.

Hemiptera (Homoptera): Cicadellidae - leafhopper

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VIDEO - POLKA DOT MOTH MATING CALL

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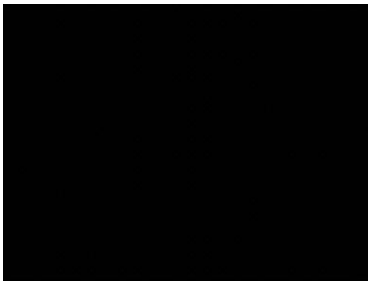
VIDEO - LEAFHOPPER CALL



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SOUND PRODUCTION

- Cicadas produce sound by vibrating their **tymbal**.
- The female picks up the sound with a **tympanum**.
- This organ has a membrane stretched tightly across an air-filled chamber (Think drum).

Many kinds of insects have these tympanal organs. They can be located in a variety of locations on the insects body including the tibia, thorax, and abdomen.

Hemiptera (Homoptera): Cicadidae
- cicada

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THOUGHT QUESTION

Think about the following questions for a few minutes.

What might be the advantages and disadvantages in using sound to attract a mate?
What are the advantages and disadvantages in using smell?

Take a minute to jot down some of your ideas then go on with the lesson. You will come back to these questions at the end of the unit.

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LAMP LIGHT

- Fireflies use their lamps to attract mates.
- Their light organ is located in their last few abdominal segments.
- Each species has its own flashing pattern.

- Male fireflies fly above grassy areas or bushes.
- A male of species 'A' may flick three short flashes and one long one
- The female of species 'A' will flick a signal back.
- A male of species 'B' could flick two short flashes and two longs and thus would not attract females of species 'A'.

A unique behavior has evolved with these light organs. Females of *Photuris* species, lure males of other species by mimicking their female's flashing pattern. When the misled male lands, the fraudulent female attacks and eats him.
This bizarre behavior was discovered by a firefly specialist, Dr. Lloyd, a professor here in the Entomology Department.

READ the following journal "Aggressive Mimicry in Photuris: Firefly Femmes Fatales" in 'attachments above, which gives a personal account of his discovery.

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BUYING LOVE

A male fruit fly will stake a claim on a walnut as his "estate" so a female will use his walnut to lay her eggs.

Stag beetles will fight off other males to stake out his "estate" so that a female will mate with him.

Some males spin silk in their mandibles to wrap gifts for their "sweetheart".

Watch the two videos to see how insects buy love.

Coleoptera: Lucanidae – stag beetle

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VIDEO – STAG BEETLES BATTLE FOR MATING RIGHTS

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VIDEO – FRUIT FLY MATING

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STAYING ALIVE OR PROTECTIVE STRATEGIES

Insects have evolved fascinating behavioral patterns in order to mate. They have also evolved incredible strategies to protect themselves

- Camouflage.
- Powerful stinging weapons.
- Ability to spray poisonous chemicals.

The 9 protective strategies are:

1. Timing
2. Radar detection
3. Hiding
4. Speed
5. Armor plating
6. Armed & dangerous
7. Chemical warfare
8. Imposters
9. Migration

Hemiptera (Homoptera): Membracidae – thornbug mimicking a thorn

TIMING

Insects have developed biological rhythms:

- ❑ Molting in the early morning when humidity is high.
- ❑ Emerging in the cooler months when predators are not as active.
- ❑ Emerging at the same time so chances for mating increases.
- ❑ Going into diapause to escape harsh temperatures.

Diapause - little or no growth; similar to hibernation.

In diapausing pupae, ecdysone is not produced and thus the pupae cannot emerge until the hormone level surges to stimulate molting.

In diapausing adults, the corpora allata is inactive and reproduction is no longer stimulated by juvenile hormone. When spring comes and the days begin to lengthen, the brain responds and stimulates the secretion of the suppressed hormones.

The pupae will molt as ecdysone is released, and reproduction will begin in the diapausing adults as JH levels return to their normal levels.

DIAPAUSE

As an insect enters diapause, it becomes relatively inactive but not immobile. Its metabolism slows down, so the need for food is low, and thus there is no need for the insect to be moving about searching for food. It seeks a protective covering, just as a bear searches for a cave to hibernate, to wait out the winter.

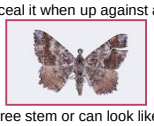

Hemiptera (Homoptera): Membracidae - treehopper

RADAR DETECTION AND HIDING

Nocturnal predators rely on chemical and/or audio cues.

- Bats target their prey with *echolocation.*
- Praying mantids can detect the radar, and drop out of sight before a bat can catch them.

What the predators don't see, they can't catch. Insects have developed remarkable concealing techniques such as seen in a geometrid moth. The wavy lines and blotchy patterns conceal it when up against a tree.


geometrid moth

Treehoppers seem to be apart of a tree stem or can look like a thorn on a branch.


thorn mimicking treehoppers

Walkingsticks as their name suggests look like twigs or branches.

VIDEO – PRAYING MANTIS MAVERICK MANEUVER

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SPEED

Speed is an obvious strategy for survival.

- ✓ Tiger beetles are adept runners.
- ✓ Grasshoppers jump quickly and high before a bird can snatch them.
- ✓ Flies are great evaders when we are trying to kill them with a fly swatter.
- ✓ Cockroaches start running before they even think about it.


Diptera: Cyclorrhapha - house fly


Orthoptera: Acrididae - lubber grasshopper

ARMOR PLATING

Insects don't have to just warn predators or use chemicals to stay alive, sometimes they simply have to survive harsh environmental conditions. Because of their tough exoskeleton, insects often can survive massive blows, such as being run over by a Land Rover.

Other mechanical defenses may be slippery scales or cuticle, or autotomy which is the ability to lose an expendilbe limb.

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VIDEO – BEETLES ROCK HARD

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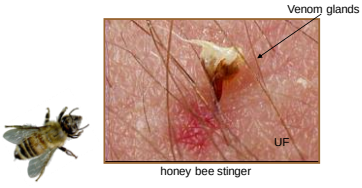
ARMED AND DANGEROUS

Bees and wasps give terrible stings when attacked. The ovipositor of a female is modified and fused to form the stiff piercing organ that stings. Glands near the ovipositor release toxic venom into the wound made by the weapon.

Honey bees have tiny hooks at the tips and once the stinger has been pierced into the victim, the barbs prevent the stinger from being removed. Thus, as the bee struggles to get away, the stinger is left behind pumping more venom in the prey.



honey bee stinger

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VIDEO – BEE STING

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CHEMICAL WARFARE

Using chemical warfare is a powerful protective strategy. Insects can either taste bad or use chemicals to thwart predators. An example of this is the bombardier beetle. The bombardier beetle sprays a noxious chemical from his abdominal tip that irritates toads, ants, and even large spiders.

Some insects use a more subtle chemical warfare. As they are feeding on foliage, they incorporate poisonous plant chemicals into their body tissues. This makes the insects unpalatable to others. The *Utetheisa* moth feeds on a poisonous legume, which makes the moth distasteful to scrub jays.


Utetheisa moth

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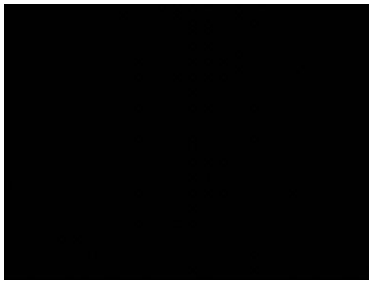
VIDEO – BOMBARDIER BEETLE



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APOSEMATIC COLORING

Usually when an insect is poisonous they have **aposematic coloring or behavior** to warn predators of their distastefulness. The word aposematic means being conspicuous and serving to warn.

Good examples of aposematic coloring are wasps and bees because of their unmistakable yellow and black markings. Once a unsuspecting predator is stung by one of these, he won't forget what they look like because of the instantly recognizable pattern.

The next time he sees anything that resembles the pattern, he will quickly get out of harm's way.

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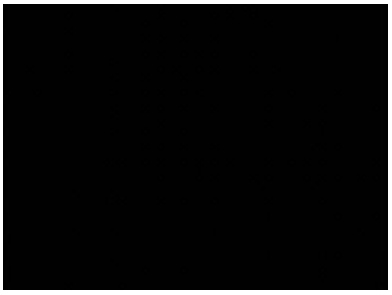
VIDEO – QUININE: THE SECRET OF MY SUCCESS



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IMPOSTERS – BATESIAN MIMICRY

Some insects display conspicuous behavior:

- ❑ Purposefully fly slowly so their aposematic colors are seen.
- ❑ Firefly larvae will flash their lamp organ when a predator approaches.
  - Firefly larvae are distasteful to many organisms.

sesiid moth

wasp

Using another insect's aposematic coloring to your advantage makes sense. Mimicking an organism that is harmful, but you are not harmful yourself, is called **Batesian mimicry**.

33

IMPOSTERS - MULLERIAN MIMICRY

Mullerian mimicry:
Two species mimic each other and they are both bad to eat.

The monarch and the viceroy are Mullerian mimics of each other. They look alike but they are both harmful to birds because as larvae they feed on milkweed. Milkweed contains toxic chemicals that induce vomiting in birds and cattle.

monarch

viceroy

The quickest way to tell apart monarchs and viceroys is by the black stripe in the hind wing of the viceroy.

34

MIGRATION

Insects have developed intricate migration patterns.

- Monarchs are famous for their 1,000-mile journey to Mexico.

Locusts have been recorded to migrate from western Africa to the West Indies of North America. This is estimated to be 3100 miles and six days in duration!

Scientists speculate that the locusts probably took advantage of wind up currents across the Atlantic to glide some of the distance.

Monarchs on tree (Lets, 2000)

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Learning Game Placeholder
Learning Game: Choices
Title: Review Quiz

CONCLUSION

An organisms main purpose, desire, or goal in its life is to reproduce to continue its species. Insects use at least 14 strategies to accomplish this. You have learned a little about each one.

You have learned 5 reproductive strategies:

1. Looking good
2. Smelling good
3. Sounding sweet
4. Lamp light
5. Buying love

grasshopper

And 9 protective strategies:

1. Timing
2. Radar detection
3. Hiding
4. Speed
5. Armor plating
6. Armed & dangerous
7. Chemical warfare
8. Imposters
9. Migration

REFERENCES

Photo:

1. LETS, 2000. "Monarchs at Lighthouse Field in Santa Cruz California" sponsored by *Let's Get Growing Internet Resources.* Online: http://www.letsgetgrowing.com/monarch.html. Accessed February 2000, unavailable 2005.