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SPARK Camp - June 2017

Buggin' Out! Ethnoentomology in the Real World

Grades 6-8

Introduction

1. **Rationale:** Students will learn skills ranging from insect collecting and identification to explanation and discussion of the roles of insects in human culture. They will also create their own "insect" that interacts with and influences modern culture as a final product, utilizing all of the skills, concepts, and content from the class to do so. Below are the rationales for the unit's major skills. Each rationale also contains reasoning for including the major pieces of content knowledge covered in this unit.

Major Skills: Students will be able to...	Rationale
● Articulate basic anatomy of insects in order to classify them and determine qualities of different families. ● Determine if an animal is an insect and explain their reasoning. ● Evaluate common insect orders to determine commonalities and differences.	Insects are the most abundant class of living things on the planet, and students will interact with them at some point in their lives, whether they choose a career in a science-related field or not. Furthermore, many students in middle school still retain their childhood fascination with small creatures, and with more education, this can blossom into a well-loved career in the field of entomology.
● Explain how insects are part of modern-day life. ● Compare and contrast the influence of insects in certain ancient cultures. ● Predict how the influence of certain insects may have influenced other cultures (ex. in an alternative universe). ● Rank the major aspects of cultures in order from least to most important, and defend thinking to peers. ● Compare and contrast the ways in which insects affect ancient and modern cultures. ● Explain the influences that different types of	Being able to analyze the intersection of two or more seemingly unconnected concepts or bodies of research is a high-level skill, one well-suited for gifted students. In this case, evaluating the ways in which insects have influenced human cultures is a unique challenge. Furthermore, being asked to perform cognitive operations that construct meaning and understanding around this more concrete topic (*how do insects influence human culture?*) also pushes students to reevaluate their own understandings of what human culture is and is not, and make changes to their internal narrative

insects have had on ancient and modern cultures.	about culture as they learn. Middle school is an excellent time to tackle this concept, as students are starting to think about their own roles in society as they mature.
• Create their own nonexistent insect, given a modern culture and the niche the insect must fill. • Justify their choice of order, physical characteristics, habits, and other identifying features of their created insect based on its environment. • Explain the role of their given insect in its environment.	This unit's performance task integrates knowledge and skills from multiple areas of study (science and social studies) in order to show understanding of all the content and skills laid out in the first part of the unit. It also assesses students' depth of understanding and is rigorous in terms of the cognitive capabilities involved. The task involves a real-world "problem" and students must initiate their own planning to complete it.

Finally, the overarching conceptual understanding in this unit is *nature shapes culture*. This is not a concept covered in most middle school curriculums, despite being an important fact of life that students should wrestle with as they mature and determine their place in the world. In fact, in today's society, students are more cut off from nature than any generation before. It is normal for us to spend as little time outdoors as possible, favoring our screens instead, and focusing on our smartphones if we do have to venture outside. It is no wonder that students nowadays do not feel that nature is an important part of their lives, despite its importance. Learning about insects demands that students spend time outside, thinking about the ways in which their lives intersect with other living beings', an essential understanding for any human. And, in addition to the in-depth research and performance task in this unit, what better way to drive home such an understanding than by spending some time in the dirt?

2. **Differentiation for gifted learners: Dimensions**
    - **Content**: the topic of ethnoentomology is college-level material. The topic can be more abstract than just entomology or just anthropology, which are themselves highly specialized fields.
    - **Process**: the unit's activities are intellectually demanding and involve higher-level thinking, especially in terms of cross-curricular investigation. The unit's culminating task requires problem solving and creativity, and the unit overall is highly accelerated for middle schoolers. Multiple lessons also contain hands-on learning for kinesthetic learners, including daily trips to check insect traps and identify insects. All lessons contain visual representations and graphic organizers for visual learners.
    - **Product**: As noted, the performance task is a real-world scenario that puts students in the shoes of an ethnoentomologist. Additionally, throughout the unit students will participate in a Socratic seminar and small group discussions, prepare and deliver presentations to their peers, do their own research on insect names, and present their created insects in a gallery walk. Therefore, students will have many and multiple ways of demonstrating learning.
    - **Learning environment**: Students will have lots of opportunities to work in different configurations (individually, in pairs, in small groups, and as a class). They will also have multiple opportunities for choice and creativity throughout the unit, especially in the last lesson. The environment as a whole is student-centered as students complete their own research.

    Differentiation for gifted learners: Features
    - **Complexity**: Students must establish and analyze the relationships between the insect and human worlds, then leverage these relationships to tell a new story. Their thinking must account for many moving parts, including the major features of human cultures, the many influences of insects on ancient and modern cultures, and the technical features of insect taxonomy and identification. Kaplan's Complexity icons for change over time (*how has insect influence on our culture changed over time?*) and across disciplines are visible here.
    - **Challenge**: This unit is designed to be taught more like a high school or college class, with content presented as more of a means to an end (the end being the deeper essential understanding) than as the end itself. Resources used are more sophisticated and require higher-level reading and writing skills.

- **Depth**: Kaplan's icons are well represented here. This unit includes quite a lot of content vocabulary (Language of the Discipline), graphic organizers for insect features and other content (Details), and factors of insect influence on human culture from ancient to modern times (Trends).
- **Creativity**: This unit involves much creativity, as students make their own names from Latin and Greek roots, develop and talk through new ideas learned from analyzing texts on insect uses, and of course, create their own insect as a final product.
- **Acceleration**: See above. This unit covers high school and college-level content in specialized fields, and the content, skills, and concepts are presented at a fast pace.

3. **Describe the population of gifted children for whom the unit is intended**: This unit is intended for gifted middle schoolers with an interest in entomology and/or anthropology, or any related field in the hard or social sciences. Students should have high-level reading and writing skills, and ideally a flair for the dramatic or creative arts as well. This unit is well-suited for kinesthetic and visual learners, whether or not students want to get their hands dirty (they'll learn to love it again, like when they were little!). Students' socioeconomic background is of little relevance here, although it may have already influenced their prior knowledge on the topics covered. This unit will address students' needs related to:
    - Multiculturalism: the ethnoentomological content spans many different cultures and ways of life.
    - Relevant and real-world experiences: students will spend a lot of time during this unit hunting and identifying their own insects, and will be expected to do so out of the class as well. More importantly, they will be studying real examples of insect influence on their own culture today, and on ancient cultures with which they may identify.
    - Flexible grouping: students have many opportunities for a myriad of groupings throughout this unit. In fact, by the end of the unit, they should have worked with every other student in the class at least once.
    - Higher-level thinking skills: most of this unit lies on the upper levels of Bloom's Taxonomy (analyze, evaluate, create).

Goals and Outcomes

1. **Content Goal**: To develop an understanding of insect characteristics and their role in the larger ecosystem.
   Students will be able to…
   - Analyze the interdependence of living organisms (insects) within their environments.
   - Explain how traits are determined by the structure and function of DNA.
   - Explain the theory of evolution by natural selection as a mechanism for how species change over time.
   - Understand the application of DNA technology.
   - Analyze how classification systems are developed based upon speciation.

   From: NC Standard Essential Standards High School Biology Curriculum.

2. **Content Goal**: To analyze human culture as a changing entity.
   Students will be able to…
   - Analyze ancient civilizations and empires in terms of their development, growth and lasting impact.
   - Understand how conflict and innovation influenced political, religious, economic and social changes in medieval civilizations.

   From: NC Essential Standards High School World History Curriculum.

3. **Process Goal**: To develop cross-curricular investigative skills with regard to science and social studies.
   Students will be able to…
   - Evaluate the achievements of ancient civilizations in terms of their enduring cultural impact.
   - Use historical analysis and interpretation to: identify issues and problems in the past, consider multiple perspectives of various peoples in the past, analyze cause-and-effect relationships and multiple causations, and evaluate the influence of the past on contemporary issues.
   - Use historical research to: formulate historical questions, obtain historical data from a variety of sources, support interpretations with historical evidence, and construct analytical essays using historical evidence to support arguments.

- Analyze the survival and reproductive success of organisms in terms of behavioral, structural, and reproductive adaptations.
- Explain various ways organisms interact with each other and with their environments resulting in stability within ecosystems (and within cultures).
- Explain how the environment can influence the expression of genetic traits.
- Explain the historical development and changing nature of classification systems.
- Analyze the classification of organisms according to their evolutionary relationships (including dichotomous keys and phylogenetic trees).

From NC Essential Standards High School World History and Biology Curricula.

4. **Concept Goal**: To understand how nature influences culture.

   Students will be able to…

   - Analyze the impacts insects have had on both ancient and modern human cultures.
   - Make predictions about ethnoentomological impacts by creating a previously nonexistent insect to fill a niche in human society.

Assessment Plan

Formative Assessments:

- Lesson 1:
    - KWL Chart: As students learn about insects, particularly on Days 1 and 3 of the unit, they will add to their Know/Want to Know/Learn chart. For example, after the gallery walk at the end of Lesson 1, students will record what they have learned from each others' compare-and-contrast posters on insect orders. These sticky notes can be added to the chart in the Learned section.
    - Insect traps: Each day, students will check their insect traps and bring specimens inside to analyze. They will present their findings to each other, using their own graphic organizers and other resources to justify their findings.
    - Anchor charts: Students will create their own anchor charts comparing and contrasting different orders of insects, in order to show understanding of insect anatomy.
- Lesson 2:
    - Think-pair-share: Students will brainstorm, then partner-share, then discuss as a class the major aspects of human cultures. While they are talking, teacher will circulate to hear their conversations.
    - Pair presentations: Students will collaborate in pairs to research an ancient culture and the insects that influenced it. The teacher will be able to formatively assess their research and summarizing skills while supporting them.
- Lesson 3:
    - Students will synthesize learning in a Socratic seminar. Teacher will be able to evaluate their ability to actively listen to their peers, along with their understanding of the essential understanding so far.

Summative Assessment:

- Lesson 4:
    - Students will use all content knowledge and process skills from the unit so far to create a unique "insect." This product is summative because it asks students to use all skills, information, and concepts taught in this unit to create something new and demonstrate understanding.

Rosen: Final SPARK Unit 2017
Lesson Plans
Accompanying Slide Presentation

TEACHER NAME			Lesson #
Rosen			SPARK Day 1
MODEL	**CONTENT AREA**	**GRADE LEVEL**	
Bruner	**Insect types, culture**	**5-6**	
CONCEPTUAL LENS		**LESSON TOPIC**	
Nature		**Insect classification (cladistics) and the job specifications of an entomologist**	
LEARNING OBJECTIVES (from State/Local Curriculum)			
n/a			
THE ESSENTIAL UNDERSTANDING (What is the overarching idea students will understand as a result of this lesson?		**THE ESSENTIAL QUESTION (What question will be asked to lead students to "uncover" the Essential Understanding)**	
Nature shapes culture.		**How does nature shape culture?**	
CONTENT KNOWLEDGE (What factual information will students learn in this lesson?)		**PROCESS SKILLS (What will students be able to do as a result of this lesson?)**	
Students will know... ● Basic classifications for insects and a few major orders of insects - see resources below ● Classifications of taxonomy (Kingdom Phylum Class Order Family Genus Species) ● Essential body plans of insects: 3 pairs of legs and 3 body parts (thorax, abdomen, head)		Students will be able to... ● Articulate basic anatomy of insects in order to classify them and determine qualities of different families ● Determine if an animal is an insect and explain their reasoning ● Evaluate common insect orders to determine commonalities and differences	

GUIDING QUESTIONS What questions will be asked to support instruction? Include both "lesson plan level" questions as well as questions designed to guide students to the essential understanding		
Pre-Lesson Questions:	**During Lesson Questions:**	**Post Lesson Questions:**
● What do you think of when you think of insects? ● Where do you see insects in your daily life? What do they look like? What are they doing? ● How can you tell if an animal is an insect? ○ What are the rules that tell us this? ● What roles do you see insects play in their environment? ○ What other animals play these types of roles? ○ What are some roles (positive and negative) that insects play in human culture?	● What do you observe about this insect? ○ What does that tell you might be true about its environment? ● What do entomologists do? ● What kind of tools do entomologists use? ● Where do entomologists work, and why? ● What might entomologists need to know for their job? ● What common characteristics do insects have? ● What makes these two insects different? ● What are the different ways we can group insects? ● Why would these particular insects be grouped together? ● Why do you think we still include caterpillars in the rule of 3? (because we group by adult forms only) ● Do all insects look the same as when they are born, and why? ○ How do we classify insects, knowing this? ● What are some ethical challenges entomologists might face, especially considering how most people view insects?	● Why are these insects grouped together? ● Why are caterpillars insects if they don't follow the rule of 3? ● Why do we classify insects by their adult bodies only? ● How do we identify insects that are not adults? (sometimes impossible without equipment) ● What tools do entomologists use to help them identify insects? (microscopes, collecting tools) ● How does nature shape culture? ● Now that you have studied many different kinds of insects, how has your view of them changed? Articulate how nature (insects) has shaped your view of the world.

DIFFERENTIATION (Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.			
Content	**Process**	**Product**	**Learning Environment**
Content is specialized; learners have chosen class.	Lesson contains lots of hand-on learning outside (kinesthetic) and includes many visual representations and graphic organizers (visual)		

PLANNED LEARNING EXPERIENCES
(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)

Engage and Connect - This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.

1. Students will be asked to make a name card for themselves and introduce themselves by their name, age, school, and why they are interested in this class, as well as their favorite insect. (15 minutes)
2. Teacher questions students on where they have seen insects before, what they are doing, etc. (pre-lesson questions). (20 minutes)
    a. While students are responding, one student will start a KWL chart on a large poster to record students' responses. Responses will be recorded in the "Know" section.
    b. Students will then answer, "What do you not know about insects that you would like to know?" and student scribe will record their answers in the "Want to know" section of the chart.

Explore - In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.

3. Teacher will project visuals of many common insects (list in links) and ask students to offer commonalities and differences (during lesson questions). Each student will also receive a color card with a different common insect that represents an important insect order printed on it. (30 minutes)
    a. **Teacher will frame this part of the lesson as "entomology training," and refer to the during lesson questions. The information taught in this part of the lesson is vital to the research of the students as budding entomologists.**
    b. While students are offering answers, teacher will visually organize their answers on a large graphic organizer that reveals the family tree and organizations of insect taxonomy.
    c. As discussion progresses, students will one at a time move to the large paper with the graphic organizer and glue down their insect card, as well as label the Latin and common name of the order. (Teacher has a key.)
    d. By end of discussion, class will be gathered around the graphic organizer with all 12-15 major orders labeled and displayed on the graph.
    e. Students and teacher will brainstorm any major insects that occur in certain families that may have been missed (ex. bees, ants, and wasps are in the hymenoptera family and should all be included).

Explain - Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.

4. Students will hang the graphic organizer on the wall as a reference (and to add to it as the week progresses), then go outside to start collecting bugs (20-30 minutes).
    a. Teacher will explain: students are about to build a pitfall trap so that they can catch native bugs and study them. **This is a vital step in becoming entomologists, as all researchers must perform field work to study their chosen insect species.**

b. Students will circle around teacher and learn how to build a pitfall trap: They will dig a hole outside, somewhere that will be out of the way, and insert one solo cup each into the ground. The cups will be evenly spaced in the same area, and the lip of each cup will be at ground level. Each cup will also have a cotton ball with alcohol on it so that it will kill any bugs that fall into it.
    i. *Teacher will be careful to guide students to dig traps away from landscaped areas of grass.*
c. Students will place a little grass across the lip of each jar to disguise it and plant a small sign in the ground ("Caution! Entomologists at work! Look for holes!").
d. If possible, outreach PhD entomology students from NC State may be involved to bring more outreach specimens for students to meet!

Elaborate —Allow students to use their new knowledge and continue to explore its implications. At this stage students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways

5. Students will return to classroom and work in pairs to complete anchor charts **detailing the major aspects of insect anatomy, and compare and contrast the anatomy of at least two insect orders studied today** (see "during- and post-lesson questions") (20 minutes)
    a. Teacher will question students as they work to ensure understanding of the basic anatomy of insects.
    b. Students will have freedom to decide design and organization of information on posters; they may want to draw rough drafts or lists in their notebooks before they start.
    c. Students will hang anchor charts to reference throughout the week.
    d. Students will complete a **gallery walk** and leave post-its commenting on each other's anchor charts before leaving.
        i. Each student must comment on each anchor chart at least once and respond to at least two other comments.
        ii. Prompts: see PPT

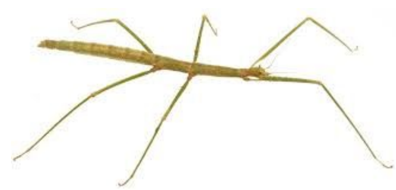
Evaluate: This phase assesses both learning and teaching and can use a wide variety of informal and formal assessment strategies.

6. Exit Ticket: students will finish answering post-lesson questions in their field notebooks before leaving. Teacher will respond to students' writings tonight.
    iii. Why are [these insects] grouped together?
    iv. Why are caterpillars insects if they don't follow the rule of 3?
    v. Why do we classify insects by their adult bodies only?
    vi. How do we identify insects that are not adults? (sometimes impossible without equipment)
    vii. What tools do entomologists use to help them identify insects? (microscopes, collecting tools)
    viii. **How does nature shape culture?** Now that you have studied many different kinds of insects, how has your view of them changed? Articulate how nature (insects) has shaped your view of the world.

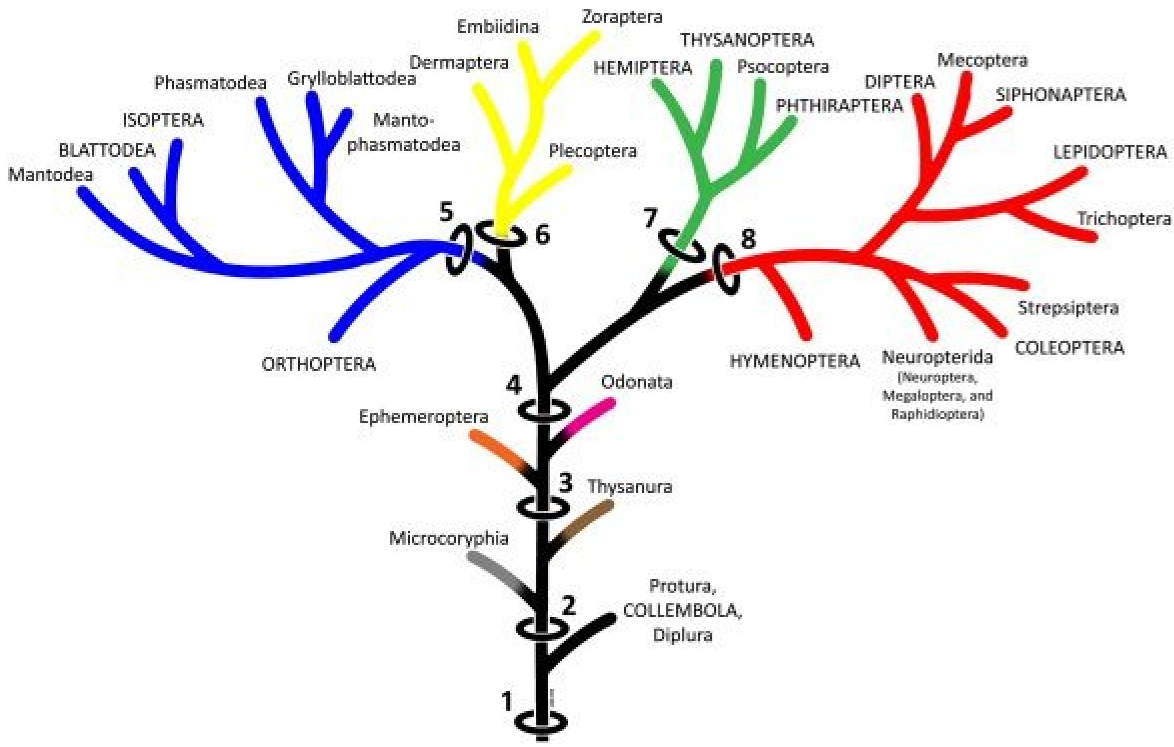
Materials needed:

- Classroom supplies:
    - 15 sheets construction paper
    - 2-4 packs of markers
    - 6-12 glue sticks or 1-2 bottles elmer's glue
    - 1 set post-it notes
    - 1 pack pencils or pens for students to write (pencil sharpener?)
- Bug trap supplies:
    - Small containers for caught bugs each day--mason jars?
    - 15 solo cups
    - 1 bag cotton balls
    - 1 small bottle rubbing alcohol
    - If obtainable by donations: butterfly nets
    - 3-5 small garden trowels for digging
    - Premade signs for pitfall traps (15 - teacher will make ahead of time, students will label)
        - 15 popsicle sticks
        - 15 pieces construction paper
        - Duct tape - 1 roll
- Large sticky note posters
    - One set up as KWL chart for insects (blank)
    - One set up as a family tree for major insect orders (blank)
    - 8+ blank posters for students to outline major aspects of insect anatomy
- Printed materials:
    - 15 color printed cards with different common insects on them
    - **Field guides for students with at least 2-3 examples of major species in each major order of insect**
- Teacher materials:
    - Key for photos, common name, and Latin name of 12-15 common insects on students' cards
    - Key for list of traits of insect anatomy - in PPT
    - Key for graphic organizer: family tree and organization of insect taxonomy (major insects)
    - Teacher notes as a quick reference

KEY: Insect Cards and Names

 Beetles (Coleoptera)	 Cockroaches: (Blattodea)	 Dragonflies and Damselflies (Odonata)
 Wasps, bees, and ants (Hymenoptera)	 True Bugs - (Hemiptera)	 Butterflies and Moths (Lepidoptera)
 Flies (Diptera)	 Grasshoppers, Katydids, crickets (Orthoptera)	 Lacewings, (Neuroptera)
 Praying mantis (Mantodea)	 Mayfly (Ephemeroptera)	  Stick and leaf bugs (Phasmida)

KEY: Insect family tree



Name ____

My Field Guide to Insects

Main Source: https://www.exploringnature.org/graphics/entomology/insect_orders(3-6%20grade).pdf

1) Beetle Order – Coleoptera

Examples of Families:

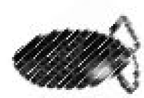
- Dung Beetle Family
- Ground Beetle Family

- Long-horned Beetle Family

- Ladybird Beetle Family

- Giant Water Bug Family
- Firefly Family

- Whirligig Beetle Family



The order Coleoptera includes the beetles. This is the largest order that contains the most species.

Wings: They have two pairs of wings. The outside pair (forewings) are hard and protective. They are called elytra. They split and spread when the insect needs to fly so the soft wings underneath (hind wings) can be used.

Mouth Parts: Most have chewing mouthparts. Some have piercing mouthparts.

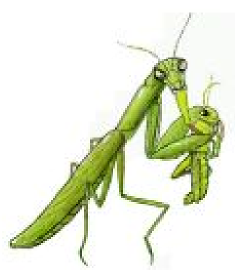
Metamorphosis: They undergo complete (complex) metamorphosis.

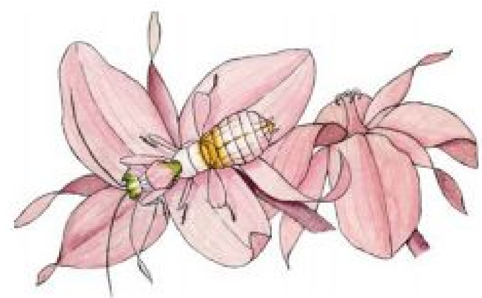
Significance to Humans: They can be beneficial (i.e. ladybugs), but some families attack food crops and are considered pests.

2) Mantid & Cockroach Order – Dictyoptera

Examples of Families:

- Praying Mantis Family
- Orchid Mantis Family
- Cockroach Family





They have long, thin antennae with many segments.

Wings: They usually have two pair of wings. The forewings are often adapted as tougher coverings and held flat over the back. Some lack wings.

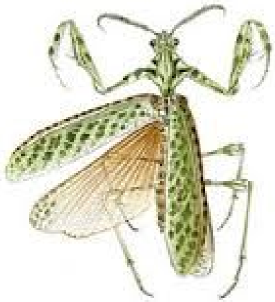
Mouth Parts: They have biting mouthparts.

Metamorphosis: They undergo incomplete (simple) metamorphosis with the nymphs looking like small versions of the adults (with underdeveloped wings).

Significance to Humans: Though some are considered pests (cockroaches), many are beneficial (praying mantis) preying on other pest insects.

***Note: Mantids and Cockroaches have recently been reclassified by taxonomists. They now form two separate orders:**

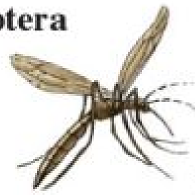
Praying mantis (Mantodea) **Cockroach (Blattodea)**



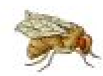
3) True Fly Order - Diptera

Examples of Families:

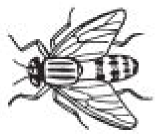
- Mosquito Family



- Fruit Fly Family



- Horse Fly Family



- House Fly Family

These are known as the true flies.

Wings: They have one pair of wings - the hind wings are adapted structures called halterers, which may help with flying.

Mouth Parts: They have piercing and sucking mouthparts. Some are parasites.

Metamorphosis: They undergo complete (complex) metamorphosis.

Significance to Humans: They are considered serious pests. They destroy crops and spread many diseases, including malaria.

4) Butterfly & Moth Order – Lepidoptera

Examples of Families:

- Swallowtail Butterfly Family
- Sulfur Butterfly Family
- Monarch Butterfly Family
- Copper and Blue Butterfly Family
- Mourning Cloak, Painted Lady, Checkerspot (brush-footed) Butterfly Family
- Luna Moth Family
- Sphinx Moth Family
- Isabella (wooly bears) and Tiger Moth Family

Swallowtail

Sulfur

Monarch

Blue

Mourning Cloak

Luna Moth

Sphinx Moth

Isabella Moth

Butterflies and moths are showy and well-known insects. Butterflies are more commonly active in the daytime as opposed to the more nocturnal moths. Moths have more feathered antennae and hairier bodies than butterflies. Both have larvae that can be destructive to trees and food crops.

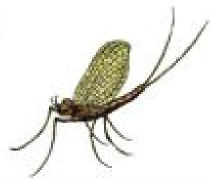
Wings: As adults they have two pairs of large wings covered with protective scales.

Mouth Parts: Adults have sucking mouthparts. Larvae (young stages) have chewing mouthparts.

Metamorphosis: They undergo complete (complex) metamorphosis.

Significance to Humans: Their young form (larval caterpillars) are considered serious pests and are responsible for crop destruction. Adults, on the other hand, can be beneficial pollinators.

5) Mayfly Order – Ephemeroptera



Examples of Families:

- Mayfly Family

Adults only survive for a couple of day to mate and lay eggs. They hatch from underwater larva and fly above the water, mate, lay eggs and die. They have long thread-like legs and two long tail strands.

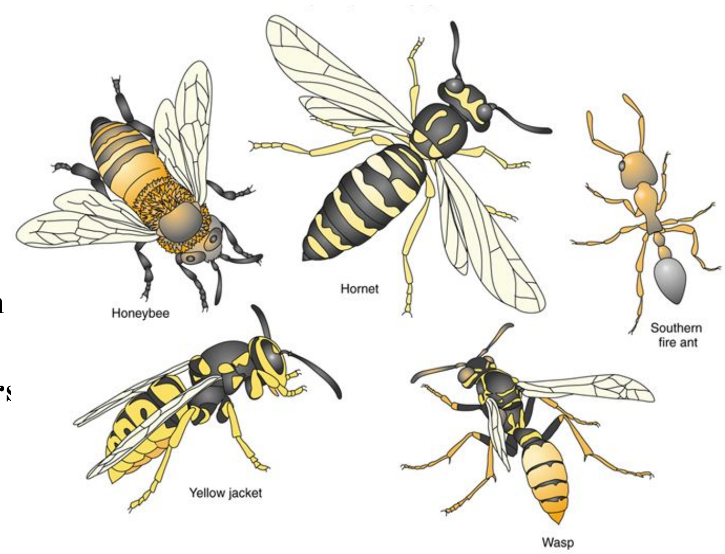
Wings: They have two pairs of triangle-shaped wings - the hind wings are much smaller.

Mouth Parts: Adults do not eat, so have no mouthparts.

Metamorphosis: They undergo incomplete (simple) metamorphosis.

Significance to Humans: They are harmless to humans and fishing flies made to look like them have helped many fishermen catch fish!

6) Bee, Wasp & Ant Order – Hymenoptera



Examples of Families:

- Ant Family
- Wasp, Yellowjacket, Hornet Family
- Bee Family

Many have a narrow "waist" between the thorax and abdomen. Many form colonies with distinct roles, such as honeybees and true ants. These insects have developed regimented social systems in which members are divided into worker, drone, and queen castes. Not all hymenoptera are social, however; many live a solitary life, coming together only for a brief mating.

Wings: Some are have wings (two pairs) and some are wingless.

Mouth Parts: Many have chewing mouthparts (ants), though some have sucking mouthparts with tongues (honeybees).

Metamorphosis: Complete/complex (worm-like larval stage and inactive pupal stage where insects look nothing like the adults, followed by maturity).

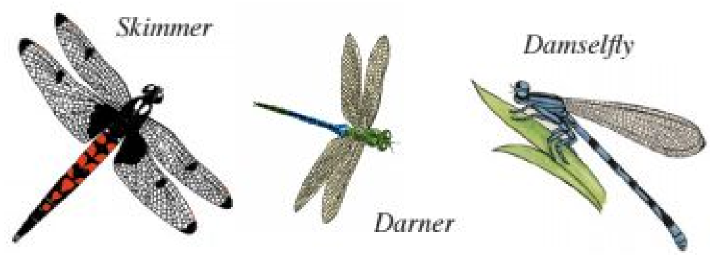
Significance to Humans: Though some have painful and venomous stings (wasps), many are very important and beneficial pollinators of flowers and crops (bumblebees). Flowers pollinated by bees are typically yellow or blue and often have patterns visible only under ultraviolet light, which bees can see.

Other plants may be pollinated by ants, or may rely on ants living within them to keep predators away. Many of these plants produce large quantities of nectar, or produce other fluids for the ants.
Less well-known, but equally spectacular, are the various families of parasitoid wasps; parasitoids lay eggs in living hosts, often other insects, which hatch into larvae that feed on the host's tissues before emerging. Such treatment typically kills the host; parasitoids are attracting interest as natural controls on insect pests. Other wasps parasitize the eggs or larvae of other insects, such as the wasp below, which is shown emerging from the egg of a hemipteran that was parasitized.

7) Dragonfly Order – Odonata

Examples of Families:

- Skimmer Dragonfly Family
- Darner Dragonfly Family
- Damselfly Family



Their young (larvae) are called naiads and live in the water (aquatic), so adults are found around wet areas, where they will mate and lay eggs. They are predators with large eyes for spotting prey and strong flight for catching prey. Dragonflies hold their wings flat and out from their bodies, while damselflies hold their wings together and pulled into the body.

Wings: They have two pairs of long wings.

Mouth Parts: They have chewing mouthparts. Naiads have piercing mouthparts for catching underwater prey.

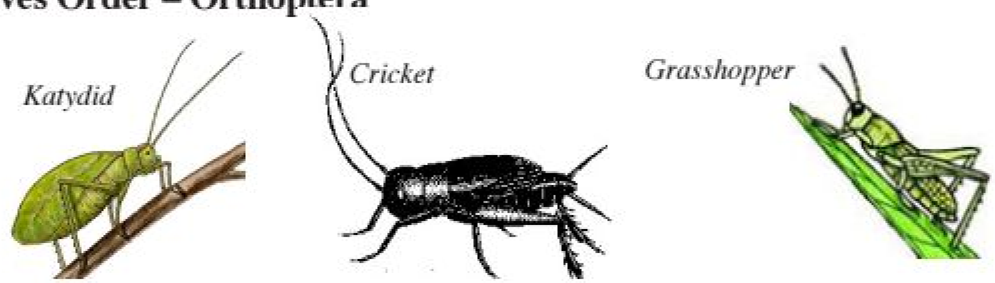
Metamorphosis: They undergo incomplete (simple) metamorphosis.

Significance to Humans: They feed on insects (especially mosquitoes), so are considered beneficial.

8) Grasshoppers & Relatives Order – Orthoptera

Examples of Families:

- Katydid Family
- Cricket Family
- Grasshopper Family



Their back legs are usually large and built for jumping.

Wings: They have two pairs of long wings, though some have no wings.

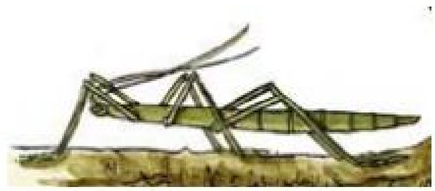
Mouth Parts: They have chewing mouthparts.

Metamorphosis: They undergo incomplete (simple) metamorphosis with the nymphs looking like small versions of the adults (with underdeveloped wings).

Significance to Humans: They can be very destructive to crops.

9) Stick & Leaf Insect Order – Phasmida

Examples of Families



- Common Walkingstick Family

They have very long, stick-like bodies with long legs and antennae. They are so well camouflaged that they move slowly on their food plants and are rarely seen by predators.

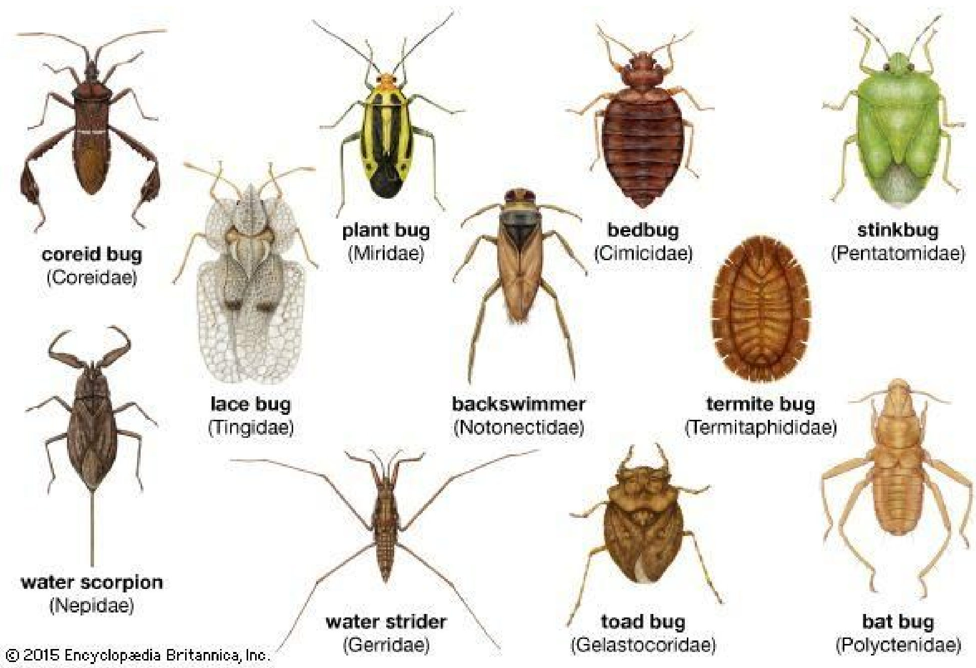
Wings: Most adults in North America are wingless (tropical forms may have wings).

Mouth Parts: They have chewing mouthparts.

Metamorphosis: They undergo incomplete (simple) metamorphosis with the young looking like small versions of the adults.

Significance to Humans: They can be very destructive to some tree species.

10) True Bugs -- Hemiptera



Examples of Families

- **Shieldbugs**
- **Plant bugs**
- **Bed bugs**
- **Stink bugs**
- **Pondskaters**
- **Cicadas**
- **Water bugs**
- **Aphids**
- **Scale insects**

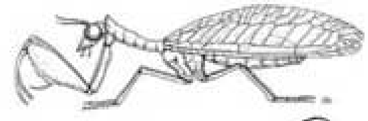
True bugs are a very large order. They are called "true" bugs because most people tend to call all insects "bugs." There are 75,000 species of true bugs. They often have antennae divided into a small number of segments, and some true bugs resemble beetles - however, true bugs' wing covers overlap, unlike beetles.

Wings: After undergoing incomplete metamorphosis, true bugs have wings as adults. Their front wings can be somewhat hardened.
Mouth Parts: Piercing so that they can suck the juices from plants or animals (usually plants). Mouth parts are contained in a beak called a *rostrum*, usually hidden underneath the body when not in use.
Metamorphosis: They undergo incomplete (simple) metamorphosis, with the young looking like small versions of the adults.
Significance to Humans: Many common pests are true bugs, and can damage agricultural crops or infest homes. For instance, aphids damage crops and can transmit viral diseases within crops. Some true bugs transmit diseases, such as chagas (transmitted by the kissing bug). Most bugs are not pests, however.

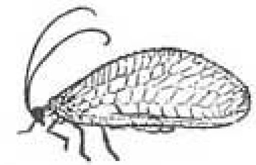
11) Lacewings -- Neuroptera

Examples of Families:

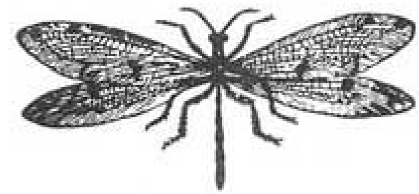
- **Lacewings**
- **Antlions**
- **Mantidflies**



Mantidfly



Lacewing



Antlion

Lacewings are delicate looking, soft bodied insects with a wingspan ranging in size from 5 to 150 millimetres and a body up to 50 millimetres in length. As their name suggests their wings appear lace-like with many intricate veins across their entire surface. Lacewings have elongate, soft bodies, relatively large compound eyes, and often long, filiform antennae, which may be clubbed in some species.
Wings: 2 pairs of membranous wings of relatively equal size. Complex wing venation with main vein forked along the bottom edge of the wing. Wings are held tent-like over the body when at rest.
Mouth parts: Mandibulate.
Metamorphosis: Complete. The larvae of lacewings, many of which are commonly known as antlions, appear very different from the adults and vary greatly in shape and size depending on the species. The larvae are grub-like with large jaws projecting from the front of the head, which are used to seize prey.
Significance to Humans: Humans have attempted to use Neuroptera in biological control of insect pests without much success. Ancient cultures have depicted neuroptera. The New Guinea Highland people claim to be able to maintain a muscular build and great stamina despite their low protein intake as a result of eating Neuroptera among other insects.

Glossary

Abdomen: the rear section of the three major body divisions, located at the end of the thorax.
Aestivate: to pass the summer in a dormant or torpid state.
Book lung: respiratory organ in many arachnids consisting of many thin folds of membrane resembling the leaves of a book.
Calcareous: consisting of or containing calcium carbonate, calcium, or limestone.
Carnivores: animals that feed on the flesh of other animals.
Caste: a distinct type of body form within a colony of social insects e.g. soldier, worker, queen.
Caterpillar: a soft bodied larva with a number of prolegs or false legs on the abdomen in addition to the six true thoracic legs. Usually refers to the larvae of moths and butterflies.
Cellulose: the substance which makes up the essential parts of tissues and fibres in plants, wood, linen and paper.
Cephalothorax: the front body section of arachnids and some crustaceans which consists of the fused head and thorax.
Cerci: a pair of jointed appendages on the tip of the abdomen of insects and other arthropods.
Chelicerae: the first pair of fang-like appendages near the mouth of an arachnid, often modified for grasping and piercing.
Cocoon: a protective case often of silk or similar fibrous material forming a natural protective covering or structure around such things as the pupae or eggs of some invertebrates.
Complete Life Cycle: the growth cycle where the young have a different form from the adults and undergo a

pupal stage to become the adult. Stages usually consist of egg-larvae-pupa-adult.
Compound eyes: eye which consists of many light-sensitive lens, each with its own refractive system and each forming a portion of an image.
Cribellum: a sieve-like organ of some spiders which is used for spinning a special kind of silk.
Cuticle: hardened or membranous protective layer covering the body of many invertebrates especially arthropods.
Elytra: the hardened forewings used to protect the membranous hind wings of insects in the order Coleoptera (beetles and weevils).
Entognathous: having the mouthparts in pockets or oral folds from which they can be protruded when feeding.
Ethyl alcohol: distilled alcohol made from grain and often used in medicines, colognes, cleaning solutions and rocket fuel .
Femur: (pl: femora) the third of five segments of an insect's' leg and is often the largest segment.
Filamentous: (filiform) thin and thread-like.
Furca: any fork-like structure; esp. in reference to the fork-like 'tails' of Collembola.
Glycerol: a syrupy, sweet, colourless or yellowish liquid obtained from fats and oils and often used in cosmetics, liquid soaps, inks, and lubricants or as a sweetener or antifreeze.
Halteres: small club-shaped structures that vibrate and act as gyroscopic stabilisers. They are the reduced hind wings of insects in the Diptera order.
Herbivores: animals that feed on plants.
Hermaphrodite: an animal or plant; having both male female reproductive organs.
Hexapod: six legged
Incomplete Metamorphosis: where the young develop gradually, appearing similar to the adults and do not undergo a pupal stage.
Instar: refers to one stage of growth between moults, e.g. 3 larval instars (or growth stages) before an insect's pupates. The number of larval instars varies between insects and may range from 3 to 30.
Isopropyl alcohol: is a clear, colourless liquid with a bitter taste and a smell of acetone. Often used in rubbing alcohol, household cleaning products and antifreeze.
Larva: (larvae) the immature stage of most insects. Usually grub-like in appearance.
Mandibles: the jaws of an insect which consist of the upper chewing pair of mouthparts, sometimes modified into other shapes.
Mandibulate: biting or chewing mouthparts.
Membranous: transparent, usually referring to the flying wings of insects.
Mesonotum: the upper surface covering the middle segment of the thorax of insects.
Metamorphosis: a change in the appearance or function of a living organism, by a natural process of growth or development.
Monofiliform: of bead-like appearance, usually in reference to the shape of antennae.
Moult: to shed the hard outer skin of an invertebrate during growth.
Nocturnal: being most active during the night.
Nymph: the immature stage of certain species of insects. Nymphs usually resemble their parents but are mostly smaller and lack wings.
Ocellus: (pl: ocelli) simple eye consisting of a single lens. Simple eyes often occur in patterns of three in many insects.
Omnivore: an animal that feeds on both animal and vegetable matter.
Ootheca: an egg case of some insects and molluscs which is formed by the hardened of a sticky substance secreted from a special organ known as the colleterial gland.
Ovipositor: tubular apparatus, usually concealed but sometimes extending some length outside the end of the abdomen, with which many female insects deposit eggs.
Parasite: (vrb: parasitise) an organism that feeds on or in a different organism while contributing nothing to the survival of its host.

Parasitoid: a term which is applied to insects whose larvae are parasites of other insects and eventually kill the host.
Pedipalps: one of the second pair of jointed appendages near to the mouth arachnids that are modified for reproductive, predatory, or sensory functions.
Pheromone: a chemical secreted by an animal, especially insects that influences the behaviour of other animals of the same species. Often used as an attractant for the opposite sex.
Phloem: the food-conducting tissue of vascular plants.
Plumose: having feathers or feather-like growths or resembling a plume.
Predators: an organism that exists by preying on other living organisms.
Preorally: before or in front of the mouth.
Prepupa: an inactive stage just before the pupal stage in the development of some insects.
Proboscis: the lengthened mouthparts which are modified to form a tube for piercing and sucking, or other specialised ways of feeding. This term may also refer to the coiled feeding tube of moths and butterflies. See rostrum also.
Prolegs: small, short leg-like appendages on the abdomen of some caterpillars that assist in locomotion.
Pronotum: the upper surface of the first segment of the thorax of an insect. May be enlarged to form a shield over the rest of the thorax.
Pupa: (pl: pupae) a non-feeding and relatively inactive stage between the larvae and adults stages of insects with a complete life cycle. Often referred to as a chrysalis in butterflies and moths.
Pupating: (pupate) to go through the pupal stage. See Pupa.
Radula: a flexible tongue-like organ in some molluscs that consists of rows of horny teeth on the surface.
Raptorial: adapted for catching and holding prey. They usually have sharp claws and spines or bristles.
Rostrum: the elongated piercing and sucking mouthparts of all species in the Hemiptera. Also applied to the snout of weevils (Curculionidae). See proboscis also.
Scape: the first and usually the largest segment of the antennae.
Scavengers: an animal that feeds on dead or decaying material.
Sclerotised: hardened or toughened tissue, like the elytra of a beetles forewing.
Spermatophore: a packet or capsule containing spermatozoa which is produced by the male to be transferred to the female for fertilisation.
Spinnerets: tubular structures found on the end of the abdomen of spiders and some insect larvae (e.g. silkworms) that secrete silk threads from which they form webs or cocoons.
Symbiotic: a relationship between two or more different organisms of different species that does not necessarily benefit each member.
Tarsus: (pl: tarsi) the last of the five sections of an insect's' leg, i.e. "the foot". The tarsus itself is also divided into five parts.
Thorax: the middle section of the three major body divisions, located between the head and the abdomen. The wings and legs are all appendages of the thorax.
Tibia: the fourth of five segments of an insect's' leg, usually the longest segment and is often thin, straight or slightly curved and may have spines.
Uropods: one of the last pair of appendages on the end of the abdomen of certain crustaceans, such as the lobster or slater.
Xylem: the supporting tissues and water-conducting tissue of vascular plants.

Teacher Notes: Ethnoentomology

Common insect orders:

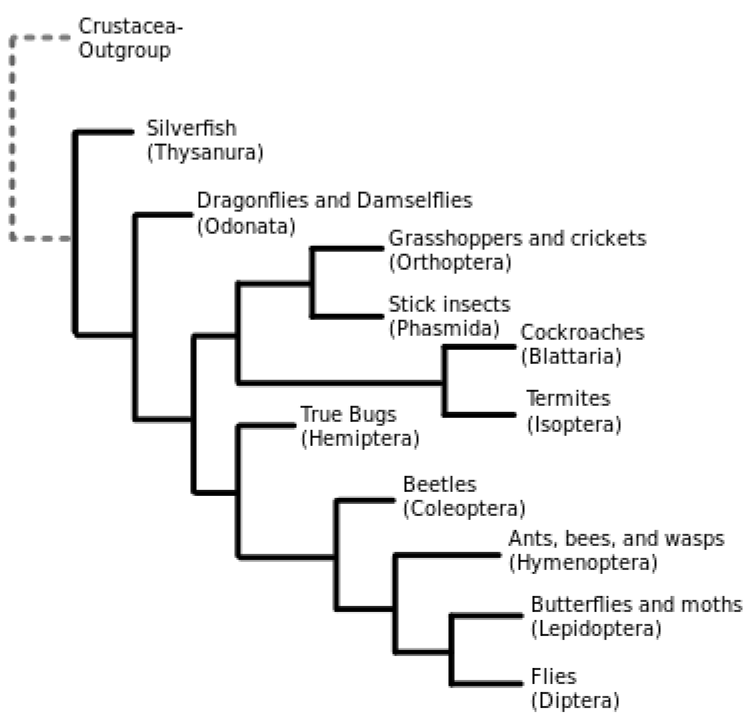
1. Beetles (Coleoptera)
   a. Scarab beetles (Scarabaeidae)- this is one of the larger families with a lot of iconic members but the green june beetle (Cotinis nitida) is an easily found native, as well as the Japanese beetles (Popillia japonica) which are not native but abundant around here
   b. Fireflies (Lampyridae) - a much smaller family than scarab beetles but pretty easily identifiable by their signature luminescent features. Photinus carolinus is a synchronous species, meaning that they blink together, that is found in the mountains of NC
2. Cockroaches: (Blattodea)
   a. American Cockroach (Periplaneta americana) also known as a "Palmetto bug", and probably native to Northern Africa
   b. German Cockroach (Blatella germanica) - also native to northern Africa, and also one of worst household pests.
3. Dragonflies and Damselflies (Odonata)- every species of dragonfly has a unique common name, which is really unusual
   a. Common Green Darner dragonfly (Anax junius) - one of the most common in the US
   b. Skimmers dragonflies (family: Libellulidae) Common family of dragonflies, often with brown and white wings. THey're found around ponds in the summer.
4. Wasps, bees, and ants (Hymenoptera)
   a. Ants (family: formicidae)
   b. European Honey bee (Apis Mellifera)
5. True Bugs - (Hemiptera)
   a. Cicadas (family: Cicadidae) Spend most of their lives under ground and then emerge as adults. We have yearly and periodical cicadas, which often emerge on 13 year, or 17 year intervals depending on the species
   b. Stinkbugs (family: Pentatomidae)
6. Butterflies and Moths (Lepidoptera)
   a. Eastern Tiger Swallowtail butterfly (Papilio glaucus) - commonly found around here
   b. Luna Moth (Actias luna) - native to the area but they aren't very common
7. Flies (Diptera)
   a. House flies (Musca domestica) - important because it's a common household pest and can transmit diseases
   b. Mosquitoes (family: Culicidae) - a common member that we find here is the invasive Asian Tiger Mosquito (Aedes albopictus)
8. Grasshoppers, Katydids, crickets (Orthoptera)
   a. Southeastern Lubber grasshopper (Romalea guttatus) - commonly found in the southeastern US, as its name implies
   b. Short-winged green grasshopper (Dichromorpha viridis) this species has two color forms. It's a member of the Acrididae family, which are names for their short antenna). Lubber Grasshoppers have longer antenna and tend to be bigger.
9. Lacewings, (Neuroptera)
   a. Green lacewings (family: Chrysopidae) the adults are really common at porch lights and the immatures are vicious predators of soft-bodied insects
   b. Mantisflies (family: Mantispidae) These are not very common but I have seen a few in North carolina. They look like a mix of a lacewing and a praying mantis.
10. Praying mantis (Mantodea)

a. Carolina Mantis (Stagmomantis carolina) - Native mantis. It's brown and often difficult to spot.
b. Chinese mantis (Tenodera aridifolia sinensis) - invasive species that is fairly common in the US

http://evolution.berkeley.edu/evolibrary/teach/68fundamentals.php

KPCOFGS - most insect ID is just getting down to families, not specifics (ex. Cockroaches are a family, butterflies are a family (lepidoptera is order which includes butterflies and moths), fireflies are a family, beetles are a huge families)

- **Do a few supporting anchor charts with examples, especially those that differ between family and order**
- **Field guide to insects**
- **https://www.exploringnature.org/db/view/662**
- **Remember that taxonomy is always shifting - groups as high as order change regularly**
- **We have usually done taxonomy by looking at animals via morphological features (ex. Hairs, veins on wings - not color, but this can be an indicator; not fluid features) → now we have DNA testing so we can verify which species are connected and how**
- **Species = animals that can mate and produce offspring**
- **Use Bug Guide website - most entomologists use it for taxonomy, has wiki moderators**
- **http://www.ducksters.com/science/scientific_classification.php**
- **http://evolution.berkeley.edu/evolibrary/article//arthropods_02 - has list of**



TEACHER NAME	Lesson #
Rosen	SPARK Day 2

MODEL	CONTENT AREA	GRADE LEVEL
Taba Concept Development	Insects in ancient cultures	5-6

CONCEPTUAL LENS	LESSON TOPIC
Nature	History of insects in ancient human cultures

LEARNING OBJECTIVES (from State/Local Curriculum)
n/a

THE ESSENTIAL UNDERSTANDING (What is the overarching idea students will understand as a result of this lesson?	THE ESSENTIAL QUESTION (What question will be asked to lead students to "uncover" the Essential Understanding)
Nature shapes culture.	**How does nature shape culture?**

CONTENT KNOWLEDGE (What factual information will students learn in this lesson?)	PROCESS SKILLS (What will students be able to do as a result of this lesson?)
Students will know... ● Major aspects of cultures ○ Literature ○ Art ○ Politics ○ Music ○ Language ○ Clothing ○ Rituals and customs ○ Food ● How insects were part of ancient cultures ○ As medicine ○ As part of folklore ○ As part of war ○ As part of the economy ○ As a food source ○ As religious/ritualistic/sacred symbols	Students will be able to... ● Explain how insects are part of modern-day life ● Compare and contrast the influence of insects in certain ancient cultures ● Predict how the influence of certain insects may have influenced other cultures (ex. in an alternative universe) ● Rank the major aspects of cultures in order from least to most important, and defend thinking to peers

<table>
<tr><th colspan="3">GUIDING QUESTIONS
What questions will be asked to support instruction?
Include both “lesson plan level” questions as well as questions designed to guide students to the essential understanding</th></tr>
<tr><th>Pre-Lesson Questions:</th><th>During Lesson Questions:</th><th>Post Lesson Questions:</th></tr>
<tr>
<td>● What makes cultures different from each other? What are the ways we tell cultures apart? What are ways cultures are similar?
● What do you think nature has to do with culture? How are they related?</td>
<td>● What do you think of when you think of culture?
● What are some major aspects of all human cultures?
● How do you think the major aspects of culture have changed through time? What clues do you have to tell you they have changed?
● How much of that change do you think insects have had? How could you find out more about this?
● How does nature shape culture?</td>
<td>● Level A:
○ How are insects part of modern-day life?
○ In what ways were insects part of ancient cultures?
● Level B:
○ What were the similarities and differences in how insects interacted with different ancient cultures?
○ How do you think the insect you studied may have influenced another classmate’s culture, or vice versa? (Ex. How might the Egyptian culture have been different if they viewed bees as more sacred? How would China have been different without the production of silk?)
● Level C
○ If you had to rank the major aspects of cultures in order from least to most important, how would you do it? Be prepared to defend your thinking to your peers.</td>
</tr>
</table>

DIFFERENTIATION (Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.			
Content	**Process**	**Product**	**Learning Environment**
Content is specialized; learners have chosen class.		Students will produce a visual presentation and participate in a verbal discussion, so will have two opportunities to show learning.	Students will be able to work alone or in pairs on their culture presentations.

PLANNED LEARNING EXPERIENCES
(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)

Engage and Connect - This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.

1. Teacher will introduce today's topic: human culture! (20 minutes)
    a. Students will have time to review the teacher's response to their journal writing yesterday in their notebooks, and answer the before-lesson question on the next page individually.
    b. **While students are working, TA will circulate with sign-up sheet for presentation topics. (see below)**
    c. After 5-10 minutes of writing time, teacher will ask students to now verbally brainstorm the major aspects of human culture (**during lesson questions**) and one student will record list on the board.
    d. Ideal list includes, but is not limited to: music, art, literature, religion, politics, language, cuisine, social customs or traditions
    e. Students will individually rank these aspects of human culture in order of importance on a guided worksheet.
    f. Students will turn and talk to the person next to them and compare and contrast their rankings. Each pair will then share out with the whole group. Teacher will facilitate the discussion as necessary. Students may come to the conclusion independently that all aspects of culture are important, and if not, teacher will offer guiding questions in that direction ("Why do we think some aspects of culture are more important? If your partner had different rankings, is there a definitive way to tell who's right?").

Explore - In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.

2. Students will choose an ancient culture that involved insects in a culturally relevant way and research on the impact of insects on that culture. (45 min-1 hour)
    a. Guided research - students will follow guidelines on a Google Classroom assignment that includes a rubric for the research and presentation.
    b. Students will work in groups of 2-3 based on interest
    c. Cultures they may choose from (see below for list and directions to students):
        - Scarab beetles in the Mediterranean (Greece, Egypt)
        - Crickets in ancient China
        - Spiders in ancient Greek or African folklore (students may choose; spiders are not insects, but we think about them as such. Include that in your presentation.)
        - Entomological warfare by Germans and Japanese in WWII
        - Silk production in China (Silk Road)
        - Honey bee products in many cultures

Explain - Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.

3. Students will finish researching and collaborate to produce 3-4 minute Google Slides presentations for their peers; during the presentations, peers will fill in graphic organizers as they learn about insects in ancient cultures, and have room to ask more questions to research afterward. (30 min to finish research and present)
    a. As students present, other students will play the roles of: timekeeper, concept recorder (filling in the graphic organizers to show development of thinking about insects in ancient cultures), and *idea listers* (adding to yesterday's Taba list of concepts related to entomological influence in ancient cultures).

Elaborate —Allow students to use their new knowledge and continue to explore its implications. At this stage students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways.

4. Students will share their learning from their projects by creating a more detailed Taba list as a class, answering the last during-lesson question:
- **How much influence do you think insects have had on human cultures?**
- **What aspects of human culture have insects influenced?**
- **How does nature shape culture?**

They may refer to the graphic organizers from the presentations, as well as their notes and field guides, to answer these questions and brainstorm. Then they will work in small teams to group the facts into at least four groups using a Taba graphic organizer. Teacher will emphasize that students can move facts between categories, and rename categories as they work, but may not place facts in multiple categories. Students will move and work in assigned groups of 3; they will not work with peers with whom they collaborated on their research projects (20-30 minutes).

a. *Students who enjoy kinesthetic learning strategies will be able to use index cards to write down concepts and manipulate them as they discuss grouping with their teams. If enough students are interested in using this tool, one person per team will be assigned as the "note taker" during the brainstorming phase.*
b. When students finish, teacher will use questioning of each group to determine how they made their grouping and labeling decisions (20 minutes).
   i. Is there any item that you could move to another group or put in multiple groups? If so, which one(s) and why? Explain your thinking.
   ii. Are there any groups you can subsume into another group? Why? Explain your thinking.
c. After this discussion, students will have another work session to regroup ideas and relabel groups. This time, they may have three groups, and may count items in multiple lists. (20 minutes)

Evaluate: This phase assesses both learning and teaching and can use a wide variety of informal and formal assessment strategies.

5. Teams of students will share out their regrouping changes and explain their thinking. Teacher will continue repeating students' ideas for clarity, having students explain each other's thinking, and using the after-lesson questions (including the EQ) to shape the conversation: **How does nature shape culture? and How do insects influence cultures differently?** (20-30 min)
   a. While discussion occurs, a student will record (on an **anchor chart**) big-picture concepts that students share (expected ideas: insects can influence all aspects of culture; they can have direct impact like in agriculture or clothing or food, OR indirect/conceptual impact on storytelling or art, etc).

6. Before wrapping up for the day, students will go outside to check their bug traps from yesterday and bring in any specimens to the classroom (10 minutes).

Materials needed:

- Printed:
  - Culture ranking worksheets (15)
  - Graphic organizers for students to take notes on while watching classmates' presentations (15)
  - Sign-up slips for students to rank their desired topics for presentation (students will not be able to see each others')
- Google Classroom assignment prepared
- 100 index cards
- Computers - 1:1
- Large chart paper for anchor charts

Student directions on Google Classroom for ancient culture presentations:

Create a presentation using Google Slides for your classmates. You and your partner(s) will attach your completed presentation to this assignment and submit. (Only one Slide presentation needs to be submitted for each group, by one person.) Each member of your group must speak during the presentation.

Your presentation must include:

- Name of insect (common and Latin), as well as its order
- Name, location, and approximate era of culture you researched (ex. "Ancient Rome: 753 BC to 476 AD")
- 3 facts about your insect
- An explanation of the impacts your insect had on the ancient culture
- A list of the aspects of culture that were impacted by the insect (ex. religion, economy, war, etc.)
- Plenty of visuals to help us understand your insect and your culture
- List of sources (this can be a list of hyperlinks on the last slide)

Below, you will find one source per topic to get you started in your research. Remember to use the research skills you have learned in school - especially when it comes to finding reputable sources!

Finally, although some topics do refer to specific insects, if you find a different insect in your research that also impacted your chosen culture, you may change your focus. Check with me first!

- Scarab beetles in the Mediterranean (Greece, Egypt): https://www.insects.org/ced1/beetles_rel_sym.html#egypt
- Crickets in ancient China: https://www.insects.org/ced3/chinese_crcul.html
- Spiders in ancient Greek or African folklore (spiders are not insects, but we think about them as such. Include that in your presentation.): http://www.ancient-origins.net/myths-legends/symbolic-spider-wove-its-way-through-history-002215?nopaging=1
- Entomological warfare (you choose the culture): http://www.montana.edu/historybug/insects-as-bioweapons.html
    - You may choose a more modern culture for this topic; WWII saw a lot of entomological warfare.
- Silk production in China (Silk Road): http://www.festival.si.edu/2002/the-silk-road/the-silk-road-connecting-peoples-and-cultures/smithsonian
- Honey bee products in many cultures (you choose the culture): http://andrewgough.co.uk/articles_bee1/

Name ___________________________________

Human Cultures

Rank the aspects of human culture that we have brainstormed in order from most important (1) to least important. Next to each one, you must justify your thinking: why did you place this piece of human culture here?

Ranking	**Part of Human Culture**	**My Justification**
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		

Part II: Talk to a partner and compare your rankings. Explain your reasoning to each other. Use these questions to guide the discussion.

- What were your criteria for rankings? How did they differ from your partner's criteria?
- If your partner had different rankings, is there a definitive way to tell who's right?
- Why do we think some aspects of culture are more important?
- How do you think the major aspects of culture have changed through time? What clues do you have to tell you they have changed?

Part III: Decision Making Matrix

In each empty box, fill in your rating for the aspect of culture, from 1 (least impactful) to 5 (most impactful). Then find your total score for each aspect. How does this list now compare to your original rankings?

Aspect of Culture	**Criterion 1:**	**Criterion 2:**	**Criterion 3:**	**Criterion 4:**	**Total:**

Name ___________________________________

Insects in Ancient Cultures: Graphic Organizer

Insect	Ancient Culture	3 Facts about the Insect	Impact of Insect on the Culture	Aspects of Culture Involved

Insect	Ancient Culture	3 Facts about the Insect	Impact of Insect on the Culture	Aspects of Culture Involved

<table>
<tr><th colspan="3">TEACHER NAME</th><th>Lesson #</th></tr>
<tr><td colspan="3">Rosen</td><td>SPARK Day 3</td></tr>
<tr><th>MODEL</th><th>CONTENT AREA</th><th colspan="2">GRADE LEVEL</th></tr>
<tr><td>Socratic Seminar</td><td>Insects and culture</td><td colspan="2">5-6</td></tr>
<tr><th colspan="2">CONCEPTUAL LENS</th><th colspan="2">LESSON TOPIC</th></tr>
<tr><td colspan="2">Nature</td><td colspan="2">Ethnoentomology</td></tr>
<tr><th colspan="4">LEARNING OBJECTIVES (from State/Local Curriculum)</th></tr>
<tr><td colspan="4">n/a</td></tr>
<tr><th colspan="2">THE ESSENTIAL UNDERSTANDING
(What is the overarching idea students will understand as a result of this lesson?</th><th colspan="2">THE ESSENTIAL QUESTION
(What question will be asked to lead students to “uncover” the Essential Understanding)</th></tr>
<tr><td colspan="2">Nature shapes culture.</td><td colspan="2">How does nature shape culture?</td></tr>
<tr><th colspan="2">CONTENT KNOWLEDGE
(What factual information will students learn in this lesson?)</th><th colspan="2">PROCESS SKILLS
(What will students be able to do as a result of this lesson?)</th></tr>
<tr><td colspan="2">Students will know...
● Insect morphology and taxonomy
○ Morphology: how insects’ bodies are formed
○ Taxonomy: how insects are named according to DNA and body parts
● The ways in which insects intersect with modern cultures
● How insect-human interactions have changed over time</td><td colspan="2">Students will be able to...
● Analyze the meaning of an insect order’s scientific name and how it relates to their morphology, using Greek roots
● Explain how taxonomy has changed in recent decades with the advent of genetic technology
● Analyze the benefits and detriments to insects’ interactions with modern culture
● Compare and contrast the ways in which insects affect ancient and modern cultures</td></tr>
</table>

<table>
<tr><th colspan="3">GUIDING QUESTIONS
What questions will be asked to support instruction?
Include both “lesson plan level” questions as well as questions designed to guide students to the essential understanding</th></tr>
<tr><th>Pre-Lesson Questions:</th><th>During Lesson Questions:</th><th>Post Lesson Questions (for seminar):</th></tr>
<tr><td>● How do we identify and name insects?
● How do we identify insects?</td><td>● What major technological breakthrough do you think affected insect identification and taxonomy? How do you think it affected this field?</td><td>● In what ways did insects influence ancient cultures?
● In what ways do insects influence human culture now?
● How have the influences of insects on human culture changed over time?
○ In other words, how has nature shaped culture?
● How has human classification of insects and other living things changed over time? What does this say about human culture?</td></tr>
</table>

<table>
<tr><th colspan="4">DIFFERENTIATION
(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.</th></tr>
<tr><th>Content</th><th>Process</th><th>Product</th><th>Learning Environment</th></tr>
<tr><td>Content is specialized; learners have chosen class.</td><td>Students will participate in a Socratic Seminar and demonstrate learning verbally, a change from the last two days’ lessons. They will have to prepare and then defend their thinking by discussing open-ended questions.</td><td></td><td>Students will work in many different configurations today: individually, as a group, and in pairs and small groups. Length of reading passages for seminar text will be based on student need.</td></tr>
</table>

PLANNED LEARNING EXPERIENCES
(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)

Engage and Connect - This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.

1. Students may have to finish yesterday's Taba final activity and finish their anchor charts detailing the influences that insects have had on the cultures they've researched. (20 min)
   a. **As students enter and finish, they will individually be directed to sign up for 2 texts on a chart on the wall. These texts will be for today's Socratic Seminar. (see chart below) While students are working today, TA will organize texts according to student interest.**
2. Students will transition to a warm-up activity where they will study insect morphology and taxonomy with a **matching** activity: Greek roots from insect order names to English equivalents. Students will work in pairs and share their answers with the class when they are done; teacher will facilitate discussion and ask students to think of words with similar roots to figure out which roots mean what in English. (10 min)
3. Students will use what they have learned about common Greek roots used for naming insects to create an "insect" **name** for themselves that describes them. Then students will each share with the group (10 min).

Explore - In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.

4. Students will watch a clip from this tutorial video explaining how taxonomy works in general and how we classify living things: https://www.youtube.com/watch?v=F38BmgPcZ_I (6:00 to end, 7 minutes). While students are watching, they will be expected to **write** down (1) new ideas in their notebook and (2) questions they have as they come up during the video. **Teacher will have students divide a page of their notebook in half to do this before starting.**

5. Students will **discuss** in small groups: "Now that you have learned about insect classification (taxonomy), think about how it has changed over the last fifty years." (20 min total)

- How have people traditionally identified insects and other animals?
- What major technological breakthrough do you think affected insect identification and taxonomy? How do you think it affected this field?
- How has the need to categorize animals (nature) shaped human culture?
- As student discussion approaches the key content idea (DNA technology has changed the way we identify insects), teacher will pause discussion and show two short, pertinent videos to help students understand the implications:
  - http://www.dnabarcoding101.org/resources/ (2:33, "What is DNA Barcoding?").
  - https://www.sciencelearn.org.nz/videos/600-using-dna-analyses-for-classification (1:03 to 2:00) "This video is about how ferns and other plants are related, but how do you think the same technology has affected insect taxonomy?"
  - While students are watching, they will continue **adding** to their two column lists (new information and questions).

Explain - Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.

5. Students will now have a list of information learned, and questions they have about the videos. They will break up into pairs and talk with one other person they have not worked with yet this week. Then, each pair will share something new they learned and one question they still have. Teacher will add to the KWL chart as pairs share. (25 min)

6. Teacher will introduce students to the second part of today's lesson: using what we know about insects to study their effects on modern society. We will study a text and hold a Socratic Seminar! (20 min)

- Teacher will introduce the guiding **questions** for the Socratic Seminar (post-lesson questions) so students know what they are looking to answer in this seminar.
- Students will each receive the same main text (pg 1-7) and one chunk of the supporting text (one of the following sections in pg 8-14). There are 8 supporting pieces, each a different length. Texts will be distributed to allow for different student needs in terms of text length.
- Class will **read** text together and annotate. They will be expected to write at least three new pieces of information and three questions as they read, as well as highlight any important points they want to remember.
- Once students are done, they will work in pairs (one or two may work alone if desired) to read the same **supporting** text.

Elaborate —Allow students to use their new knowledge and continue to explore its implications. At this stage students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways.

7. Teacher will have students arrange desks into an inner and outer circle and explain ground rules of the seminar to them: everyone speaks at least two times. We do not interrupt each other. We allow others a chance to speak before we do (step up/step back). As inner circle discusses, outer circle takes **notes** on graphic organizer. (5 min)

8. Students will begin seminar. Teacher will have a designated student **leader** reintroduce the guiding questions. Teacher will have student leader use prompting questions from this resource to help push discussion, and display an anchor chart of sentence starters from the resource as well to help students generate ideas. (20 min)

- Each inner circle student will be evaluated by one outer circle member assigned to them. Outer circle watchers will be expected to write down one comment they agreed with, one they disagreed with, and one that made them think more.

9. Students will switch roles and continue the seminar with the second group. (20 min)

Evaluate: This phase assesses both learning and teaching and can use a wide variety of informal and formal assessment strategies.

10. Students' peer **assessments** from the seminar will be the one of two forms of evaluation in today's lesson. The other will be a seminar **reflection** that each student completes individually afterward (see below). Students will have quiet writing time outside at the end of class to think through their answers and write in their science notebooks (as well as check their traps). (20 min)

Materials needed:

- Printed:
  - Insect morphology worksheets (15)
  - Matching activity (7 sets)
  - Resource for seminar leaders from this (2 for kids, 1 for teacher)
  - Seminar evaluation reflection sheet for each student (15)
  - Scientific Root Words Resource for field guide (15)
  - Texts for Socratic Seminar (15 main texts, rest of it split into 15 pieces x 1)
    - pg 1-2: 15 copies
    - pg 3-4: 4 copies
    - pg 5-6: 4 copies
    - pg 7-8: 4 copies
    - pg 9-10: 4 copies
    - pg 11: 3 copies
    - pg 12: 3 copies
    - pg 13-14: 3 copies
    - pg 15-16: 2 copies
    - pg 17: 2 copies
    - pg 18: 2 copies
- Highlighters for texts
- Videos queued up and ready to show when class starts
- Seminar leaders designated ahead of time
- Anchor chart for Socratic Seminar guiding principles
- Anchor chart for seminar sentence starters
- Sign-up chart for texts: see below

Sign Up for Your Socratic Seminar Texts!

Write your name next to **one** text from each column.

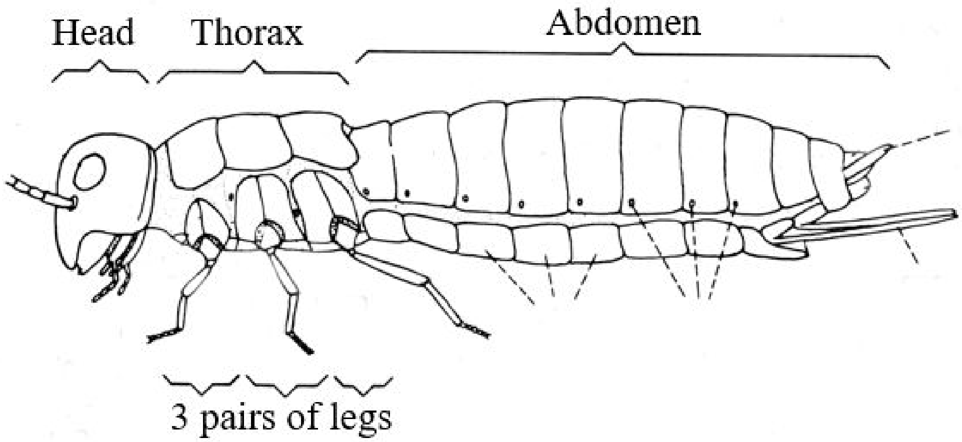
Insects in culture and religion 1. ____________ 2. ____________ 3. ____________ 4. ____________ Insects in language and literature 1. ____________ 2. ____________ 3. ____________ 4. ____________ Insects in science and technology 1. ____________ 2. ____________ 3. ____________ 4. ____________ Insects in medicine 1. ____________ 2. ____________ 3. ____________ 4. ____________	Economic impact of insects 1. ____________ 2. ____________ 3. ____________ Insects as food 1. ____________ 2. ____________ 3. ____________ Ecological impacts of insects 1. ____________ 2. ____________ 3. ____________ Insect products: honey and beeswax 1. ____________ 2. ____________ Insect products: silk and shellac 1. ____________ 2. ____________ Insect products: cochineal and tannic acid 1. ____________ 2. ____________

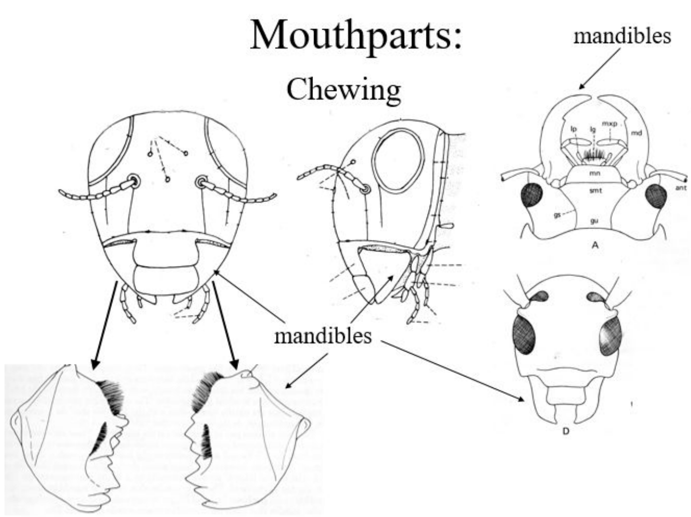
Matching: Roots to Meaning from Insect Order Names

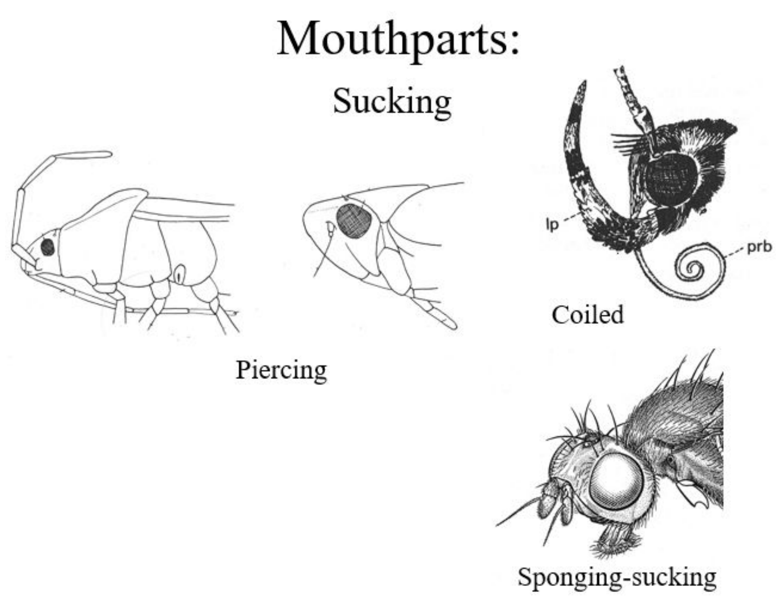
Odon	Tooth	Blatta	Cockroach
Orthos	Straight	Ptero(s)	Wing
Derma	Skin	Hemi(sys)	Half
Koleos	Sheath	Di	Two
Hymen	Membrane	Lepido	Scale

Name ____ *Add me to your Field Guide!*

Insect Morphology







How do we identify and name insects?

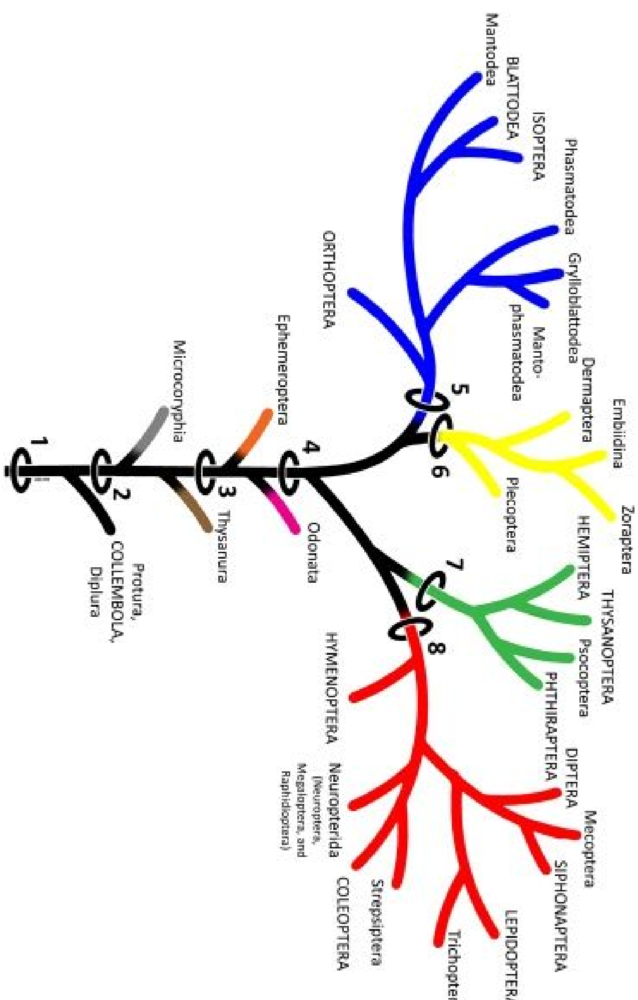
- Morphology: study of how things are formed (words or bodies)

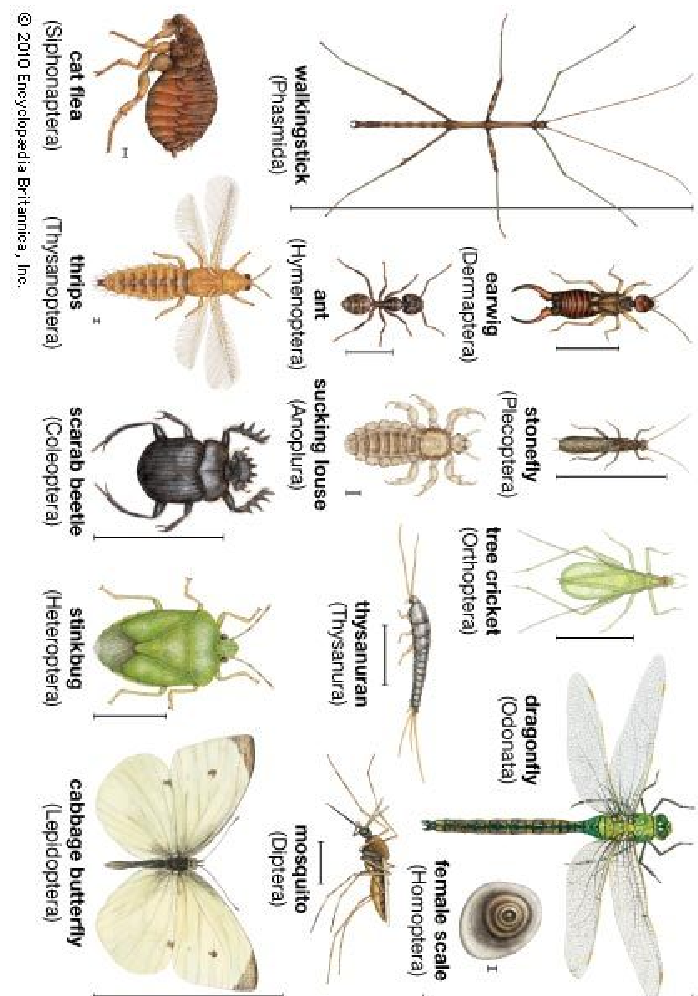
Greek Roots:

- Ortho: ________________
- Odon: ________________
- Derma: ________________
- Koleos: ________________
- Hymen: ________________
- Blatta: ________________
- Ptero(s): ________________
- Hemi(sys): ________________
- Di: ________________
- Lepido: ________________

You have learned a lot about insects this week! Use what you have learned about the basic characteristics of insects to determine the meaning of each order's name.

- Coleoptera: ____
- Mantodea: ____
- Blattodea: ____
- Diptera: ____
- Lepidoptera: ____
- Ephemeroptera: ____
- Hymenoptera: ____
- Odonata: ____
- Orthoptera: ____
- Phasmida: ____
- Hemiptera: ____
- Neuroptera: ____





Name ___________________________

Socratic Seminar: The Many Faces of Insects

My partner: ______________________

Complete at least five sentence starters as you read the text to stimulate your thinking:

- What puzzles me is ____
- I'd like to talk with people about____
- I'm confused about ____
- Don't you think this is similar to ____
- Do you agree that the big ideas seem to be ______________________________________
- I have questions about ____
- One similarity I see is ____
- One difference I see is ____
- Do you think ____?

As you read, use these ideas and your own thoughts to create questions you have for your peers. Questions should be open-ended, thought-provoking, and clear.

- *What word or phrase is most important in this text?*
- *What is the most surprising statement in the text?*
- *What would be another good title for this piece?*
- *What is the relationship between ….. and …..?*
- *What does ….. mean?*
- *When do we use …..?*
- *What comes after …..?*
- *What's the opposite of …..?*
- *Where's the stress in …..?*
- *What do you think about …..?*
- *Have you ever….when/where …..?*
- *If you had …..what…..?*
- *What kind of …..?*
- *How do you …..?*
- *How does this tie in with what we learned before?*
- *What are some possible implications of ….. ?*
- *What do you think caused ….. to happen?*
- *How would you summarise ….. ?*
- *How would you use this concept in real life?*
- *How does this concept tie into other subjects you've studied?*

My questions:

____

____

____

____

____

Outer Circle Observers

Contributes a New Idea	Asks a Question	Refers to the Text	Makes a Positive Comment	Makes a Negative Comment	Other Feedback
One comment your partner made that promoted more conversation: One comment your partner made that made you think:					

Seminar Reflection

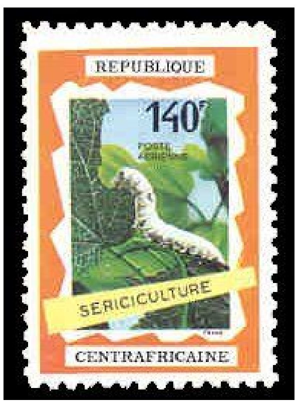
Take your time to reflect on our seminar today. Write your answers to these reflection questions in your journal.

- What did I do well during the seminar?
- What could I improve in order to be a more effective participant?
- How did my thinking grow/change as a result of participating in the seminar?
- What questions or confusion did I have going into the seminar?
- How was my thinking clarified?
- What actions did I observe others doing that I felt were effective?
- What was one new thing I learned during today's seminar?
- **What did I learn from this seminar that shaped my thinking on how nature shapes culture?**

Cultural Entomology

John Meyer, NC State Department of Entomology (2016)

There is no question that insects have shaped and molded human civilizations. On more than one occasion, the presence of insects has thwarted human attempts to colonize new settlements. Early Norse communities on the island of Greenland, for example, were abandoned long before Columbus "discovered" the New World because the settlers could not compete with insect herbivores (probably armyworms, *Agrotis noctua*) that pillaged their crops and pasturelands. Mosquitoes and chiggers (the immature stages of certain mites) foiled Francisco de Montejo attempts to conquer the Mayan civilization in 1549 and delayed Spanish rule over the Yucatan peninsula (Mexico) by nearly 150 years. Even today, tsetse flies (*Glossina* spp.) prevent colonization of large parts of central Africa because they spread the trypanosome parasites that cause sleeping sickness in humans and nagana in cattle.



On the other hand, insects have also served to accelerate cultural evolution. Silkworms, for example, were certainly a driving force behind the establishment of trade between Europe and China, and were still a factor in 1492 when Christopher Columbus stumbled onto the New World in his quest to find a sea route to the silk and spices of the Orient. The cotton boll weevil, a major agricultural pest that ravaged the South's economy during the late 1800's, has been credited with forcing agricultural diversification, stimulating industrial development, and stabilizing the South's rural economy. A large monument erected in 1919 on the town square of Enterprise, Alabama is inscribed: "In profound appreciation of the boll weevil and what it has done as the herald of prosperity."

The sociological impact of insects has been keenly felt on the battlefield. It is certainly no exaggeration to say that, over the course of human history, more soldiers have died from lice and mosquitoes than from bullets and bombs. These insects spread diseases that have affected entire armies, influenced the outcome of wars, and determined the fate of empires.

Body lice are notorious for the spread of epidemic typhus, often called trench fever because it thrives so well in the unsanitary conditions of wartime. Malaria and yellow fever, both transmitted by mosquitoes, have also taken a deadly toll - especially when battles have been fought in tropical and subtropical climates.

The wartime impact of insect-borne disease has decreased ever since the discovery of modern chemical insecticides. The turning point came during World War II (1942-1945) when American forces gained a tactical advantage over their enemies by using DDT, a newly discovered insecticide, to kill the lice and mosquitoes that spread disease. In fact, DDT has been credited with saving more lives than penicillin, particularly in the Pacific theater. The Japanese army was not well-equipped to fight insect-borne disease, and some historians believe that widespread epidemics of typhus and malaria would have soon forced Japan to surrender, even if the United States had not dropped the atomic bomb.

Culture, Religion, and Aesthetics

In view of their abundance and the range of their impact on the lives of our early ancestors, it is not surprising that insects have become thoroughly integrated into human culture from arts and crafts to mythology and religion. In ancient Egypt, for example, people saw how the scarab beetle (*Scarabaeus sacer*) rolled a ball of manure along the ground and concluded that a giant celestial dung beetle must roll the sun across the sky each day. Thus, the beetle became revered as a symbol of rebirth and immortality -- its daily journey across the sky became an allegory of human life. Images of the dung beetle were incorporated into Egyptian art and religion: the god Khepera was always depicted with a scarab-shaped head, stones carved to resemble scarabs were placed over a person's eyes and mouth after death to protect the body from evil spirits,

and scarab-shaped gems and icons were a recurring motif in Egyptian jewelry and other decorative artifacts.

The symbolic character of insects is also ingrained in many other cultures. To ancient Greeks, the goddess Psyche (represented by a moth) was a symbol of the soul or spirit. To the Chinese, a mantis symbolized cruelty and mystery. To Buddhists, the cicada was a symbol of resurrection. To Egyptians, the fly represented valor (the "Order of the Golden Fly" was a military honor presented for outstanding bravery). But to the Hebrews, flies were the manifestation of evil -- a personification of Beelzebub, Lord of the Flies (Satan himself).

The religious and symbolic significance of these insects was often reflected in the art, literature, music, and dance of the times. Early renaissance artists, for example, sometimes included the image of a fly in religious paintings to illustrate the omnipresence of evil. The Chinese, who regarded the butterfly as a symbol of joy, used it extensively in their artwork. Love was often portrayed in the form of bees or butterflies, as in the 16th century painting "Venus and Cupid" by Lucas Cranach.

Many insects are valued simply for their beauty. Colorful beetles, alive and tethered, are worn as brooches or ornamental pins in some parts of Africa and South America. The iridescent wings of *Morpho* spp. butterflies and *Urania* spp. moths are also crafted into beautiful jewelry and other decorations. Insect imagery is commonly found in textiles, ceramics, kitchenware, and even on the face of coins and postage stamps.

Boy with a Butterfly Net by Henri Matisse

Insects appear in famous paintings of many artists dating back to the days of our cave-dwelling ancestors. They were commonly used as focal points in the delicate silkscreens of early Chinese and Japanese artists. They can be found (often with meticulous detail) in the floral still lifes created by Jan van Huysum and other 18th century Dutch realists. They also appear in the modern graphic art of Charles Harper and M. C. Escher. Flies and ants are common features of Salvador Dali's surrealistic landscapes, copper-plate etchings of butterflies are a hallmark of Anneli Arms, and Charles Burchfield is best known for his visualization of natural sounds (e.g. chirping crickets and katydids).

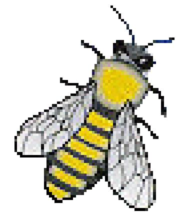
Song Match

Can you identify which insect is featured in each of these songs?

1. "Shattered" (Rolling Stones)	a. Honey bee
2. "Terrapin Station" (Grateful Dead)	b. Butterfly
3. "Tupelo Honey" (Van Morrison)	c. Crickets
4. "Jimmy Crack Corn" (Folk song)	d. Termites
5. "Jay My Love" (Eno/Cale)	e. Maggots
6. "Someone Saved My Life" (Elton John)	f. Blue-tail fly

Many people regard insect sounds as a form of music. The Chinese sometimes keep crickets as pets in bamboo cages in order to enjoy the chirping. In fact, crickets were the inspiration for "El Grillo", a popular song written by Josquin des Pres (16??) for one of Leonardo da Vinci's garden parties. "El Grillo" was the first musical score to be printed on John Guttenburg's moveable-type press. Robert Schumann's "Papillons" is a series of short musical compositions written between 1829 and 1831. These melodies feature fanciful changes of mood and direction as the music (or the butterfly) flits from one scene to another. "Flight of the Bumblebee", written in 1900 as part of the opera "Tsar Saltan", is probably the best-known musical score that evokes images of an insect. Its composer, Nikolai Rimsky-Korsakov, is remembered for his great music -- few people even know that he was also an avid insect collector.

Insects in Language and Literature



Busy as a bee

Although much of the religious and symbolic significance of insects has faded in the glare of modern science and technology, our language still reflects many traditional associations: busy as a bee, annoying as a fly, mad as a hornet. We still recognize the ant as a symbol of hard work, the lady beetle as a harbinger of good luck, and the butterfly as an object of transient beauty.

Insects and their underlying symbolism are prevalent in our literature (both lyric and prose). There are over 30 references to insects in *The Bible*, including three of the ten plagues on Egypt (flies, lice, and locusts -- Exodus, chapters 8-10). Buddhist and Islamic writings also include references to insects.

Secular writers have used insects as an effective counterpoint to human desires and aspirations. "To a Louse, On Seeing one on a Lady's Bonnet at Church" was written by Robert Burns (1785) as a sermonette on vanity and a satire of the social classes. His final stanza, in Scottish vernacular, includes a thoughtful admonition for humility:

"O wad some Pow'r the giftie gie us

To see oursels as others see us!"

"Metamorphosis", a novel by Franz Kafka, also makes a strong social statement by portraying the fate of Gregor Samsa, a traveling salesman who awakes one morning to find that he has been transformed into a cockroach.

On a lighter note, Archie the Cockroach and Jiminy Cricket are two of the most famous insect "personalities" of all time. The character of Jiminy Cricket was created by Ward Kimball, an animation artist for Walt Disney's feature-length film "Pinocchio". This little "orthopteran" who played the part of Pinocchio's conscience became a box office hit singing "When You Wish Upon A Star". Archie the Cockroach was the brainchild of Don Marquis, a newspaper columnist for the "New York Sun". Archie allegedly contributed his wit and wisdom at night by jumping onto the keys of Marquis' typewriter, one letter at a time. Since Archie could strike only one key with each jump, his correspondence was limited to lower case letters and other symbols that did not require use of the "Shift" key.

In the twentieth century, movies have become an important part of our culture. Cinematographers usually portray insects as villains or monsters [e.g., "The Fly" (1958), "Mothra" (1962), "Bug" (1975), and "The Swarm"

(1977)], and entomologists themselves don't fare much better [e.g., "The Collector" (1965) and "Invasion of the Bee Girls (1973)]. Insects are often included for their "shock" value, to set a "creepy" mood, or to provide comic relief. Although realistic portrayals of insects (and entomologists) are rare, there are a few outstanding exceptions: e.g., the swarm of locusts in "The Good Earth" (1937), and various insects in "Summer Magic" (1963). In contrast to the popular cinema, documentaries produced for Nova, National Geographic, and various Public Television stations include outstanding footage of insects in their natural surroundings. "The Ruling Class" (WQED, Pittsburgh) and "Slaves to the Queen" (WNET, Boston) are especially noteworthy.

Movie Match

Can you identify which insect is featured in each of these movies?

1. "Silence of the Lambs" (1991)	a. Army ants
2. "Hellstrom Chronicle" (1971)	b. Houseflies
3. "The Naked Jungle" (1954)	c. Moth
4. "The Amityville Horror" (1979)	d. Cockroaches
5. "Doctor Doolittle" (1967)	e. Tsetse flies
6. "Congo Crossing" (1956)	f. Sphinx moth

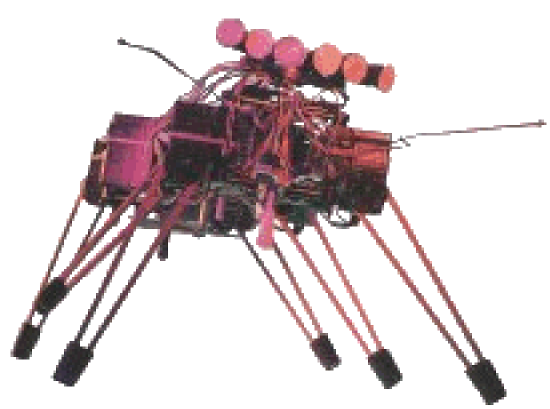
Science and Technology

Much of what we know about anatomy, development, and ecology has been learned just within the past 300-400 years. As recently as the mid 1800's, it was widely believed that complex organisms sprang to life from inanimate matter within their environment -- worms came from soil or wood, and maggots came from the juices of decaying meat. An Italian biologist, Francesco Redi, set the record straight in 1668 by demonstrating that flies had to lay eggs on meat before maggots would develop, but the theory of spontaneous generation persisted in one form or another until it was finally debunked by Louis Pasteur's classic experiments in the early 1860's.

Drosophila

The study of insects, particularly their life cycles, physiology, genetics, and ecology, has contributed a great deal to our overall understanding of biology. In the late 1600's, Antoni van Leeuwenhoek, the Dutch microscopist who first described bacteria and protozoa, used the eye of a louse as his standard unit of measurement for microscopic observations because "it's size was ever constant". The geneticist's fruit fly (*Drosophila melanogaster*) has contributed much to our knowledge of chromosome structure, mutation, and sex-linked inheritance. Its four pairs of chromosomes have been mapped with over ten thousand individual genes. The first association between pathogens and disease grew out of Louis Pasteur's studies of silkworm diseases (1865-1870).

Our knowledge of physiology has been advanced by studying the processes of growth and development in assassin bugs (*Rhodnius* spp.) and in various silk moths (e.g., *Bombyx mori* and *Hyalophora cecropia*). Population ecology has profited from studies of house flies, blow flies, and darkling beetles. Toxicology relies heavily on flies, cockroaches, and hornworms to assess the toxicity of insecticides. The study of insects has also provided basic knowledge in nutrition, metabolism, endocrinology, and neuromuscular physiology.



Insect-like robot

A knowledge of insect structure has even proven useful in non-biological professions. In 1983, engineers at McDonnell Douglas Corp. studied the legs of a grasshopper (Orthoptera) to help them design shock absorbers for a new jet fighter, the Hornet. Dr. Rodney Brooks at MIT's Artificial Intelligence Laboratory is developing six-legged robots with an electronic control system that is modelled after the distributed nervous system of insects. This approach, known as "subsumption architecture", has recently stimulated a great deal of interest (and controversy) in the world of robotics.

Law enforcement agencies have discovered that insects and other arthropods can furnish valuable evidence for criminal investigations. Specialists in forensic entomology can often deduce how, when, or where a crime was committed by blending good police work and careful observation with a knowledge of species' distributions, development rates, behavior, and ecology. In Australia, for example, narcotics agents were able to identify insect fragments in a shipment of marijuana, trace the cargo to its country of origin, and arrest members of a drug cartel. In Hawaii, a man accused of rape was charged (and later convicted) after police discovered a grasshopper's broken leg in the cuff of his pants and matched its fractured edge with the rest of the leg found earlier in the victim's clothing. And in murder cases where the corpse is not found for days or weeks after the crime, insects (especially fly larvae, carrion beetles, and ants) can provide surprisingly accurate information about the time of death, the number and location of wounds, and even whether the body has been moved from one place to another.

Medical and Therapeutic Value

During much of the seventeenth century, people in Europe believed that all plants and animals were created by God to either punish or serve humanity. They presumed, therefore, that any insect with no obvious detriment must possess some useful characteristic, often related to curing disease. As a result, insects (and other organisms) were carefully studied for their medicinal value and many species were incorporated into remedies that may (or may not) have actually worked.

At least a few of these drugs did contain pharmacologically active compounds. For example, blister beetles (family Meloidae) contain relatively high concentrations of cantharadin, a compound with notable effects on the vertebrate urogenital system. Once prescribed as an aphrodisiac, cantharadin is now used to induce mating in some domestic animals and as a therapy for some disorders of the urinary tract.

During World War I, medics noticed that gunshot wounds infested with blow fly maggots seldom developed bacterial infections. Their observation led to the use of maggot therapy (sterile-reared fly larvae for cleaning necrotic tissue from deep wounds), and the later discovery of allantoin, a chemical secretion of the larvae that inhibits bacterial growth. Synthetically produced allantoin was commonly used as an antibacterial ointment until penicillin and other antibiotics became commercially available in the 1940's.

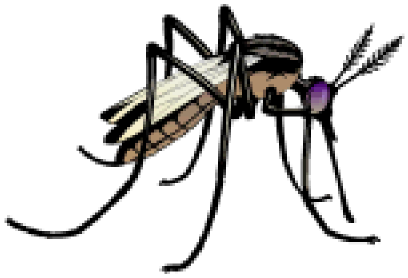
Honey bees (or their products) have been used for medicinal purposes since medieval times. This practice, known as apitherapy, still exists as a form of "alternative" medicine in Europe and other parts of the world. Some proponents of apitherapy use bee stings as a treatment for patients who suffer from arthritis, multiple sclerosis, lupus erythematosus, Parkinson's disease, and other autoimmune conditions. Recent evidence suggests that bee venom (or one of its components) has long-lasting effects on the human body, perhaps by increasing the body's own production of cortisol, an anti-inflammatory compound similar to cortisone but with fewer harmful side effects.

In the past few years, Chinese athletes have been setting new world records at an astonishing rate. Some people believe this success may be due, in part, to a diet that includes a tea-like beverage made from dried caterpillars (*Hepialus bifurcus*) that have been killed by a fungus (*Cordyceps sinensis*). The Chinese have used this potion for hundreds of years. They claim that it reduces the physiological effects of stress on the human body and permits a more intensive training regimen.

Research has uncovered other substances with anti-viral, anti-fungal, and anti-inflammatory activity in a variety of other insects, and there are undoubtedly more beneficial compounds still waiting to be discovered.

Some entomologists, such as Dr. Tom Eisner at Cornell University, have advocated a more methodical search for these new medicines. Eisner calls it "chemical prospecting"; he believes pharmaceutical companies will find enough new drugs in the class Insecta to keep them busy for many hundreds of years.

Economic Impact of Insects



Because they dominate all terrestrial environments that support human life, insects are usually our most important competitors for food, fiber, and other natural resources. They have a direct impact on agricultural food production by chewing the leaves of crop plants, sucking out plant juices, boring within the roots, stems or leaves, and spreading plant pathogens. They feed on natural fibers, destroy wooden building materials, ruin stored grain, and accelerate the process of decay. They also have a profound impact on the health of humans and domestic animals by causing annoyance, inflicting bites and stings, and transmitting disease.

The economic impact of insects is measured not only by the market value of products they destroy and the cost of damage they inflict but also by the money and resources expended on prevention and control of pest outbreaks. Although dollar values for these losses are nearly impossible to calculate, especially when they affect human health and welfare, economists generally agree that insects consume or destroy around 10% of gross national product in large, industrialized nations and up to 25% of gross national product in some developing countries.

But despite the tremendous economic losses they may cause, it is not entirely fair to cast the members of Class Insecta as villains who rob us of our food and livelihoods. They are also cherished allies on whom we depend to keep the natural environment clean and productive. They have shaped human cultures and civilizations in countless ways, they supply unique natural products, they regulate the population densities of many potential pest species, they dispose of our wastes, bury the dead, and recycle organic nutrients. Indeed, we seldom stop to consider what life would be like without insects and how much we depend on them for our very survival. To paraphrase William Shakespeare, "The evil that insects do lives after them, the good is oft interred with their exoskeletons."

Insects as Food

Silkworm pupae for human food in Thailand

Insects represent an important food source for a wide variety of other animal species. Freshwater game fish such as trout, bass, and bream feed extensively on aquatic insects like mayflies, stoneflies, or hellgrammites. Artificial "flies" used by anglers are often made to resemble a fish's natural prey. Many toads, frogs, turtles, snakes, and lizards also consume insects as a major part of their diet. Insectivory is common among land-dwelling birds. Purple martins, barn swallows, vireos, warblers, flickers, whippoorwills, and swifts, for example, survive almost exclusively on insects. Other birds (such as egrets, quail, geese, plovers, snipes, and bluebirds) have a more varied diet, but they still derive a large percentage of their total nutrition from insects. There are even some insectivorous mammals: shrews, moles, bats, armadillos, and anteaters, for example. When other food is scarce, even foxes, raccoons, skunks, and bears will turn to insects as a source of food.

Insects were undoubtedly an important source of nutrition for our early human ancestors. Even today, they are still collected and eaten by people of many cultures. In Mexico, dried grasshoppers are sold in village markets. High in protein and low in fat, they may be fried or ground into meal and mixed with flour to make tortillas. Sago grubs, the larvae of a wood-boring beetle, are considered a delicacy in Papua New Guinea. The islanders boil the larvae or roast them over an open fire. Ants, bees, termites, caterpillars, water bugs, beetle larvae, flies, crickets, katydids, cicadas, and dragonfly nymphs are among a long list of edible insects that provide nutrition for the people of Australia, Africa, South America, the Middle East, and the Far East. Indeed, Americans and other descendents of western European culture appear to be unique among peoples of the world in having such a strong cultural taboo against the use of insects as food.

A Recipe for Maggot Crispies

4 cup margarine	4 cups small marshmallows
3 cups crispy cereal	3 cups dry roasted maggots or mealworms

In a saucepan, melt margarine and marshmallows. Remove from heat and stir in cereal and maggots. Spread mixture in a 9x13 greased pan and allow to cool.

Ecological Impact of Insects

As consumers, scavengers, and decomposers, insects play a vital role in the biogeochemical cycling of

nutrients. Insects help aerate the soil, improve its retention of rainwater, and enhance its tilth. They turn more soil than earthworms and redistribute nutrients within the root zone as they burrow and nest in the ground. Flies and dung beetles prevent the buildup of manure from large animals and speed up its decomposition by fungi and bacteria. Without such scavengers, the gradual accumulation of waste products from large herds of cattle and other ungulates (mammals with hooves) would soon render much of the landscape unsuitable for agricultural purposes. Faced with just such a situation, ranchers in Hawaii, Australia, and the southern United States have imported dung beetles from East Africa in an effort to accelerate the decomposition of manure on pasturelands that support large herds of livestock.

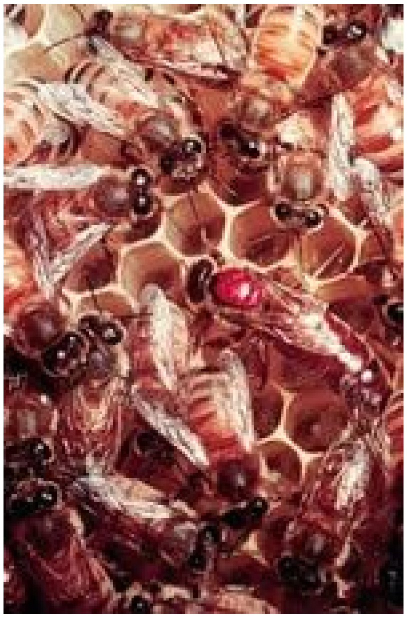
As parasites and predators of other organisms, insects are part of a natural system of checks and balances that strengthens community stability and prevents explosive population growth from overrunning natural resources. So far, over 6000 insect species have been tested and released as biological control agents to fight insects and weeds that we regard as pests. But there are also countless other species that work for us as population regulators, often unnoticed until they are accidently destroyed by a natural disaster or human intervention. Indeed, human disruption of natural ecosystems is a common cause of pest outbreaks. Over half of all agricultural pests in the United States have been accidentally imported from abroad: *e. g.* fire ants from South America, Japanese beetles from the Orient, and gypsy moths from Europe. Many of these species are not regarded as serious pests in their homelands because population growth is suppressed by native parasites, predators, and diseases.

But above all else, insects play an essential role as pollinators of flowering plants (angiosperms). These plants are dominant producers in many terrestrial ecosystems, but they cannot reproduce without insect intermediaries to carry pollen (the male gametophyte) from flower to flower. It is a close symbiotic relationship that has been shaped and polished by eons of co-evolution. The plants produce a wide array of colors, odors, rewards, and ruses to attract or seduce their insect accomplices. Each flower's architecture is specially designed to insure that insect visitors do not leave without a thorough dusting of pollen -- destined, perchance, for the stigma of another flower nearby. Various flower types are adapted for luring different groups of insects -- not only bees and butterflies but also many species of wasps, moths, beetles, and flies. Wild ginger, for example, produces an unobtrusive brown flower that smells like a dead rat. It is pollinated by fungus gnats, flesh flies, and other saprophytic insects.

Many of our agricultural crops like almonds, apples, cherries, blueberries, cucumbers, squash, melons, etc. would be non-productive without insect pollinators. In the United States, there are more than 250,000 commercial and hobby beekeepers who manage over four million beehives and provide pollination services to crops on 20-25 million hectares of farmland each year. These services cost growers about 50 million dollars annually, but they produce a net gain of over nine billion dollars a year through increased yield and quality of agricultural products. Wild bumblebees and certain species of solitary bees (e.g., *Nomia melanderi* and *Osmia* spp.) are also important pollinators for the production of alfalfa seed and some fruit crops.

Products of Beneficial Insects

Honey & Beeswax



Since ancient times, honey bees (*Apis mellifera*) have been valued for the honey and beeswax they produce. In many cultures, these products, as well as the bees themselves, are viewed with mystical or religious significance. To ancient Greeks and Romans, honey was the "nectar of the gods" -- endowed with healing properties and supernatural powers. People of Asia used it as a preservative for fruits and cakes, Egyptians employed it as an embalming fluid, and doctors in Europe and colonial America applied it as an antiseptic to treat burns and lacerations. In Europe, honey was often mixed with wine or beer and could be fermented to produce a popular alcoholic beverage known as mead. For many thousands of years, honey was the only sweetener most people ever used. The crystalline form of sugar sold today was not readily available until the early 1800's when the first commercial refineries were built to extract sucrose from cane or beets.

Honey is one of the beehive's principle food resources. It is produced from droplets of flower nectar gathered by worker bees. The nectar is temporarily held in the bee's foregut where enzymatic action begins to convert sucrose into dextrose (glucose) and levulose (fructose). In the hive, this nectar-enzyme mixture is transferred to waxen cells, reduced in volume by evaporation of water, and allowed to ripen into honey. The bees seal each cell with a wax cap when the process is complete. Worker bees make as many as 50,000 trips to and from the hive and visit up to 4 million blossoms in order to produce a single kilogram of honey (2.2 lbs). Large, healthy hives may average more than 25 kg (55 lbs) of honey per year. Although the market for honey is not as large or as profitable as it once was, annual U.S. production is still over 115 million kg. Most of this honey is used as a primary sweetener or as a substitute for refined sugar in baked goods. It is also an ingredient in a few cough medicines and laxatives.

Specialized glands on the ventral side of a worker bee's abdomen secrete flakes of beeswax, a soft, malleable material that bees use to build the comb where honey is stored and larvae are reared. The wax has a relatively low melting point so it is easy to extract and purify with heat. Beeswax is still used commercially in the manufacture of cosmetics, candles, furniture waxes, leather dressings, waxed paper, inks, and medicinal ointments. Annual U.S. production is about 2 million kilograms.

In recent years, there has been a growing market for bee pollen and royal jelly, two other products derived from honey bees. The pollen is collected when worker bees squeeze through a special screen at the hive entrance which dislodges pollen from the hind legs. Some nutritionists regard bee pollen as a "complete" dietary supplement. It is sometimes sold in health food stores, often with astonishing claims for its medicinal or restorative powers. Royal jelly is a glandular secretion that nurse bees feed to larvae of future queens. It is rich in vitamins and proteins, and is also sold for its curative properties. It has become a major ingredient in some expensive skin care products that promise to reduce wrinkles and retard aging.

Products of Beneficial Insects

Silk: A silkworm, *Bombyx mori*, is the source of a unique natural fiber used to make silk cloth. This species now exists only in captivity where it is reared to maturity on a diet of mulberry leaves. As each larva spins its cocoon, it produces a continuous fiber of silk that is about 0.075 mm (3/1000 inch) thick and 900 to 1500 m (3000-5000 ft) in length. This "domestic" silk is highly valued for its light color and lustrous finish. Silk is also harvested from the cocoons of several other moth species (mostly *Antherea* spp.) that live in the forests of India, China, and Japan. These "wild" silks (Eri, Yamamai, Muga, and Tussah are the most common types) tend to be heavier, darker, and less highly valued than that of *Bombyx mori.*

Silk is the strongest of all natural fibers. It is comparable to steel or nylon in tensile strength, but considerably more elastic. It can be dyed, spun into thread or yarn, and woven into fabrics that are warm in winter, cool in summer, resistant to wrinkling, and exceptionally light in weight. Until the discovery of nylon in 1938, silk was the only fiber strong and light enough to be used in the manufacture of parachutes, surgical sutures, and women's hosiery.

Although it has largely been replaced by less expensive synthetic fibers in most manufacturing applications, there is still a strong demand for silk in today's textile industry. Commercial production is centered mainly in China and Japan, where there is an abundant supply of mulberry leaves. Annual silk production exceeds 50,000 metric tons -- most of it woven into fabric for clothing or blended with other fibers for draperies and upholstery.

Shellac: *Laccifer lacca*, a tiny scale insect that grows on soapberry and acacia trees in India and Burma, is the source of lac, a sticky resin that forms the principal ingredient of commercial shellac.

Twigs bearing the scale insects are heated to extract and purify the resin. Up to 200 insects are needed for each gram of lac (90,000 per pound). Shellac, made by dissolving the lac in alcohol, was widely used as a varnish (protective coating) for floors, furniture, draperies, photographs, playing cards, and dried flower arrangements. Alkali emulsions of shellac have been molded into electric insulators, phonograph records, and dental plates. Today, lac has been largely replaced by synthetic materials, such as polyurethane and vinyl, but it is still used as a stiffening agent in the fabrication of felt hats, leather shoes, sealing waxes, and various types of inks, dyes, and polishes. Lac is the only commercial resin of animal origin.

Products of Beneficial Insects

Cochineal

Cochineal is a scarlet pigment extracted from *Dactylopius coccus*, a scale insect that lives on prickly pear cacti in Mexico and Central America. First used by Aztec Indians as a medicine, a textile dye, and a body paint, cochineal was discovered by Spanish conquistadors under the command of Hernando Cortez (1519). The pigment was highly valued for the intensity and permanence of its color and became a staple of trade with Europe during the 17th century. Cochineal was very expensive because of its scarcity [150 insects are needed to produce one gram of dye (70,000 per pound)], so it was used in only the finest fabrics. During the American Revolution, British soldiers, known as "redcoats", wore uniforms dyed with cochineal. Today, the textile industry has largely replaced cochineal with less expensive aniline dyes, but it is still used as a coloring agent in foods, beverages, cosmetics (especially lipsticks), and art products.

Tannic acid

Tannic acid is a chemical compound widely used in the leather industry (for tanning and dying) and in the manufacture of some inks. Until the mid 1800's, most of the world's supply of tannic acid was obtained from the Aleppo gall, an abnormal plant growth found on oak trees in Asia Minor. The trees produce gall tissue in response to a chemical substance secreted by tiny wasps (family Cynipidae) that infest the trees. Larvae of these gall wasps live and grow inside the galls which unwittingly provide both food and shelter for the insect invaders. Today, there is no commercial market for oak galls because tannic acid can be extracted more economically from the quebracho tree, a South American member of the sumac and poison ivy family (Anacardiaceae).

<table>
<tr><th colspan="3">TEACHER NAME</th><th>Lesson #</th></tr>
<tr><td colspan="3">Rosen</td><td>SPARK Day 4</td></tr>
<tr><th>MODEL</th><th>CONTENT AREA</th><th colspan="2">GRADE LEVEL</th></tr>
<tr><td>Creative Problem Solving</td><td>Insects and culture</td><td colspan="2">5-6</td></tr>
<tr><th colspan="2">CONCEPTUAL LENS</th><th colspan="2">LESSON TOPIC</th></tr>
<tr><td colspan="2">Nature</td><td colspan="2">Ethnoentomology</td></tr>
<tr><th colspan="4">LEARNING OBJECTIVES (from State/Local Curriculum)</th></tr>
<tr><td colspan="4">n/a</td></tr>
<tr><th colspan="2">THE ESSENTIAL UNDERSTANDING
(What is the overarching idea students will understand as a result of this lesson?</th><th colspan="2">THE ESSENTIAL QUESTION
(What question will be asked to lead students to “uncover” the Essential Understanding)</th></tr>
<tr><td colspan="2">Nature shapes culture.</td><td colspan="2">How does nature shape culture?</td></tr>
<tr><th colspan="2">CONTENT KNOWLEDGE
(What factual information will students learn in this lesson?)</th><th colspan="2">PROCESS SKILLS
(What will students be able to do as a result of this lesson?)</th></tr>
<tr><td colspan="2">Students will know...
● The influences that insects have had on both ancient and modern human cultures
● The traits that define insects, and how they affect their niche in nature</td><td colspan="2">Students will be able to...
● Explain the influences that different types of insects have had on ancient and modern cultures
● Create their own nonexistent insect, given a modern culture and the niche the insect must fill
● Justify their choice of order, physical characteristics, habits, and other identifying features of their created insect based on its environment
● Explain the role of their given insect in its environment</td></tr>
</table>

<table>
<tr><th colspan="3">GUIDING QUESTIONS
What questions will be asked to support instruction?
Include both “lesson plan level” questions as well as questions designed to guide students to the essential understanding</th></tr>
<tr><th>Pre-Lesson Questions:</th><th>During Lesson Questions:</th><th>Post Lesson Questions (for seminar):</th></tr>
<tr><td>● In what ways did insects influence ancient cultures?
● In what ways do insects influence human culture now?
● How have the influences of insects on human culture changed over time?
● How has human classification of insects and other living things changed over time? What does this say about human culture?</td><td>● How do insects’ environments affect how they evolve? (i.e., their physical attributes and their behavior)

● How do humans interact with insects? What does this tell us about insects’ influences on human cultures?</td><td>● How does your choice of order, physical characteristics, habits, and other identifying features of your created insect reflect its environment?
● What is your insect’s role in its environment? How would an entomologist recognize the insect’s role?
● Why is it important for humans to understand and continue to learn about insects?
● How does nature shape culture?</td></tr>
</table>

<table>
<tr><th colspan="4">DIFFERENTIATION
(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.</th></tr>
<tr><th>Content</th><th>Process</th><th>Product</th><th>Learning Environment</th></tr>
<tr><td>Content is specialized; learners have chosen class.</td><td>This lesson incorporates writing, building, discussions, and presentations, so will target multiple learning styles.</td><td></td><td>Students will have lots of choice in this lesson as they create their insects.</td></tr>
</table>

PLANNED LEARNING EXPERIENCES
(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)

Engage and Connect - This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.

1. Students will begin by reading the teacher's comments on their journal reflections from yesterday's Socratic Seminar, and sharing with a neighbor their answers to the questions. Each pair will share at least one of their thoughts with the group (20 min).

Explore - In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.

2. Class will review all we have learned this week by reviewing the KWL and anchor charts they have created together. Students will work individually to create a "mini anchor chart" on one page in their journal that holds all the key information they have learned this week. Identifying which information is most important will be up to students, but they may circulate throughout the room and talk to each other while completing this task. When students are finishing, they will come back together as a group and each student will share what they see as one important piece of information they chose to include, and why. (30 min)

Explain - Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.

3. Teacher will introduce final project: students will create their own insect today! Students will log onto Google Classroom to see the assignment, which will instruct them to choose from one of several modern cultures (not American), research that culture, and find a niche that an insect could fill. Then students will create that insect in theory, before creating a 3D visual from scrap materials (30-45 min). (See Google Classroom assignment below.)

- Students will have 30-45 minutes to do their research and create an insect. They must include the insect's order, "Latin" name, physical characteristics, habits/behavior, and any other identifying features, as well as the insect's role in its environment.
- Students must decide on this information before sketching a 2D rough draft of what their insect will look like. Teacher will check students' progress at each stage and provide feedback.
- Students will work individually on this final product.

Elaborate —Allow students to use their new knowledge and continue to explore its implications. At this stage students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways.

4. Students will move on to creating their insect from scrap material and continue fleshing out all of its facets. Teacher will circulate while they work to provide feedback (45 minutes).

- While teacher is circulating, she will ask during lesson questions:
- How do insects' environments affect how they evolve? (i.e., their physical attributes and

their behavior)

- How do humans interact with insects? What does this tell us about insects' influences on human cultures?

Evaluate: This phase assesses both learning and teaching and can use a wide variety of informal and formal assessment strategies.

5. Students will finish as much of their 3D insects as they can, but end with enough time to journal their answers to the post-lesson questions (20 min):

- How does your choice of order, physical characteristics, habits, and other identifying features of your created insect reflect its environment?
- What is your insect's role in its environment? How would an entomologist recognize the insect's role?
- Why is it important for humans to understand and continue to learn about insects?

6. If there is time, students will present their insects to the group and explain their answers to the post-lesson questions as they present.

7. Students will be able to bring home their field guides and insect projects to continue working on at home. Before leaving, students will check their pitfall traps one more time and fill in the holes, then take the traps home as well (5 min).

Materials needed:

- Google Classroom assignment posted with directions (see below)
- Lots of different materials to build insects (from Scrap Exchange) - felt, metal, newspaper, etc.
- Tape, glue, scissors, rulers, pencils - for building insects

Google Classroom Assignment: Insect Discovery Performance Task

You are an (ethno-)entomologist performing field research in a modern-day culture of your choice. You have recently realized that a common, local insect has been overlooked by the scientific community, and never been formally described! You must study the insect, describe its traits and behaviors, and make a presentation to the board of the International Journal of Entomological Research to showcase this insect and earn your place in history. To do this, you must research the culture, discover the niche in which the insect may fit, describe the insect physically and behaviorally (including giving it a common and Latin name), and prepare a 3D model of the insect to present to the board.

Steps you will take to accomplish this:

1. Choose the modern culture you will research. Use the graphic organizer from Tuesday's ancient culture research to guide you.

2. Use what you know about the culture to "discover" the role your newfound "insect" plays. Does it live in people's houses? Does it eat a certain type of garbage? Does it interact with humans in a new way? Be creative!

3. Sketch your insect on paper in color, labeling or listing its attributes. These include: order, common name, Latin name, physical attributes that identify it as an insect, role it plays in the culture, behavior, and aspects of culture it affects (ex. art, politics, music, war, etc.). You may include other details you find relevant.

4. Get approval from either teacher to begin building your insect model from scrap materials. Make it as realistic as possible, and be prepared to explain all the attributes of your insect when we present to the board!

Performance Task Rubric:

Criterion	3	2	1	Total
Planning and Execution	• Shows clear and thorough understanding of the major aspects of culture • Includes all required elements of imagined insect's behavior and physical traits	• Shows some understanding of the major aspects of culture • Includes most required elements of imagined insect's behavior and physical traits	• Shows little understanding of the major aspects of culture • Includes few of the required elements of imagined insect's behavior and physical traits	__/3
Presentation	• 2D sketch and 3D model of insect are clearly labeled with its physical and behavioral traits, including its niche in the modern culture • Student clearly communicates these traits in their presentation	• 2D sketch and 3D model of insect do not include all required elements of insect's traits, or the 2D/3D model is missing • Student does not clearly communicate these traits in their presentation	• Only 2D or only 3D model of insect is present, and is not complete • Student does not communicate insect's traits in their presentation	__/3
Creativity	• Student generates original, unique ideas as they design their insect	• Student reuses others' ideas or creates an insect exactly like one that already exists	• Student does not create an insect at all	__/3

Total: ____ / 9

How can I learn more on my own?

- Iowa State Entomology Department - a great list of fabulous insect names and how they came to be: http://bugguide.net/node/view/13648
  - This resource also has an excellent Insect Guide in another tab!

- Scientific Root Words, Prefixes, and Suffixes: http://www.jdenuno.com/PDFfiles/RootWords.pdf

- DNA Barcoding: http://www.dnabarcoding101.org/resources/

- Seminar Text: Impacts of Insects https://projects.ncsu.edu/cals/course/ent425/text01/impact1.html
  - Main library for this source: https://projects.ncsu.edu/cals/course/ent425/ (NC State Entomology)

- Identifying Insects: http://gk12calbio.berkeley.edu/lessons/less_quickinsect_id.html
  - Check out the PowerPoint in this link!

- Cultural Entomology, C. Hogue (1987): https://www.insects.org/ced1/cult_ent.html

- CSIRO's Resource for Insects and Allies: http://www.ento.csiro.au/education/

Also, don't miss Bugfest, an annual event in downtown Raleigh!

This year's Bugfest is September 16 from 9 AM - 7 PM.

http://naturalsciences.org/bugfest

Unit Resources

Articles:

Meyer, J.R., 2007, Importance of Insects, *General Entomology*, https://projects.ncsu.edu/cals/course/ent425/text01/index.html.

Hogue, C., 1987, Cultural Entomology, *Annual Review of Entomology*, 32(1), https://www.insects.orkin.com/ced/issue-1/cultural-entomology/.

Scientific Root Words, Prefixes, and Suffixes, *Succeed in Science*, http://www.jdenuno.com/PDFfiles/RootWords.pdf.

Web Sites and Videos:

Iowa State Entomology Department - this resource contains a great list of fabulous insect names and how they came to be, as well as a useful Bug Guide. http://bugguide.net/node/view/13648

This resource contains videos on the development and uses of DNA barcoding, which is a method of identifying organisms by using short genetic markers. It is a revolutionary method of identification because it is more accurate than the standard system of identifying organisms based solely on physical and behavioral attributes. http://www.dnabarcoding101.org/resources/

Identifying Insects: This is a guide for teaching students to identify insects. It contains a useful PowerPoint presentation and worksheet. http://gk12calbio.berkeley.edu/lessons/less_quickinsect_id.html

CSIRO's Resource for Insects and Allies: This is an excellent resource for teachers and students to use in researching insects. http://www.ento.csiro.au/education/

Exploring Nature's Field Guide to Insects: I expanded on this resource and updated it to include several other insect orders. Students each received their own copy in print. https://www.exploringnature.org/graphics/entomology/insect_orders(3-6%20grade).pdf

Understanding Evolution: A teacher's resource for teaching evolution to middle schoolers on a big-picture scale. http://evolution.berkeley.edu/evolibrary/teach/68fundamentals.php

Student-friendly introductory video to taxonomy, created by Crash Course Biology:

https://www.youtube.com/watch?v=F38BmgPcZ_I

For students' ancient culture research, they may choose from one of five ancient cultures that involved insect influence. Each has a resource to get them started:

- Scarab beetles in the Mediterranean (Greece, Egypt): https://www.insects.org/ced1/beetles_rel_sym.html#egypt
- Crickets in ancient China: https://www.insects.org/ced3/chinese_crcul.html
- Spiders in ancient Greek or African folklore (spiders are not insects, but we think about them as such. Include that in your presentation.): http://www.ancient-origins.net/myths-legends/symbolic-spider-wove-its-way-through-history-002215?nopaging=1
- Entomological warfare (you choose the culture): http://www.montana.edu/historybug/insects-as-bioweapons.html
- Silk production in China (Silk Road): http://www.festival.si.edu/2002/the-silk-road/the-silk-road-connecting-peoples-and-cultures/smithsonian
- Honey bee products in many cultures (you choose the culture): http://andrewgough.co.uk/articles_bee1/