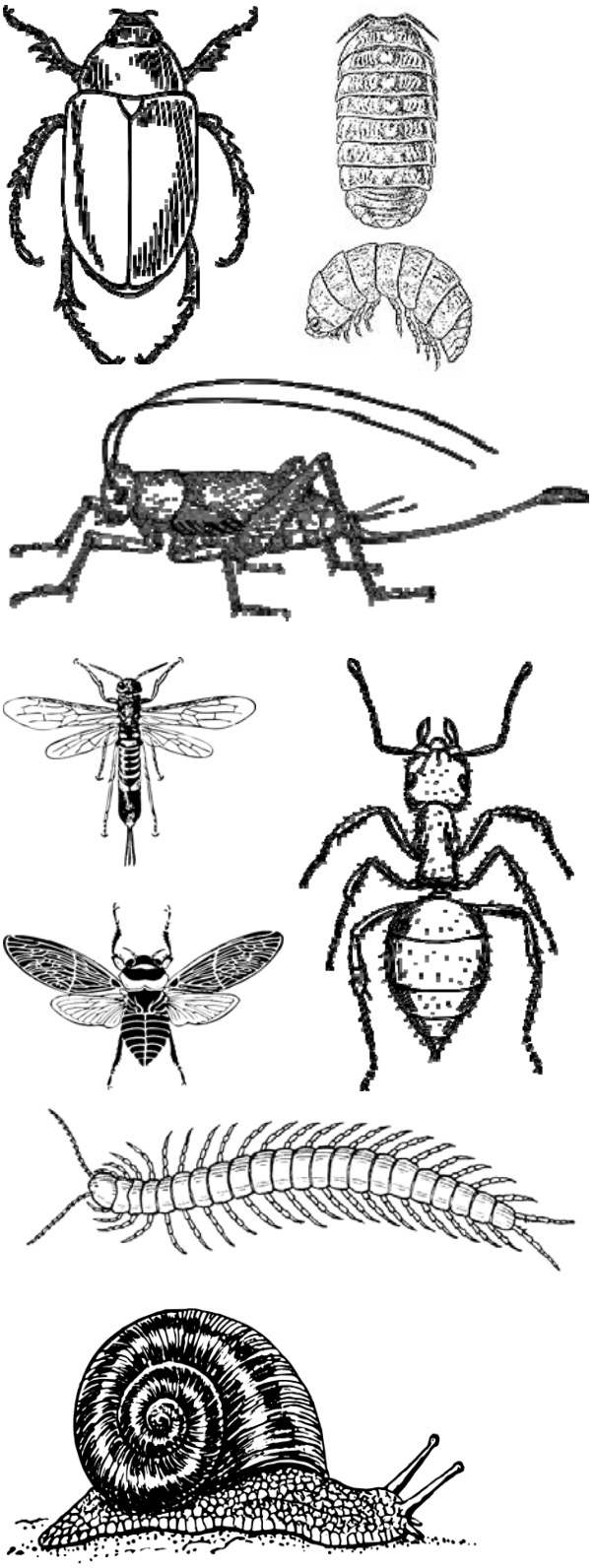


Investigating Invertebrates in Escondido

Mission and Rincon Middle Schools

May 2014

Student Resource Guide

Teacher _____

Cooperative project with:

San Diego Science Alliance

San Diego Children and Nature Collaborative

USDA Forest Service

Appendix A: Group Job Descriptions

Whole group responsibility: While making observations, all group members should discuss observations together to get the best most accurate details possible. For instance, if you see a hawk, as it is flying note colors of underside and discuss them as you notice them. Share information with the Scribe and Illustrator so you have the most comprehensive and accurate information possible.

Photographer/ Illustrator: Takes pictures of specimens in their environment. Sketches specimens and the environments in which the invertebrates are found. Remember, some of these creatures move fast! Label drawings with input from group. Make sketches below or on blank pages at the end of this science journal.)

Mapper/Time keeper: Records specific location on the schoolyard map and time of study. Also records details about where the invertebrates are found (under a rock, under a log, under bark, on a leaf, in the bushes) and measures the size of the invertebrates that are found. Keeps time to assure that their group is on time for meeting up with the class.

Scribe: Takes notes on date, weather conditions including air temperature. Incorporates information, questions, and hypotheses from the group about their specimens. Guesses are good!

Leader: You are responsible for the team. Be sure they do their job. You carry the equipment, you are the first one to collect a specimen, and you must set the example for the care of the animals.

Appendix B: Collection and Care of Specimens

Insects are FRAGILE. Be CAREFUL! They can easily be injured when handling.

- Use containers, spoons and, other supports such as leaves or soil to keep your animals safe while transferring into collection containers and make sure insects have good clearance before closing containers.
- Then take out items (sticks, leaves) one at a time to better view your animal. Some animals move very quickly and will hide and be camouflaged by their surroundings to be sure to locate your animal before removing items and losing your specimen.
- Make sure rugs, rocks, logs etc. are put back carefully and in the same place to avoid harming remaining animals and to keep moisture in.
- Place a moist paper towel in your collection container. Some invertebrates can dry out and die in less than an hour if they do not have enough moisture.
- Other things to consider: _____

Appendix C: Specimen Collection Methods

Students will be assigned to one of five collection methods. Follow the scientific methods described for the method you are assigned. Scientists follow methods very carefully but sometimes discover that they don't work exactly as they are written. Therefore, record any changes made to the methods.

1. Sticky Traps Collection for Flying Insects

Place your traps in places where you think insects commonly occur. Most insects prefer to travel in dark areas and along edges. Hence the best placement of a sticky card is in an out-of-the-way location in direct contact with a wall. The two open ends of the trap should run parallel to the wall to make it easy for insects to enter. Look for places that might provide the essential requirements of all animals: food, shelter, and breeding. Some of the pests readily trapped by sticky traps include spiders, cockroaches, crawling insects, mites and scorpions.

Sticky trap collection method:

1. *Take a new Sticky Trap with you when you leave. You will use it to replace the one you are taking. Take a ziploc bag labeled with your group name and period number.*
2. Go to the area where you are assigned on the school map.
3. Quietly observe the area for 4-5 minutes. Any movement? Sound? Animals? Record what you observe.
4. Collect the Sticky Trap and carefully put it into the zip lock bag, and zip it closed.
5. Put the new Sticky Trap down where the old one was and leave it alone.
6. Remember to be gentle so the insects keep all their body parts.
7. Return to the classroom.

1. Bug Rug Collection for Soil Invertebrates

Many invertebrates live in the soil. On campus, soil areas can be kept moist under a carpet square, "bug rug," that is a substitute for leaf litter, rocks, and logs that cover and keep soil moist. A large variety of insects and other invertebrates can be collected this way including pillbugs, worms, beetles, ants, termites, earwigs, roaches, and crickets. Once you have collected the insects, *be sure to put the rock, board or carpet square back the way you found it. This is important as it provides shelter for many types of animals and should be disturbed as little as possible.*

Soil invertebrate collection ("bug rug") method:

1. Take metal spoons or trowels with you to move around soil if no invertebrates are available on the surface. *Take a ziploc bag labeled with your group name and period number.*
2. Go to the area where you are assigned on the school map.

3. Quietly observe the area for 4-5 minutes. Any movement? Sound? Animals? Record what you observe.
4. Gently lift up the rug.
5. With your hand or tweezers, catch the invertebrates you can see.
6. Collect the specimens you find and put them in the container.
7. If you do not find invertebrates on the soil surface, use a spoon to dig down an inch or so.
8. Remember to be gentle so the invertebrates keep all their body parts.
9. Put the Bug Rug back and return to the classroom

2. Ant Collection (Pecan Sandies and Petri Dish)

Ant collection method:

1. *You will need to take a new petri dish out with you. You will be leaving one petri dish for the next group when you pick up your petri dish. Take a ziploc bag labeled with your group name and period number.*
2. Go to the area where you are assigned on the school map.
3. Quietly observe the area for 4-5 minutes. Any movement? Sound? Animals? Record what you observe.
4. Open the zip lock bag and quickly put the petri dish (cookie and all) into the bag. Zip it closed.
5. Put the new petri dish in this spot and put a new cookie in the dish.
6. Remember to be gentle so the ants keep all their body parts.
7. Return to the room

3. Bee Bowl Collection for Flying Insects

Bee Bowls are small colored plastic bowls or cups that are filled with soapy water. Bees are attracted to these colors, fly into the water, and drown. A bowl trap is set when it is filled with soapy water and left outside. The soap decreases the surface tension so that even small insects sink if they land on the surface. Most insects stop moving within 60 seconds of hitting the water.

Bee bowl collection method:

1. Take the bowls out with you if you are the first group of the day. The last group will collect the bowls. Take 6 tubes (some large and small) a spoon with you so that you can gently remove the specimens that you find in the bowls. Take a ziploc bag labeled with your group name and period number.
2. Go to the area where you are assigned on the school map.
3. Quietly observe the area for 4-5 minutes. Any movement? Sound? Animals? Record what you observe.

4. The first class of the day will collect the night's catch and fill up bowls with soapy solution. The last class of the day (or teacher) can collect the bowls and this collection can be used for the study. Some classes will not be setting out or collecting the bowls, but they can observe the collection and findings.
5. To set out bowls: Place three bowls (one blue, one yellow, one white) on the ground or on a high flat surface. Set the bowls about 2 meters apart. Fill each bowl, up to 1 cm below the top of the bowl.
6. To make collections: With a spoon, carefully collect the specimens you find and put them in the collection tubes.
7. Remember to be gentle so the insects keep all their body parts.
8. Carefully put the tubes into the Ziploc bag, and zip it closed.
9. Return to the classroom.

4. Beat Sheet Collection

Many insects feed and/or rest on trees, bushes, and other plants. These insects are often difficult to spot by casual observation, but can be easily collecting by beating the plants with some sort of stick or net handle while holding a beating sheet (light colored paper plate or pan) under the bush, tree or grass. The insects on the plant will fall onto the sheet and must be collected quickly before they escape.

Sheet collection method:

1. *Take a ziploc bag labeled with your group name and period number. Go to bushes where you are assigned on the school map.*
2. Quietly observe the area for 4-5 minutes. Any movement? Sound? Animals? Record what you observe.
3. For plants that are small and low to the ground, place the sheet (tray or paper plate) on the ground next to the plant.
4. For plants that are higher, hold the plate, pan or beat sheet in one hand while hitting the plant several times with a stick held in the other hand.
5. Gently shake the bush. Leaves and insects may fall onto the sheet.
6. Gently pull the sheet out from under the bush and collect all living specimens in the container.
7. Return to the classroom.

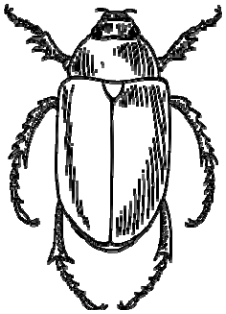
Optional: Night Lights

Many insects are attracted to lights at night. Because of this, porch lights and street lights are a great place to collect. The tools needed are an aerial net, a killing jar, tweezers, and an aspirator. As it starts to get dark outside, turn on your porch light and see what turns up. For most of the insects you will just need a jar and some tweezers. If you are lucky enough to find some larger moths, then the aerial net will come in handy. Very small insects like mosquitoes, gnats, and leafhoppers can be

collected with an aspirator. There are also many types of light traps and night traps that can be used with great success.

Appendix D: Glossary of Terms Used by Entomologists and other Scientists

Glossary- Organized by Lesson plan



Lesson 1: conclusion, hypothesis, inferences, science, scientific inquiry, theory

Lesson 2: abdomen, thorax, antenna, compound eye, entomologist, exoskeleton, vertebrate, invertebrate, mandible, spiracles, locomotion

Lesson 3: arachnid, arthropod, crustacean, insect, larva, molting, nymph, pupa, hermaphrodite, symbiotic, kingdom, phylum, class, order, family, genus, species, dichotomous key, incomplete and complete metamorphosis

Lesson 4: biomimicry, conserve, eradicate, invasive, scientific method

Abdomen: The part of an animal's body that contains the digestive system and the organs of reproduction. In insects and spiders, the abdomen makes up the rear of the body.

Antenna: A slender organ on an animal's head that it uses to sense its surroundings. Antennae is the plural form. Insects have two antennae, which are known as "feelers."

Arachnid: Arthropod characterized by four pairs of legs and the absence of wings and antennae (belongs to the class that includes scorpions, ticks, and spiders.)

Arthropod: An animal with jointed legs and a hard exoskeleton. Arthropods make up the largest group of animals on Earth and include insects, spiders, crustaceans, centipedes, and millipedes.

Biomimicry: The imitation of the models, systems, and elements of nature for the purpose of solving complex human problems.

Complete metamorphosis: A way of growing in which a young insect first hatches from an egg in the form of a worm-like immature called a larva. From this stage it changes to a pupa (an intermediate stage) and then finally, an adult. A butterfly experiences complete metamorphosis.

Compound eye: An eye comprised of many smaller eyes, each with its own lens. Compound eyes are found in most insects.

Conclusion: Summary of data collection to determine whether a hypothesis was correct or incorrect.

Conserve: protect (something, especially an environmentally or culturally important place or thing) from harm or destruction

Crustacean: Hard-shelled animal with jointed limbs

Dichotomous key: A two-choice key that uses small differences in color, size and shape to guide identification.

Entomologist: A scientist who studies insects.

Eradicate: Obliteration or destruction of an entire group or entity.

Exoskeleton: A hard external skeleton or body case that protects and supports an animal's body. All arthropods are protected in this way.

Hermaphrodite: An individual capable of producing both eggs and sperm.

Hypothesis: proposed explanations made on the basis of limited evidence as a starting point for further investigation

Incomplete metamorphosis: A way of developing in which a young insect hatches from an egg as a nymph and then develops gradually into an adult. A grasshopper has incomplete metamorphosis.

Inferences: a conclusion reached on the basis of evidence and reasoning

Insect: An arthropod with three body divisions, three pairs of legs, and with one or two pairs of wings.

Invasive: (especially of plants or a disease) tending to spread prolifically and undesirably or harmfully.

Invertebrate: An animal without a backbone. Some invertebrates are soft-bodied but others, including insects are protected by hard body cases.

Larva: A young animal that looks completely different from its parents. Some insect larvae (the plural form) change into adults by complete metamorphosis.

Locomotion: Ability to move from one place to another

Mandible: Parts of the mouth that are jaw-like.

Molting: The shedding of an insect's exoskeleton when it is outgrown.

Nymph: Immature stage of some insects such as true bugs, aphids, cockroaches.

Pupa: The intermediate stage between larva and adult stage.

Science: a way of understanding the world through thought and experimentation.

Scientific inquiry: The diverse ways in which scientists study the natural world and propose explanations based on evidence they gather.

Scientific method: An organized way to investigate answers to problems and curiosities. It is based on gathering data to test a hypothesis.

Symbiotic: A biological relationship in which two or more dissimilar organisms mutually benefit by living in close association with each other.

Species: A group of similar living things that mate and produce young.

Spiracles: A round opening that leads into an insect's trachea, or breathing tube.

Taxonomic group: Related, similar levels of relationships among living things. The highest is Kingdom, then Phylum, Class, Order, Family, Genus and Species.

Theory: A generalization based on many observations and experiments; a verified hypothesis.

Thorax: The middle part of an insect's body, between its head and abdomen, to which the legs and wings are attached.

Vertebrate: An animal possessing a spine.

Appendix G: Student Readings

Why are invertebrates important to us?

Bugs, spiders, creepy-crawlies—these words can make your spine tingle. Slimy earthworms, dirty cockroaches, and black widow spiders with deathly bites are all creatures that people often try to avoid. These animals, that can make the hairs on your arms stand up, are actually invaluable members of the earth's ecosystems. As disturbing as they are to some of us, the invertebrates are responsible for sustaining most life on this planet, directly or indirectly. The invertebrates also make up the largest group of living things, more numerous than all other species of plants and animals combined.

What are invertebrates? Invertebrates are, simply enough, animals without backbones. This group is very diverse and includes aquatic animals like jellyfish and sponges, as well as terrestrial animals such as all insects, worms, and snails. Scientists continuously attempt to count and describe all of the living species on earth. So far, 1,100,000 arthropod species along have been described in science. Phylum Arthropoda consists of insects, arachnids, crustaceans, and many other groups.

The importance of terrestrial invertebrates is immeasurable. Aside from products we can use like bees' honey and wax, and silk from the silkworm, invertebrates play an essential role in natural ecosystems. For example, many plants would not be able to grow and reproduce without bees, flies, and other airborne insects. These are the primary carriers of pollen from flower to flower. Relationships between plants and their pollinators can be as specific as the one between the monarch butterfly and the milkweed plant. Both species are unable to survive without each other, in what is called a symbiotic relationship. Monarch butterfly larvae feed on the milkweed plant and then spread its pollen to other milkweed plants as an adult. Soil invertebrates help decay materials and create the nutrient-rich humus layer in soil necessary for plant growth. They also serve as a food source for many birds and small mammals, reptiles, and amphibians. Any way you look at it, invertebrates play a major role in the cycle of life on this planet.

From http://handsontheland.org/environmental-monitoring/terrestrial-invertebrate-study.html?showall=&start=1

What is an Entomologist?

An entomologist is a zoologist who focuses specifically on the study of insects. Given that the insect world is vast and incredibly diverse, most people in this field focus on a specific order or family of insects. Careers in entomology are incredibly varied, ranging from forensic entomology to agricultural entomology. Numerous colleges and universities around the world offer training in entomology to people who are interested in this field of study.

Entomology is a very old science. Humans have had an interest in the insect world for centuries, thanks to agricultural pests and home invaders of the insect variety. Early entomologists probably learned to identify potential crop pests and to treat infestations of unwanted insects, and entomology was even involved in forensics at a fairly early state in human history. Many prominent scientists including Charles Darwin and E.O. Wilson also studied insects.

There are a number of branches within entomology. Entomologists may look at insect behavior, morphology, nutrition, and ecology. They can also study the ways in which insects interact with other animals and agricultural products. Such an entomologist might look at insect vectors of disease in humans, for example, or the impact of locusts on crops in the Middle East. Entomologists are also active in fields like paleontology, learning about the evolution of insects.

Forensic entomology is the science of using insects to help solve a crime. By understanding insect form and function, a forensic entomologist may be able to identify an insect invader from a few insect parts or even the tracks that an insect makes! Forensic entomologists must keep careful records so the insect data they collect can be used in investigations.

Some entomologists work as pest management specialist. They are often involved in education and teaching, since reducing pest populations requires the cooperation of those who work and live in a building. When people are taught accurate facts about pests, their fear decreases, tolerance levels increase, and they are more willing to implement control tactics. Entomologists often collect live specimens for observation and experimentation in their laboratories to help them learn more about insects and their behavior.

From http://www.wisegeek.org/what-is-an-entomologist.htm and *Teaming with Insects,* National 4-H Curriculum