

Pod Investigation



Objectives:

Students will be able to:

- make observations and ask questions about palo verde seedpods and bruchid beetles.
- conduct the Ecology Explorers Bruchid Beetles and Seedpods protocol.
- use appropriate graphs to analyze their data.

Author:

Ecology Explorers Education team

Time:

2-3 50 minute classes

Grade Level:

3-10

Standards:

AZ Science Strands

Inquiry; Life Sciences

NGSS - Core Ideas

Human impacts; Structure and function; Energy flow in organisms; Information processing; Ecosystem dynamics; Group behavior; and more

Practices

Investigations; Obtaining information; and more

Crosscutting Concepts

Patterns; Cause and effect; Energy flow; and more

Specific AZ, Common Core, and NGSS standards on page 3.

Background:

The Central Arizona–Phoenix Long-Term Ecological Research (CAP LTER) project is one of 24 long-term sites funded by the National Science Foundation (NSF). Most LTER sites are located away from urban areas; the CAP LTER site provides a unique addition to the LTER research by focusing on an arid-land urban ecosystem. Biological, physical, and social scientists from Arizona State University and a wide range of local partners are working together to study the effects of urban development on the Sonoran Desert. Dr. Tim Craig looked at the differences between urban and desert ecosystems, particularly at the interaction of bruchid beetles and palo verde tree seedpods (<http://caplter.asu.edu/research/research-projects/?id=36>). Palo verde trees are native to the desert and are now common in urban desert landscaping. Bruchid beetles lay eggs on the pods, and the larvae feed on the seeds. Urban palo verde trees are watered and fertilized, often isolated from other palo verde trees, and mixed together with other non-native tree species. All these variables can influence the bruchid beetles. Through this study, students can compare how beetle populations in urban and/or desert settings respond to these variations and participate in a long term ecological research project. Understanding the interactions between plants and animals is important to urban ecologists (<http://caplter.asu.edu/research/research-highlights/research-highlight-3/>)

Vocabulary:

ecology: Branch of biology that studies interactions among living things as well as interactions of living things and their physical environment

community: In ecology, this term refers to the populations of animals and plants that live within a defined area. (For example, all the plants and animals that live in South Mountain Park would be a community.)

larvae: Immature stage for some insects (frequently looks worm-like).

legume: The fruit or seed of leguminous plants (as peas or beans) used for food.

life cycle: The sequence of events in the lifetime of an organism that starts with the first embryo through its growth until it can reproduce and the cycle begins again.

random Sample: A group from a larger population chosen by chance.

urbanization: the process of transforming natural areas or agricultural areas into cities.

xeriscape: Utilizing low-water use plants in landscape design.

Safety Precaution:

The seeds are very hard to dissect, do not try to do this with a knife or scalpel—garden shears can be used.

Advanced Preparation:

Go out and collect seedpods from a blue palo verde tree. Be sure that some of the pods have holes in them. This is so students can see holes in the pods, but do not use this method of collecting seedpods when conducting the protocol.

Have a place in mind that you will be conducting the protocol. Are there some palo verde trees on campus? In the neighborhood surrounding your school? At a nearby park or business? If you will be collecting in the neighborhood, be sure to get permission before taking the students to collect seedpods.

Notebook pages are provided for those that use Science Notebooks in their classrooms. You can use the notebook pages provided, but feel free to adapt the pages to meet the needs of your students.

Materials:

- notebook pages
- pods from blue palo verde trees
- rulers
- containers for sorting and collecting seedpods (Petri dishes, Ziploc bags, or any plastic containers...)
- hand lenses
- dry erase board or easel pad of white paper and markers

Handouts:

- 1) *What is feasting on those seedpods?:* <http://ecologyexplorers.asu.edu/our-ecosystem/beetles-seeds-study/>
- 2) *Life History & ID Key:* <http://ecologyexplorers.asu.edu/our-ecosystem/beetles-seeds-key/>
- 3) *Bruchid Beetles and Seedpods Protocol:* <http://ecologyexplorers.asu.edu/our-ecosystem/beetles-seeds-protocols/>
- 4) *Site and Habitat Description Data Sheet:* <https://ecologyexplorers.asu.edu/docs/explorers/SiteHabitatDescribeBruchids.pdf>
- 5) *Bruchid Beetle and Desert Legume Data Sheet:* <https://ecologyexplorers.asu.edu/docs/explorers/BruchidBeetleDataSheet.pdf>

Procedure:

Engagement (1 lesson)

1. Present students with the following scenario: You found these seedpods on a tree in the schoolyard (or wherever you collected them) and think they are very interesting. You would like your students to observe them and record their observations and any questions they have about the seedpods.
2. Students can work in groups to investigate the seedpods. Each student should record their observations and questions. Give students plenty of time. Provide hand lenses, rulers, and any other tools that might help them to closely observe the seedpods. It is OK for them to open the seedpods and look inside.
3. Once the students are ready, have each group prepare a list of observations and questions they have to share with the class. Have the groups post these in the room for everyone to see. Have a class discussion about the similarities and differences among the different group's questions and observations.

Exploration: Conducting the Protocol (2 - 3 lessons)

- 1) Introduce the students to Ecology Explorers and the Bruchid Beetle and Seedpods Protocol. It is important to explain to the students that this research is part of a larger research project and their data will be used by scientists and other students.
- 2) Read and discuss handouts 1 & 2 from the Ecology Explorers web site. Students should record new facts, questions, or any other thoughts or comments they have while reading the pages from the Ecology Explorers web site.

Possible discussion questions include:

- Why are the ecologists at CAP LTER interested in studying the palo verde tree?
 - What is the relationship of the bruchid beetles and the palo verde tree? "
 - How are the holes in the palo verde seedpods created?
 - What do they tell use about our urban ecosystems
 - Were any of your original questions answered?
 - What new facts did you learn?"
 - What new questions do you have?
- 3) Steps for the protocol can be found at: <https://ecologyexplorers.asu.edu/our-ecosystem/beetles-seeds-protocols/> . Read the steps together as a class and make a

plan for collecting seedpods. Be sure to have a system for collecting and labeling the pods.

- 4) Once students are back in the classroom with their seedpods. Have them use the Bruchid Beetle data sheets to record their data. Additional data to collect may include the length of the pod. Students can then enter their data into the Ecology Explorers database here: <http://ecologyexplorers.asu.edu/our-ecosystem/ecology-explorers-data/>

Explanation and Expansion

- 5) Students can now analyze the data they have collected. Possible analyses include:

- compare the number of holes and seeds between desert and urban tree;
- compare holes and seeds between the various trees you collected pods from;
- find average number of holes and seeds per tree or per site (urban, desert, mesic yard, xeric yard).
- What do the numbers tell you?

- 6) Have students write an interpretation of their data

- Do they see a pattern?
- What might account for the pattern?
- Is there a difference between the trees they collected from in terms of holes?
- In terms of seeds?
- What further questions do they have?
- Were there any sources of error in the investigation?
- Are there further investigations they need to do?

- 7) Students should complete the investigation by presenting their findings. The presentation can take the format of an article for the school or class newspaper, or displaying a poster about their research in the classroom, school science fair, or CAP LTER Poster Symposium.

Evaluation:

- 1) Students record observations and questions about palo verde seedpods and bruchid beetles in their science notebooks.
- 2) Students successfully conduct the Ecology Explorers Bruchid Beetle and Seedpods protocol.
- 3) Students use appropriate graphs and mathematical analyses to analyze their data.
- 4) Students present their investigation in a final format (i.e. poster, report, etc...).

Extensions: What else can you do?

- Life-cycle – Bruchid beetles are easy to raise! Students can observe feeding, mating, egg-laying, as well as the complete metamorphosis of the beetles, while studying the complete life cycle of these Sonoran Desert natives.
- Pods in a jar – Collect pods from various trees, place the pods in jars with the lids not all the way closed and observe to see what emerges. Record what you find and then let the animals go!

Resources:

Power Point slides can be found at: <http://ecologyexplorers.asu.edu/get-started/slide-sets/>

Bruchid Beetle Protocol Box for is available for Checkout from Ecology Explorers!

Standards

Arizona Science Standards

Inquiry Process: C1-GR2-3-PO1 C1-GR2-5-PO2 C1-GR4-PO4 C1-GR5-PO3 C1-GR7-PO2 C2-GRK-8-PO1 C2-GR4-5-PO5 C3-GR5-PO1 C3-GR5-PO2

Life Science: C2-GR2-PO1 C3-GRK-PO1 C3-GRK-PO2 C3-GR1-PO1 C3-GR1-PO3 C3-GR3-PO1 C3-GR3-PO2 C3-GR3-PO3 C3-GR3-PO5 C3-GR4-PO1 C4-GR3-PO1 C4-GR4-PO2

NGSS Core Ideas

ESS3.C: Human impacts on Earth systems

LS1.A: Structure and function

LS1.B: Growth and development of organisms

LS1.C: Organization for matter and energy flow in organisms

LS1.D: Information Processing

LS2.A: Interdependent relationships in ecosystems

LS2.B: Cycles of matter and energy transfer in ecosystems

LS2.C: Ecosystem dynamics, functioning, and resilience

LS2.D: Social interactions and group behavior

(NGSS Core Ideas, Cont'd)

LS4.C: Adaptation

LS4.D: Biodiversity and humans

NGSS Practices

Asking questions

Planning and carrying out investigations

Analyzing and interpreting data

Using mathematics and computational thinking

Obtaining, evaluating, and communicating information

NGSS Crosscutting Concepts

Patterns

Cause and effect

Scale, proportion and quantity

Energy and matter: Flows, cycles, and conservation

Structure and function

AZCCRS/ELA Literacy

RST2: Summarize key points

RST4: Interpret technical language

RST7: Integration of knowledge and Ideas

WTS7: Research/investigate to answer a focused question

WTS9: Draw from informational text to support research work

SL1: Comprehension and Collaboration

SL2: Integrate oral information

SL4: Present effectively to listeners

AZCCRS/Mathematics

Domains: Number and Quantity, Measurement and Data, Statistics and Probability

Math Practices:

8. Look for and express regularity in repeated reasoning.

