Grade Level: Fourth

Piagetian Level: Concrete

Learners at the concrete operations stage of development are suited for this activity.

STEM *Science, Technology, Engineering, & Mathematics*

Learn & Grow Educational Series℠

Living Machines

Instructional Goal: Following instruction, students will demonstrate an understanding that both plants and animals have internal and external structures and processes that function to support survival, growth, behavior, and reproduction.

Lines of Inquiry:

- *What are some examples of structures or processes in animals that promote their survival?*
- *What are some examples of structures or processes in animals that promote their growth?*
- *What are some examples of structures or processes in animals that promote their behavior?*
- *What are some examples of structures or processes in animals that promote their reproduction?*
- *What are some examples of structures or processes in plants that promote their survival?*
- *What are some examples of structures or processes in plants that promote their growth?*
- *What are some examples of structures or processes in plants that promote their behavior?*
- *What are some examples of structures or processes in plants that promote their reproduction?*

Materials:

- Student Instructional Guide
- Student Data Sheets
- Student Presentation Scoring Rubric
- 5 Mantis Oothecas
- Materials to build a self-watering container garden per the instruction found at

Common Core Standards:

- W.4.1: Write opinion pieces on topics or texts, supporting a point of view with reasons and information.
- SL.4.5: Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes.
- 4.G.A.3: Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded across the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.

CA State Standards—Science:

- 4-LS1-1: Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

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Living Machines, continued...

http://learn-and-grow.org—it is strongly recommended that the pieces be pre-cut and –drilled by adults or students in a shop class under stop teacher supervision.

- You may choose to have one container per student or a smaller number of containers that collectively belong to your class, depending upon the availability of resources and/or space.
- Soil, plants, and water for each self-watering container.
- Appropriate clothing and safety equipment.
- Computer, art, craft, or other media resources appropriate for students to create visual presentations.

Instructions:

- Have your students read the Student Instructional Guide to themselves.
- Have them note the words in italics that appear throughout the text.
- Discuss with your class the words that appear in italics throughout the text relative to the lines of inquiry for this lesson.
- Assist your students to build out a container garden using polyculture methods (i.e., plant a mixture of different kinds of food-bearing plants throughout the garden).
- Have your class start the garden in early spring, as soon as it is warm enough.
- Order/purchase your oothecas at the same time that your class' garden is started and, once you have them, have your students place the oothecas around the garden in their containers.
- Have your students take data on the aspects of plant and mantis development indicated on their Data Sheets.
- Near the end of the Spring semester/ trimester/quarter, whatever session ends right before Summer, have your students give group presentations on the conclusions they drew from their investigative findings.
- Each student must write and prepare the presentation materials for a segment of his/her group's presentation.
- Visual aids can include actual planted containers, photos, drawings, animations, or videos.
- In presenting his/her segment of the presentation, each student should express an opinion as to the conclusions that can be drawn from his/her group's findings relative to the segment he/she is presenting.
- Score each student's presentation according to the scoring rubric included here and review the outcome of each for demonstration of concept master.
- Collect your students' data sheets and review them for demonstration of concept mastery.

Where possible, children should be encouraged to eat the fruits and vegetables they grow in order to make the cognitive connections between growing food, where food comes from, how food provides fuel to the human body, and how healthy foods make a difference in how the mind and body feel and work. This also gives them a sense of empowerment and control over their environments that encourages their intrinsic motivation to eat healthy foods.

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Student Presentation Scoring Rubric

Student	Expresses Opinion	Opinion Based on Conclusion	Conclusion Based on Evidence	Evidence Presented

Item Score	Score Meaning
1	Not or inaccurately presented
2	Partially presented
3	Fully presented

PRINT AS MANY SHEETS IS NECESSARY TO CAPTURE YOUR ENTIRE CLASS

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Knowledge Powers Solutions for Parents

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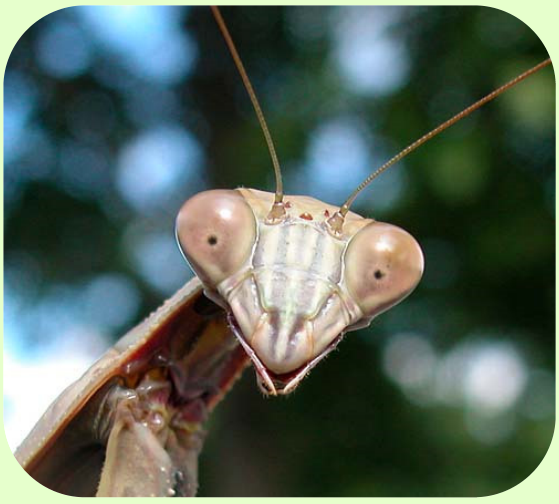
Living Machines — Student Instructional Guide

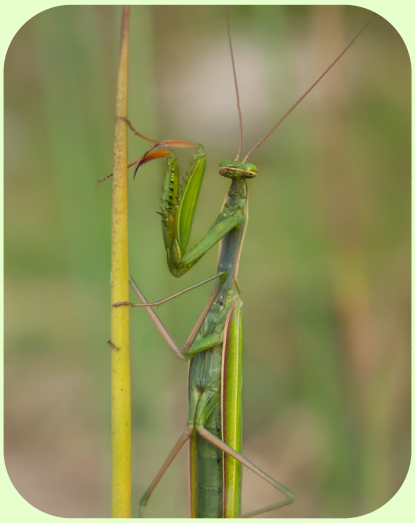


Praying mantises are insects. Insects are one type of animal that occurs in nature. Other types of animals include birds and mammals.

All animals have parts of their bodies that perform specific jobs. Those jobs are intended to help each animal survive and grow, act as it needs to in its environments, and have babies so its species continues to survive.

Praying mantises are no different. To survive in nature, they must blend in with their environments so the other bugs they eat will not see them. They use *camouflage* to hide in plain sight from their prey as well as other animals that might what to eat them.

Praying mantises have different body colors depending on the habitat in which each one lives. These colors can range from green to pink, but are most often shades of green and brown. By having body colors that match their environments, praying mantises are camouflaged from being seen by their prey and their predators.



Praying mantises eat all kinds of other insects, such as moths, grasshoppers, crickets, aphids, and flies. Some of these other insects can be harmful to garden plants. Because praying mantises naturally eat these garden pests, organic gardeners release praying mantises into their gardens to eat the harmful bugs and protect the plants.

Hunting and eating other bugs makes praying mantises *predators*, but this is the kind of food they need to grow. The hunting behaviors of praying mantises are fascinating to watch.

Praying mantises can live about six months to a year. They hatch from eggs.

Female praying mantises *lay about 100 to 400 eggs* at a time, once they have mated with a male. They lay the eggs on a stem or stiff leaf and their bodies produce a liquid that hardens around the eggs to create *a protective case called an ootheca*. The ootheca is very hard and can survive extreme changes in the weather.

Nymphs hatch from the eggs and emerge from the ootheca in mid-Spring. Immediately after hatching, the nymphs stay close to the ootheca and attempt to eat each other. Once they begin to disburse, they begin to hunt small insects, like fruit flies.

Nymphs shed their skins, or exoskeletons, several times as they get older, getting bigger each time they shed. They are vulnerable to larger predators, such as bats, spiders, birds, and other insects. Many nymphs to do not survive to adulthood.

Adolescent mantises are bigger than nymphs and do not shed, or molt, their exoskeletons as often. Molting makes the mantises vulnerable to other predators since they have to sit in one place for several hours and can't move.

The mantises become adults by early summer. They can be as small as one inch and as long as six inches, depending on which species of praying mantis they are. Larger praying mantises will prey

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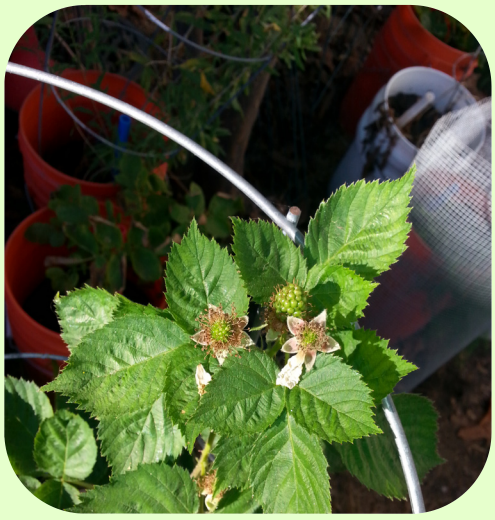
Living Machines — Student Instructional Guide, continued

upon small birds, mice, lizards, and frogs.

While *mating*, the female praying mantis will eat the head of the male. Once done, she will eat the rest of his body. After laying her eggs, the female mantis then dies.



Just like animals, plants' bodies come with structures and processes that promote their survival, growth, behavior, and reproduction. Blackberry plants come with *thorns*, which protect their fruits from being taken by animals that would have to climb their branches to get to it. All plants use *photosynthesis* to turn water and sunlight into food energy within their leaves using chlorophyll, which makes the fuel necessary for the plants to grow.

Pretty much all plants move to orient themselves towards light. While their movements may be so slow that it seems like they aren't moving at all, time lapse photography shows that they do, in fact, move to maximize their exposure to light so they can engage in photosynthesis. This behavior of plants moving toward light is called *phototropism*.

Fruiting plants use *flowers* to reproduce. Some plants have flowers with both male and female parts while other plants have male flowers and female flowers. Either way, the male parts produce pollen that then gets on the female parts by being blown by the wind or moved by pollinators, such as bees, which then makes a fruit of some kind with seeds in it.

This is why things people often call vegetables, like beans and tomatoes, are actually fruits. Vegetables are technically leaves, like lettuce and kale, and roots, like carrots and onions.

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Living Machines — Student Data Sheet

Name: _____

Mantis Ootheca	Date Received	Date Hatched
1		
2		
3		
4		
5		

Name of Plant	Date Planted	Date Harvested

Activity: Pick a leaf from one of the plants in the garden. Look at the leaf and how it is shaped. Notice the crease down the middle and how each side looks like the opposite of the other side. Draw your leaf in the box below.

Based on your observations and reading, what are some traits that the mantises and plants each show to meet their needs?

Need	*Mantises*	*Plants*
Survive		
Grow		
Behave		
Reproduce		

Based on your findings, what is ***one*** thing you can conclude about the parts of plants' and/or animals' bodies and the processes they support?

_____

What evidence did you see with the mantises and garden that support your conclusion?

_____

_____