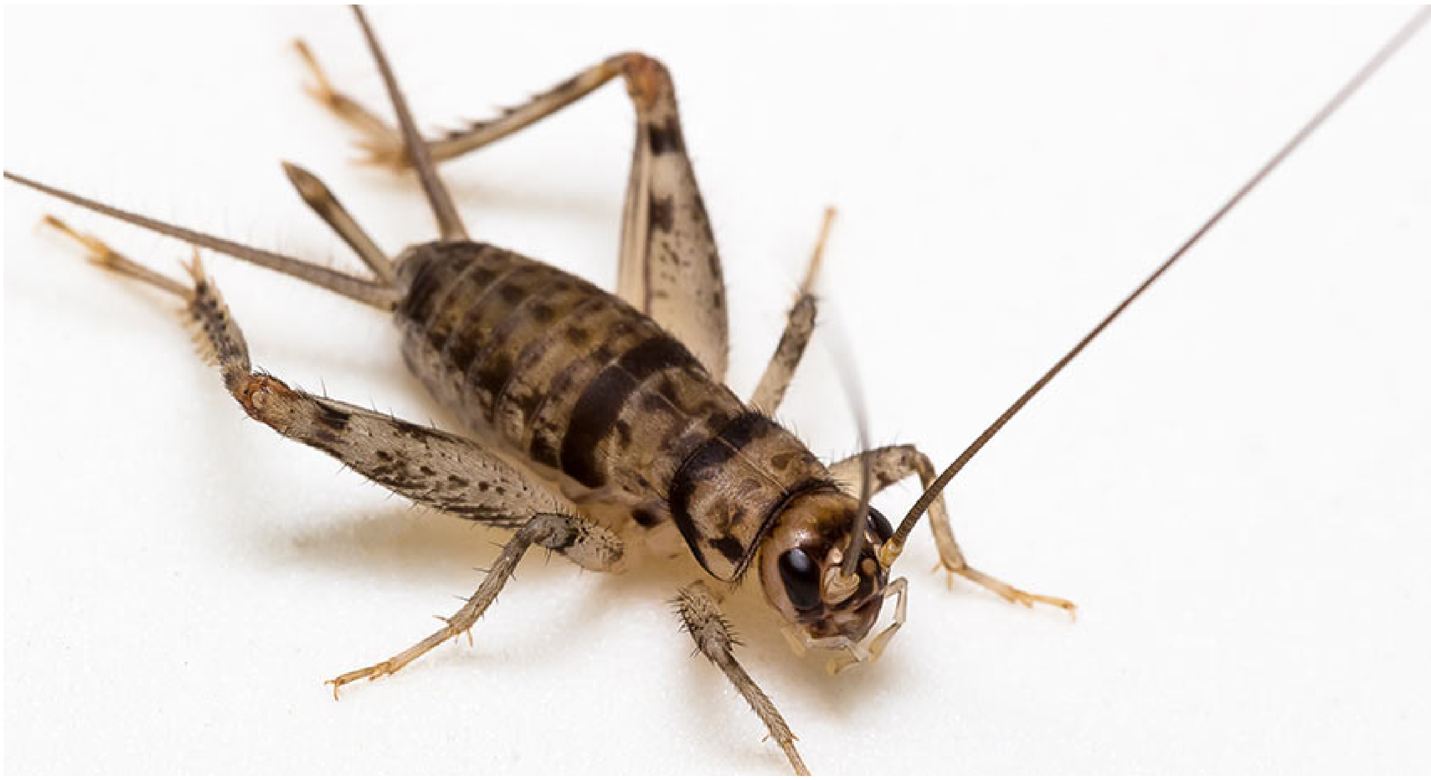
Science News
EDUCATOR GUIDE



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May 11, 2019 & May 25, 2019
Down on the (Cricket) Farm

SOCIETY FOR SCIENCE & THE PUBLIC

SN EDUCATOR GUIDE

May 11, 2019 & May 25, 2019

Down on the (Cricket) Farm

About this Guide

The *Science News* article "Down on the (cricket) farm" describes how a team of Silicon Valley entrepreneurs is trying to scale up insect farming. If they can mix ancient herder–style insights about domesticating animals with computer-vision algorithms and robot design, insects might just become a widespread, economical and environmentally friendly food source in North America and Europe. This Guide encourages students to assess their own views on insect eating, to explore the nutritional value of insects relative to snack food and to consider the challenges of insect farming, along with potential solutions.

This Guide includes:

Article-based observation, Q&A — Students will answer questions based on the *Science News* article "Down on the (cricket) farm," Readability: 9.5. Questions ask students to report on the current status of insect farming, read and analyze graphs and consider the style and language in the *Science News* article.

> **Article-based observations, questions only** — These questions are formatted so it's easy to print them out as a worksheet.

Cross-curricular connections, teacher guide — The discussion presents four challenges that insect farmers might face and asks students to come up with a design solution, then work through the proposed solution's implementation and potential consequences.

Activity: Chirpy Jerky

> **Purpose:** Students will learn procedures for various biochemical tests to find and compare the nutrient compositions of insects with those of more conventional snack foods. Students will consider the implications of eating insect-based food on their diets, and for society more broadly. This activity builds on the article "Down on the (cricket) farm."
>
> **Approximate class time:** 1 class period.

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Standards

Next Generation Science	Common Core ELA
Ecosystems: Interactions, Energy, and Dynamics: HS-LS2-1, HS-LS2-4, HS-LS2-6, HS-LS2-7	Reading Informational Text (RI): 1, 2, 4, 5, 7
Earth and Human Activity: HS-ESS3-2	Writing (W): 1, 2, 3, 4, 6, 7, 8, 9
Engineering Design: HS-ETS1-1, HS-ETS1-2, HS-ETS1-3	Speaking and Listening (SL): 1, 2, 4, 5, 6
	Reading for Literacy in Science and Technical Subjects (RST): 1, 2, 3, 4, 5, 7, 8, 9
	Writing Literacy in History/Social Studies and Science and Technical Subjects (WHST): 1, 2, 4, 7, 8, 9

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Article-Based Observation, Q&A

Directions: After students read the article "Down on the (cricket) farm," have them answer the questions below. Questions cover science content, reading graphs and writing style and language — and are categorized accordingly.

Science content

1. What is Ovipost and what is its goal?

Ovipost is a startup company that aims to automate cricket farming to make it more sustainable and economical.

2. Why is large-scale insect farming challenging?

Insect farming can be labor-intensive, which adds to production costs and makes insects more expensive than some meat. Cricket egg-laying and egg-counting, for example, are tedious and take a lot of time to manage. Insect pests are a big issue because the measures to control them can kill insect livestock, too.

3. Name one specific challenge Ovipost is trying to address and explain how.

One of the first things Ovipost did was automate the management of cricket egg-laying and egg-counting. Before, farmers would count offspring by coaxing them into measuring containers. Ovipost developed shortcuts that made the task easier and faster. Another example is that Ovipost is looking for a spray-on coating that could be used around the edges of cricket bins to keep the crickets from climbing out. The slick, brown packing tape currently used has to be replaced after several weeks.

4. Why are people interested in farming insects for human food? What happened in 2013 that altered the insect farming industry in the United States?

If developed, insect farming might be more sustainable than other forms of meat production, perhaps releasing less greenhouse gases than farming more typical sources of protein, for example. In 2013, a United Nations report argued that insect farming could be a way to meet the protein requirements of a rapidly growing human population. After the report came out, the insect farming industry in the United States experienced a boom. Insects are already commonly eaten in other parts of the world.

5. How many insects are considered edible? Why are some more environmentally friendly to farm than others?

There are more than 2,000 edible insects. How environmentally friendly they are to farm depends on factors including what they eat and what waste they produce. Some insects need meat to eat, which adds to their carbon footprint. Others, such as termites, produce the powerful greenhouse gas methane.

Reading graphs

6. According to the graph and caption "Power protein," how does the protein content of the insects shown compare with beef and fish? Explain your answer.

Crickets, termites, grasshoppers and mealworms might pack more protein per 100 grams of body weight than cattle and tilapia, or they might have less. Protein ranges overlap depending on what the insects and other meat sources are fed, as well as other factors that go into raising them.

7. What does the "Gentler farming?" graph show? Explain the information presented on the x-axis and y-axis, including the units provided. Give an example of a quantitative data point that can be drawn from the graph.

The graph shows greenhouse gas emissions of farmed insects and other livestock in various countries. The x-axis shows kilograms of greenhouse gases released per kilogram of edible meat farmed. The y-axis shows the country where details on the named animal or insect were gathered. Approximately 17 kilograms of greenhouse gases are released per kilogram of beef produced in Mexico.

8. What is one conclusion that you can you draw from the "Gentler farming?" graph about the efficiency of cricket farming in Thailand? Make sure the graph supports your answer.

While cricket farming in Thailand already releases less greenhouse gases per kilogram of edible meat than farming chicken, salmon, pork and beef in European countries and Mexico, there is room for improvement. Cricket farming could be made to release even less greenhouse gases in the future.

Style and language

9. List and explain two ways the author uses imagery to describe current insect farming and insect farms.

The author describes insect farming as "silent ranching." "Ranching" because it is animals and "silent" because, from the outside at least, the author wouldn't even be aware it was happening. While farms typically bring to mind pastures and fences, insect farms in the United States are located indoors. The author describes insect farms as "less Old MacDonald and more server farm," a reference to the buildings that house computer servers.

10. List and explain one way the author uses imagery to describe future insect farms.

The author discusses how cricket farms of the future might be similar to Willy Wonka's chocolate factory. Like the fictional factory, cricket farms could highly automated, with a system of conveyor belts feeding and sorting crickets, for example.

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Down on the (Cricket) Farm

Article-Based Observation, Q

Directions: After reading the article "Down on the (cricket) farm," answer the questions that your teacher assigns.

Science content

1. What is Ovipost and what is its goal?

2. Why is large-scale insect farming challenging?

3. Name one specific challenge Ovipost is trying to address and explain how.

4. Why are people interested in farming insects for human food? What happened in 2013 that altered the insect farming industry in the United States?

5. How many insects are considered edible? Why are some more environmentally friendly to farm than others?

Reading graphs

6. According to the graph and caption "Power protein," how does the protein content of the insects shown compare with beef and fish? Explain your answer.

7. What does the "Gentler farming?" graph show? Explain the information presented on the x-axis and y-axis, including the units provided. Give an example of a quantitative data point that can be drawn from the graph.

8. What is one conclusion that you can you draw from the "Gentler farming?" graph about the efficiency of cricket farming in Thailand? Make sure the graph supports your answer.

Style and language

9. List and explain two ways the author uses imagery to describe current insect farming and insect farms.

10. List and explain one way the author uses imagery to describe future insect farms.

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Down on the (Cricket) Farm

Cross-Curricular Connections, teacher guide

Directions for teachers: After students have had a chance to read "Down on the (cricket) farm," ask your students to put themselves in the shoes of a farmer who is trying to produce crickets for human food in a sustainable and economical way. Consider reviewing the concept of a life cycle analysis, as discussed in the article with the entire class. A brief overview of the life cycle analysis concept is provided at Population Education's PopEd Blog. Ask students to define how each life cycle analysis step could apply to agriculture, and in particular, a cricket farm.

After the short class discussion, divide your students into groups and assign each group to think about one problem that a cricket farmer might face (four possible problems are listed below). Have the groups work toward a solution by answering the questions provided. Encourage students to draw inspiration from the article but also go beyond it, applying their knowledge of ecosystem interactions, energy transfer, nutrient cycling and engineering design.

Problem 1: Your crickets are low in protein relative to insects from a neighboring farm. If you can't find a way to boost protein content and so become more competitive, your sales will drop.

Problem 2: You've long fed your crickets by hand, ensuring that each population gets the right amount of food at the right time, including during the night. But a labor shortage in your area is making this approach too expensive to sustain. You need to find a more economical solution.

Problem 3: Your crickets are dying in large numbers and you suspect some type of bacteria or virus has infected your farm. You need to move quickly to identify the menace, mitigate the issue and protect your remaining crickets.

Problem 4: Cricket sales are strong and you are looking to expand your business. You'd like to bring on another insect without dramatically disrupting your current operation — but what insect should you choose?

Questions for all problems:

1. What additional information would you want to gather before you take any action?

2. How would you find that info? Would it come from existing expertise or outside sources?

3. Propose one approach you might take to solve the problem. Would this approach require multiple actions to achieve a solution, or could the problem be solved with a single action?

4. Will you test the approach before large-scale implementation? If not, why not? If so, how?

5. Name at least four steps you'll take to implement your approach. Put them in order.

6. What might be the downsides of this approach? Can you predict any unintended consequences or ripple effects?

7. How will you evaluate the success of the implementation?

8. Can you think of an entirely different approach?

Down on the (Cricket) Farm

Activity Guide for Teachers: Chirpy Jerky

Purpose: Students will learn procedures for various biochemical tests to find and compare the nutrient compositions of insects with those of more conventional snack foods. Students will consider the implications of eating insect-based food on their diets, and for society more broadly. This activity builds on the article "Down on the (cricket) farm."

Procedural overview: Students will test insects and snack foods for protein, fat, starch, glucose and pH using common biochemical reagent tests. After completing the tests, students will analyze their results by comparing them to the nutrition labels and ingredient lists provided and answer the associated questions.

Approximate class time: 1 class period.

Supplies:
Chirpy Jerky student activity guide
Gloves
Safety goggles
Twenty-four 20-milliliter test tubes per group
Markers to label test tubes
One test tube rack per group
One small graduated cylinder per group
Water
One mortar and pestle or other tool for pulverizing samples per group
Digital scales or balances
Weigh paper
Disposable plastic pipettes
Biuret reagent for protein testing (available at Home Science Tools or other chemical supply company)
Sudan red reagent for fat testing (available at Home Science Tools or other chemical supply company)
Iodine for starch testing
Glucose test strips (available on Amazon.com or at a pharmacy)
Universal colorimetric pH test strips (available on Amazon.com or at a pharmacy)
Three different dried insect samples* per group (found locally, bought at a pet or bait shop, or from Amazon.com: mealworms, crickets or other mixed bugs)
Three different snack food samples* per group (peanuts, beef jerky, crackers, chips, chocolate, dried fruit, for example)
*Be sure to keep the packaging that lists the ingredients and nutritional value and provide it to students

Directions for teachers:

Set up a lab station for each group (you'll want two to three students per group) with the equipment listed above. Have groups share equipment, if needed. Place all biochemical reagents, test strips and samples (insects and snack food) on a central table for students to share. Try to round up a variety of at least three snack foods and three insect types so that each test will have some positive and some negative results. Reading through the possible student answers under “Directions for students” can inform your insect and snack food selections.

Have students answer the pre-lab questions individually and then divide them into groups. Students will test for protein, fat, starch, glucose and pH. Make sure students are wearing gloves and goggles for the chemical tests; students should not be touching any of the chemical reagents directly or eating any of the insects or snack foods. Remind students that they should never eat or taste anything in a laboratory setting. As they test insects and snack foods in biochemical assays, have students think about the nutritional value of insects.

Depending on the time available, have students either complete the analysis questions in groups or for homework.

Directions for students:

The *Science News* article “Down on the (cricket) farm” discusses raising insects as a food source for humans. What do you know about the nutritional value of insects? Would you eat insects as a snack or make them a regular part of your diet? During this investigation you will perform common biochemical tests for protein, fat, starch, glucose and pH to find and compare nutrient compositions of insects with those of more conventional snack foods. After completing the tests, you will analyze the results and compare them to the nutrition labels for the snack food and insects tested. Finally, you’ll see if your opinion about insect consumption, and its possible benefits, has changed.

Please note: You should never eat or taste substances in a laboratory setting!

Pre-lab questions

Answer the following pre-lab questions individually before joining your group to complete the activity.

1. What are your current ideas about eating insects as snacks? Have you ever eaten an insect? Would you try one if you were given the opportunity?

2. Do you think insects could be a viable food source for people more broadly? Explain your answer.

Biochemical investigation

1. Grind up examples of each type of dried insect and snack food using a mortar and pestle or other tools provided by your teacher. Carefully clean the mortar and pestle after each sample to avoid cross-contaminating the samples. Weigh out 1.5 grams of each ground sample, add it to a test tube and label the test tube. Add 15 ml of water to each test tube. Seal each test tube tightly with a cap or with your gloved

thumb and shake it vigorously to mix. After one minute of shaking, allow the contents to settle for about two minutes, and record your visual observations of the sample tubes.

Insect 1:

Insect 2:

Insect 3:

Snack food 1:

Snack food 2:

Snack food 3:

Student answers will vary, but students should note whether the water is clear, cloudy or colored, whether the solution separates into layers as the particles settle after shaking (especially a layer of fat at the top) and whether visible particles float to the top, fall to the bottom or remain suspended within the water over the course of about two minutes.

2. Dip a pH strip into each tube, let it dry for 30 seconds or so and compare its color to the pH color code that came with the strips. Record your results.

Insect 1:

Insect 2:

Insect 3:

Snack food 1:

Snack food 2:

Snack food 3:

Some samples may be noticeably acidic. For example, proteins are made of amino acids and thus are acidic, and dried fruit may contain significant amounts of citric acid and ascorbic acid (vitamin C).

3. Dip a glucose test strip into each tube, let it dry for 30 seconds or so and compare its color to the color code that came with the strips. Record your results.

Insect 1:

Insect 2:

Insect 3:

Snack food 1:

Snack food 2:

Snack food 3:

Some foods will have detectable glucose, especially snack foods that contain corn syrup (a mixture of glucose and fructose).

4. Seal and shake up the test tubes again, then divide the contents of each one equally among four test tubes, three new test tubes and the tube holding the original sample. The three new tubes for each type of sample will be used for testing, and the remaining tube will be the control. You will compare your test results to the control tube to see how the contents have changed. Be sure to label all the tubes.

5. In one tube of each type, use Sudan red as a test for fat. Sudan red dissolves in fats or oils but not in water. Add one drop of Sudan red to one tube of each type. If the Sudan red colors a layer near the surface, that layer contains fat. Generally, the thicker the layer, the more fat is present. If the Sudan red keeps to itself or just forms a light color throughout the sample, the sample does not contain fat. Record your observations.

Insect 1:

Insect 2:

Insect 3:

Snack food 1:

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Snack food 3:

Examples of foods with significant fat are peanuts, potato chips and beef jerky.

6. In another tube of each type (not the tube that already has Sudan red), test for starch. Add one to two drops of iodine. If the iodine is yellow or light brown in solution, no starch is present. If the iodine turns the solution bluish-purple, dark brown or black, starch is present. Generally, the darker the color, the more starch is present. Record your observations.

Insect 1:

Insect 2:

Insect 3:

Snack food 1:

Snack food 2:

Snack food 3:

Examples of foods with lots of starch include crackers and chips.

7. In a third tube of each type, test for protein. Add one to two drops of biuret reagent. (Be careful, biuret reagent is corrosive!) If the solution turns blue, no protein is present. If the solution turns purple, protein is present. Generally, the more purple, the more protein is present. Record your observations.

Insect 1:

Insect 2:

Insect 3:

Snack food 1:

Snack food 2:

Snack food 3:

The insects and snack foods such as beef jerky and peanuts should contain significant amounts of protein.

Analysis questions

1. Examine the list of ingredients and the nutritional information on the bags that the snack foods and edible insects came in. How well do they agree with your biochemical test results? What does this tell you about the accuracy of the tests you performed? What might be the sources of error?

2. What are the main nutritional components of the insects you tested? What are the main nutritional components of the snack foods you tested?

3. Does any of the snack food or insect nutritional information surprise you?

4. Based on your biochemical test comparisons and knowledge from the ingredient list, which if any of the following would you eat? Why or why not?

Meat from animals that have been fed insects (for example farmed fish)

Foods that contain powdered insects in the recipe

Deep-fried insects

Chocolate-covered insects

Salt-covered insects

Plain and crunchy insects

Live insects

5. After completing this lab, have your thoughts about consuming insects changed? Would you substitute insects for your common snack foods? Would it be beneficial to consider making insects a part of your regular diet? Why or why not?

6. Why do you think it's not common to eat insects in the United States? Do you think it could become a common trend? Why or why not?

7. Based on the reading of the article and this activity, how likely is it that insects will play a substantial role in feeding a growing global population? Could eating insects be beneficial for society? Explain.

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Down on the (Cricket) Farm

Student Activity Guide: Chirpy Jerky

Directions: The *Science News* article "Down on the (cricket) farm" discusses raising insects as a food source for humans. What do you know about the nutritional value of insects? Would you eat insects as a snack or make them a regular part of your diet? During this investigation you will perform common biochemical tests for protein, fat, starch, glucose and pH to find and compare nutrient compositions of insects with those of more conventional snack foods. After completing the tests, you will analyze the results and compare them to the nutrition labels for the snack food and insects tested. Finally, you'll see if your opinion about insect consumption, and its possible benefits, has changed.

Please note: You should never eat or taste substances in a laboratory setting!

Pre-lab questions

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2. Do you think insects could be a viable food source for people more broadly? Explain your answer.

Biochemical investigation

1. Grind up examples of each type of dried insect and snack food using a mortar and pestle or other tools provided by your teacher. Carefully clean the mortar and pestle after each sample to avoid cross-contaminating the samples. Weigh out 1.5 grams of each ground sample, add it to a test tube and label the test tube. Add 15 milliliters of water to each test tube. Seal each test tube tightly with a cap or with your gloved thumb and shake it vigorously to mix. After one minute of shaking, allow the contents to settle for about two minutes, and record your visual observations of the sample tubes.

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Down on the (Cricket) Farm

Related Articles

Science News:
"A big analysis of environmental data strengthens the case for plant-based diets," Readability: 13.6
"A caterpillar outwits corn defenses by gorging on fattening 'junk' food," Readability: 9.2

Science News for Students:
"Why can't bugs be grub?," Readability: 7.1
"Crickets for breakfast?" Readability: 7.9
"Cool Jobs: Finding foods for the future," Readability: 6.5