Unit 4

Matter Cycling and Photosynthesis:

Where does food come from, and where does it go next?

Student Procedure Guide

GRADE 7 Core Knowledge Science®

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Matter Cycling and Photosynthesis:

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Core Knowledge Science®

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Matter Cycling and Photosynthesis

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Readings

Lesson 1: Where does this stuff come from?

Explore the food we ate today.

In your notebook

1. Stop and jot: Pick a meal—breakfast or lunch. In your science notebook, write down everything you ate for that meal.
2. Be ready to share your thoughts with a partner.

Turn and talk

3. Where did the foods you ate originally come from (way before they got to the grocery store or cafeteria)? What originally made the food?

Where did the food we ate for breakfast come from?

In your notebook

4. Look at your list of foods.
   a. In your science notebook write the question, “Where does our food come from?” and draw three bins: “100% from plants,” “Mixture/Not Sure/Other”, and “100% from animals.”
   b. Then categorize which of the foods you ate came from the following: Plants, Mixture/Not Sure/Other, and Animals.

Taste the maple syrup.

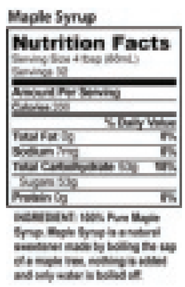
Your teacher recently ate a food that they were surprised came 100 percent from a plant. It was maple syrup. They brought in some samples so we could all have a taste.

In your notebook

5. Create a t-chart in your notebook, under the title “Maple Syrup.”

Notice	Wonder

6. Your teacher will soon provide you with a sample of maple syrup to taste.
7. Record these observations in your notebook:
   a. What do you notice that would help explain why it smells or tastes the way it does?
   b. Did food labels include any food molecules we learned about before while studying M’Kenna’s case?
   c. Which food molecules do you recognize?



d. What did you notice about the food molecules found in maple syrup?

e. Why are sugars listed under total carbohydrates?

f. What is going into the system that gives this output of this really sweet food? Where is syrup coming from?

Watch a video of where maple syrup comes from.

In your notebook

8. The video you will see https://youtu.be/NuY5n61TVtE shows how maple syrup is tapped from trees.

9. Record what you notice and wonder about this process in the same Maple Syrup observations and questions table in your science notebook.

a. What patterns do you notice about the system during the maple syrup tasting and the video of tapping a maple tree?

b. What did you notice about the inputs and outputs of the system?

c. What do you think the clear maple sap coming straight out of the tree tastes like?

Share our observations and patterns of maple syrup.

With your class

10. What patterns do you notice about the system during the maple syrup tasting and the video of tapping a maple tree?

11. What did you notice about the inputs and outputs of the system?

12. What are you wondering about now?

Set up a table to observe maple sap.

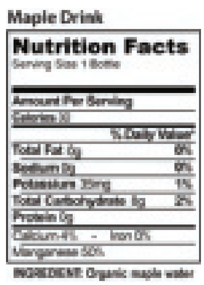
On your own

13. Draw a t-chart in your notebook, under the title Maple Sap.

Notice	Wonder

14. Your teacher will soon provide you with a sample of maple sap to taste and the Maple Sap Food Label to observe.

15. Record these observations in your notebook.



Recall what happens to the food we eat.

Close your eyes. Think about the sugar in the maple sap we just drank.

In your notebook

16. Stop and jot: Visualize what just happened to the maple sap we put into our mouths. Over the next 24 hours, where will it go? What will happen to it?

With your class

17. Share out what you think will happen to the food you just ate now that it's in your body.

Reexamine food molecules.

We learned in the Inside our Bodies Unit that when we eat food, it gets broken down and that we use it for energy, for growth, or for later use by storing it.

With your group

18. Your teacher will handout *Food Molecule Cards.*

19. Share as a class: What is food made out of according to our *Food Molecule Cards*? And what primarily makes up those food molecules?

Predict which food molecules are in plants

With your group

20. Look at your original list of foods that you individually categorized.

21. Write each food from your individual list on a sticky note.

22. Work with your small group to combine all the sticky notes with foods you ate into three groups: 100% from plants; Mixture/Not Sure/Other; and 100% from animals. Get rid of any repeats.

On your own

23. Use your 100% from plants category to make a prediction: "Which food molecules would we find in these plant foods?"

24. Record your predictions on *What's in the foods we eat that come from plants?.*

Navigation

We left off making predictions about what food molecules were in plants and reading about breakfast foods from around the world.

In your notebook

25. Take out your science notebook.

26. What were some of our predictions about which food molecules were in food from plants?

27. What did we want to do to figure out our predictions?

28. What do we want to look for when investigating our predictions about what is in the food we eat and food from around the world that comes from plants?

Read about breakfast food around the world.

Before we investigate our food from plants to see what food molecules they have, let's take some time to see if people around the world also eat food from plants!

Home learning

29. Why might it be important for us to look at foods from around the world?

30. Why might it be important for us to look at foods that are personally relevant to us?

31. You will each read *What do kids around the world eat for breakfast?* which is about children in other countries and what they eat for breakfast.

Investigate what is in food from plants.

With your group look up nutrition labels for what's in the foods we eat that come from plants.

With your group

32. Record your findings in the "Results" section of the table on *What's in the foods we eat that come from plants?*.

33. Have a representative from your small group chart the findings of 2–3 foods you ate on the whole class Related Phenomena poster titled, "What's in the Foods We Eat That Come from Plants?"

34. What do our results tell us about what might be different about the structure of starch (complex carbohydrate) versus glucose (sugar) molecules?

Develop initial models of how plants get food molecules.

On your own

35. Develop an initial model of the plant system to explain: How did this plant get its food molecules? Where did the food molecules come from?
    a. Use pictures, symbols, and words to try to explain your thinking. Label any drawings.
    b. Try to account for *all* of the things happening that we noticed; focus on explaining what might be causing those things to happen.
    c. Record questions that you have if you become stuck.

Compare initial models of how plants get food molecules.

With a partner

36. Draw a t-chart in your notebook under the title "Comparing Our Models."

Similarities	Differences

37. Explain your model to an elbow partner at your table.

38. Each student talks for one minute.

39. Then record in your science notebook similarities and differences you notice about the ideas represented.

Revisit classroom norms.

Scientists Circle

40. With your class, you will form a Scientists Circle and revisit the *Classroom Norms* for how the class wants to work together and learn together in science class.

41. Remember that we have our *Communicating in Scientific Ways* to help us talk to each other.

Develop a consensus model of how plants get food molecules.

Scientists Circle

42. Gather in the Scientists Circle with your notebook.

43. The purpose of our whole-class consensus discussion is to:

a. Summarize some important similarities and differences we have.

b. Develop a model together that identifies where we have some promising ideas and other places where we are less certain.

Navigation: Record your questions.

On your own

44. Write down any new questions you are thinking about after making our class consensus model.

45. Be prepared to share these with the whole class, in our next class.

Share questions to post on our Driving Question Board.

With a partner

46. Review the questions you brainstormed at the end of last class. Use these question starters to create two revised or new questions to post to our DQB:

- Why . . .?
- How . . .?
- How would it be different if . . .?
- What if . . .?
- What is the purpose of . . .?
- What causes . . .?

47. Then write one question per sticky note. Write in marker—big and bold. Put your initials on the back in pencil.

Build the DQB.

Scientists Circle

48. How to build a Driving Question Board:

Take out your sticky notes with questions. Bring those with you to the Scientists Circle along with your science notebook.

a. The first student reads his or her question aloud to the class, then posts it on the DQB near the part of the model the question most relates to.

b. Students should raise their hand if any of their questions relates to the question that was just read aloud.

c. The first student selects the next student whose hand is raised.

d. The second student reads his or her question, says why or how it relates, and posts it near the question it most relates to on the DQB.

e. The student selects the next student to share a related question or a new question.

f. We will continue until everyone has at least 1 question on the DQB.

Ideas for Investigations

In your notebook

49. What investigations could we do to help us figure out how plants get their food molecules and to help us answer our DQB questions?

- Add your ideas to a new notebook page titled "Ideas for Future Investigations and Data We Need." Be prepared to share these with the class.

With your group

50. Share your ideas for investigations with the whole class.

Lesson 2: Do plants get their food molecules by taking them in?

Navigation

At the end of the last class, we generated many questions about where the food molecules in plants are coming from. Before that, we also made a consensus model as a class about things we agreed on. What were some of those ideas? We can use a tool called a Progress Tracker to help us keep track of everything we are figuring out.

On your own

1. Add a new row in your Progress Tracker. Use two columns with the headings "Question" and "What I figured out".
2. Record the lesson question, "Where does this stuff come from?"
    - Think about "What was inside all the food items we checked?" and "What were the inputs we agreed on that went into the plant?" Record the ideas you figured out related to this question and what you did to figure it out.

Where should we go next?

Turn and talk

3. With a partner discuss, "Where do you think plants get these food molecules?"

With your class

4. Be prepared to share out your ideas.
5. What question is your class wondering about?

Exploring Plant Growth in Class

With a partner

6. Analyze the photo, seeds, and nutrition labels for the plants growing in class.
7. Answer the following questions:
    - Which types of food molecules does each plant have? (Radish, sugar beet, spinach)
    - How does the amount of matter in a single seed compare to the amount of a plant that has grown for five weeks? How does the size of each compare?

With your class

8. Discuss your answers on *Photos of Plants Growing in Class.*
9. When we say something has more "matter," what do we mean by that? What does "matter" mean?

Investigating Inputs from Our Candidates List

With your class

10. If soil and water are sources of food molecules, how would they be getting into the plant?

11. Would they be going into the plant above the surface or below the surface?

Observations and Patterns We Noticed

On your own

12. Sketch an observation table in your science notebook under the title "Hydroponic plant system".

What I observed	Questions I have

13. Gather around the hydroponic plant system with your teacher. Bring your notebook to write down what you observe and any questions you have.

Updating Our Progress Tracker

On your own

14. Add a new row in your Progress Tracker. Use two columns with the headings "Question" and "What I figured out".

15. Record the lesson question, "Is soil a source of food molecules?"

- Record the ideas you figured out related to this question and what you did to figure it out.

Analyzing the Hydroponic Plant System

With a partner

16. Analyze the hydroponic plant setup.

17. Answer the questions below:

- What does the bubble rock do?
- What happens when the buoy gets to the red mark?
- What is added to the water?
- Why do you think the water solution needs to be replenished?

With your class

18. Discuss your answers from above. Add your new candidate to the candidates list.

What are food molecules made out of again?

Pull out your molecular models of food *Food Molecule Cards*. What are food molecules? What are they made out of?

Turn and talk

19. What evidence would help us determine whether hydroponic plant food is the source of food molecules?

20. What could we do to figure out whether hydroponic plant food is the source of food molecules?

Investigating Hydroponic Plant Food as a Possible Candidate

With a partner

21. Analyze the hydroponic plant food label on the slide.

22. Do you see evidence that is the source of all the food molecules? Why or why not?

With your class

23. Share out ideas you came up with about how to test whether hydroponic plant food is the source of food molecules for plants.

Lab Experiment Using Food Indicators to Test Hydroponic Plant Food

Part 1: Designing Our Experiments

With your class

24. Work with your class to figure out the answer to these questions:

- What should our negative control group be? (a substance that we know would NOT change color/appearance)
- What is our "experimental" group? (the substance we are interested in seeing whether its color/appearance changes)
- How could we make sure our food indicators are working properly (+ control group)? (substance we *know* should change color/appearance)

Part 2: Data Collection

Wear goggles while running your experiments.

With your group

25. With your group, follow the procedure on *Lab experiment using food indicators to test hydroponic plant food* to carry out the investigation.

26. Use *Which food molecules are in the hydroponic plant food?* to record your data during the investigation.

Record class data.

With your group

27. When your group is finished with your experiment, come to the board and record your individual result by putting a "Y" if you saw a change in the hydroponic plant food water sample or an "N" if there was no change.

Making Sense of Our Data

With your class

28. Discuss:

- What does our data tell us? Are food molecules found inside hydroponic plant food (HPF)? What is your evidence?
- How do you know your food indicators were working?
- What should we do with HPF on our candidates list?
- Are there any other candidates on our list that we tested for food molecules?
- What should we do with that candidate on our candidates list?

Updating Our Progress Trackers

On your own

29. Add a new row in your Progress Tracker. Use two columns with the headings "Question" and "What I figured out".

30. Record the lesson question, "Is hydroponic plant food (HPF) a source of food molecules?"

- Record the ideas you figured out related to this question and what you did to figure it out.

31. Add another new row in your Progress Tracker. Use two columns with the headings "Question" and "What I figured out".

32. Record the lesson question, "Is plain water a source of food molecules?"

- Record the ideas you figured out related to this question and what you did to figure it out.

Lesson 3: What other inputs could be sources of food molecules for the plant?

Navigation

Turn and talk

1. Stand in the Scientists Circle with your notebook around our consensus model.
   a. What did we figure out last lesson?
   b. What are we wondering about?

What do we already know about light?

With your class

2. Discuss what we figured out about light in our Cup Design and Storms Units.
   a. What do we know about sunlight already?
   b. What have you figured out in earlier units?
   c. What is sunlight made of?
   d. What does sunlight do?

What do we already know about air?

With your class

3. Discuss what we figured out about air composition in previous units.
   a. What is air made of?
   b. Is air one substance?
   c. Is air matter?

Analyze the composition of air to look for food molecules.

With a partner

4. Look at *Composition of Air* and discuss with your partner:
   a. What do we notice when looking at the composition of air?
   b. What molecules make up food?
   c. Are any of those food molecules found in air?

Problematize candidate sources for plant food molecules.

With a partner

5. Look at *Food Molecule Cards* and compare it to what we have figured out about light, air, water, and hydroponic plant food.
   a. What patterns did you notice between parts of food molecules and candidates?

With your class

6. Share out with your class:

   a. What patterns did you notice between parts of food molecules and candidates?

Revise our candidates list.

With your class

7. Let's revisit our candidate list and make some updates based on evidence we collected.
8. We can go through each candidate and move it to where it fits best with our new question.

Revise our consensus model.

With your class

9. What inputs can we confirm on our consensus model?
10. How could we represent this on our model?
11. What inputs have we figured out some things about but still might need more evidence?

Navigation: Record new questions.

On your own

12. Explain your reasoning using evidence. Why have we revised our question to be what candidates are possible sources for parts of food molecules for plants?
13. What else do we need to figure out about potential sources of food molecules?

Lesson 4: Are any parts that make up food molecules coming into the plant from above the surface?

Navigation

At the end of the last class, we decided to start looking at candidate inputs for parts of food molecules since none of the candidate inputs were whole food molecules. We saw that below the surface, water and hydroponic plant food had some parts of food molecules.

Turn and talk

1. Refer to our consensus model and talk with a partner.

a. What were some of the things we noticed when we compared the composition of substances around plants to food molecules?

b. What did we decide to do now?

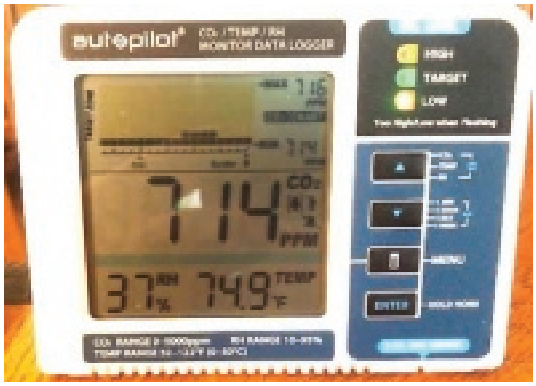
Ideas for Investigating Above the Surface

With your class

2. Discuss ideas for investigating above the surface with your class.

a. How could we test the idea that plants are taking in gases out of the air?

We have this carbon dioxide detector that also detects relative humidity.



Turn and talk

3. Will just placing the detector close to the plant leaves tell us if gases are going into the plant? Why or why not?

With your class

4. Discuss

a. What part of the plant should go in the bag?

b. Which parts of the plant are touching the air?

Measuring Gases in the Air

In your notebook

5. Tape *Investigating Above the Surface Inputs* into your science notebook and fill in the gases we will be monitoring in the "Substance" column.
6. Predict what will happen to the amounts of carbon dioxide and water in the closed system and why. Record your predictions under part A of *Investigating Above the Surface Inputs* in your science notebook.
7. Record the gas levels for each substance in part B after the detector has been in the closed ziplock bag for 5 minutes.

Measuring Gases in the Air Around Plants

In your notebook

8. After 5 or 10 minutes, record the ending time and the gas levels for each substance in part C.

With a partner

9. Record your responses to the questions in the "Making sense of our results" section of the *Investigating Above the Surface Inputs* handout in your science notebook.

Making Sense of Our Results

With your class

10. Discuss the following questions:
    a. Are any ***parts*** that make up food molecules going into plants from above the surface? What claims can you make based on evidence from this experiment?
    b. What are you unsure of or what new questions does this raise for you?

Comparing Arguments About Water

Turn and talk

11. Discuss what you think about the following student claims with a partner:
    a. The same water molecules that come into the plant through the roots go out of the plant through the leaves. They just flow through the plant without changing.

b. The water molecules that go into the plant are used to make food molecules, and other chemical reactions in the plant form water molecules that come out of the leaves.

c. Some of the water passes straight through the plant unchanged but some of it is used to make food molecules.

In your notebook

12. Tape *Comparing and Critiquing Arguments about Water in Plants* into your science notebook. Using your Progress Tracker and the "Making sense of our results" section of the *Investigating Above the Surface Inputs* handout in your science notebook as sources of evidence, provide feedback to each student. How does the evidence support their claims?

Home learning

13. In your science notebook, explain which student's claim about what happens to water inside plants you think is best supported by the evidence.

Navigation

With your class

14. Last class we looked at carbon dioxide and water levels in the air around plant leaves. Discuss the following questions:

a. What did we figure out in that investigation?

b. What questions did this raise?

Reading About Another Class's Experiment

With your class

15. Read *Another Plant Experiment* in the student edition. Discuss similarities and differences in how their data were produced compared to our data.

In your notebook

16. Based on what we saw happen in the class investigation we did, what do you predict about how carbon dioxide, water vapor, and oxygen levels will change? For each substance, record whether you think it will increase (+), decrease (–), or stay the same (=). Record your predictions in a T-chart in your notebook using the following example.

My Predictions	
Gases	How they will change

Analyzing Data with the Identify and Interpret (I²) Strategy

With your group

17. Tape *Data from Leaves in the Light* into your science notebook.

18. Use the Identify and Interpret (I^2) strategy to analyze the data tables and graphs.

a. First, make observations:

i. Point to something you notice in the tables or graphs.

ii. Talk with your group using "What I see" (WIS) comments.

b. Second, interpret what these observations mean:

i. Think about what each observation means.

ii. Talk with your group about "What it means" (WIM) for each of your observations.

Consensus Discussion: Updating Our Model and Progress Trackers

In your notebook

19. Record a claim and support it with evidence:

a. What inputs can we add to our model that contain parts of food molecules?

b. What outputs can we add to our model?

Be prepared to share your claims and new questions that you have with the class.

With your class

20. Bring your notebook to the Scientists Circle.

21. Have a Consensus Discussion with your class using evidence to decide what can be added to our model with certainty.

In your notebook

22. In the progress tracker section of your notebook, create the 3-box Progress Tracker shown (shown below).

Progress Tracker	
Question	**Source of evidence**
Are any parts that make up food molecules coming into the plant from above the surface?	
What I figured out in words/pictures	

23. List the sources of evidence from this lesson and use your own words and pictures to describe what we figured out.

Next Steps

On your own

24. Write your answer to the question, "Why are these gases moving in and out of plant leaves? How does that happen?" Then record ideas for how to investigate this question.

Lesson 5: How are these gases getting into and out of leaves?

Navigation

Turn and talk

1. Using your Progress Tracker, turn and talk with a partner about what we figured out last class.

a. How do you think gases are moving into and out of leaves?

b. What proposals did we have for ways to investigate how gases were getting into and out of leaves?

Prepare Leaf Observations data table and observe spinach leaves.

In your notebook

2. Tape *Leaf Observations* data table into your science notebook.

a. Add in a description for for data source A: "Leaves under a magnifying lens."

In your notebook

3. Make observations of the leaf structure with a magnifying lens.

a. Record your observations of leaf structures and ideas about their function on *Leaf Observations.*

With a partner

4. Discuss spinach leaf observations.

a. What did you observe about the surface of the leaves?

b. Do the structures remind you of anything?

c. Does the structure of the leaf provide any evidence for how carbon dioxide gets into a leaf, how oxygen gets out, or what is happening inside the leaf?

Zoom in on the surface of a leaf.

In your notebook

5. Find data sources B and C on *Microscopic Leaf Images* and make observations of the images.

a. Record your observations of leaf structures and ideas about their function on *Leaf Observations.*

Zoom in on the inside of the leaf.

In your notebook

6. Use data source D on *Microscopic Leaf Images* to make observations of the inside of a leaf.
   a. Record your observations of leaf structures and ideas about their function on *Leaf Observations.*

With your group

7. Work with your small group to make sense of your observations of data sources B through D.
   a. Make sure to record any new observations and ideas about function on *Leaf Observations.*
   b. Write a description of each source under each source in the 'Data source' column.

Watch a video of the inside of a leaf.

In your notebook

8. Watch https://youtu.be/tQOjO2LJGGc and make observations of data source E.
   a. Record your observations of leaf structures and ideas about their function on *Leaf Observations.*

With your group

   b. Work with your small group to make sense of your observations of the last data source (E).

Make sense of our observations.

With your class

9. Share your ideas about data sources A through E with the class.
   a. What structures did you notice on the surface of the leaves and inside the leaves?
   b. What do these structures remind you of?
   c. What ideas do you have about the function of these structures?
   d. What evidence do your observations provide for how gases could get in and out of the leaves?

What new questions do we have?

In your notebook

10. Record any new questions that you have.
    Be ready to share your new questions with the class.

What is inside a leaf?

With a partner

11. Read *Plant Cells* to gather information about what is happening inside plant leaves.

In your notebook

12. Jot down notes in your science notebook about the discussion questions as you discuss the prompts with a partner. If you are not sure about an answer, record your initial ideas or any questions that may arise.
Be prepared to share your ideas with the class.

Build understandings about plant and animal cells.

With your class

13. Gather in the Scientists Circle and discuss the following questions with your class. Base your answers on your prior knowledge and evidence you gathered from the reading.

a. What do we know about animal cells?

b. How are plant and animal cells similar and different?

c. We know plants need sunlight. How do plants use sunlight?

d. What new questions do you have?

Revisit our class model.

With your class

14. As a class, decide if we need to add to or revise our model.

a. Are there any new pieces we need to add to our model?

b. How would we represent these new pieces?

Navigation: Ideas for Investigation Exit Ticket

With your class

15. What inputs and outputs have we figured out some things about but might need more evidence?

a. What exactly is going on inside a plant cell?

b. How can we figure out if something is happening to our inputs inside the plant?

c. What structures inside the plant would you zoom in on?

Scientists often build computer simulations to help investigate and visualize systems that have parts in them that are too small to see. Computer simulations are programmed to have the objects and interactions that the user wants or needs.

On your own

16. Think about what you would want to see included in such a computer simulation that would help you better understand what's going on inside of a plant cell.

17. Complete an exit ticket answering the following questions.

a. What inputs and outputs of the plant system would we want to represent?

b. What structures of the plant would we want to represent?

Lesson 6: How are all these things interacting together in this part of the plant?

Navigation

At the end of the last class, we saw that there are small openings in the leaves of plants. Now we want to investigate how the inputs we have on our candidate poster are interacting within the plant cell to make food. We will use a computer simulation to investigate this.

With your class

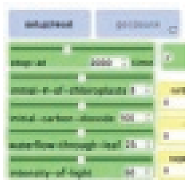
1. What were some of the inputs and outputs of the plant system we wanted to represent in that simulation?
2. What were some of the structures of the plant we wanted to represent?

Orienting to the Simulation

On your own

3. Write this question your science notebook:
   A. How are all these things interacting together in this part of the plant?
4. The simulation gives you a control panel to adjust the inputs and structures in the virtual plant cell. Each slider controls a different variable. **Which, if any, of these inputs were ones we also wanted to see included in the simulation?**

5. The simulation also shows monitors and a graph to help you keep track of inputs and outputs to the virtual cell. A key describes the things that are interacting in the model, off to the right. **Which, if any, of these inputs were ones we also wanted to see included in the simulation?**



Investigation A

6. Open a web browser and go to this web address: https://www.openscied.org/Chloroplasts-and-Food
7. Do not change the sliders. Just press the  .
8. **Record the things you notice that are now in the simulation before you go any further in your science notebook.**
9. Press the GO/PAUSE button. -----------> 
10. Keep the auto-stop slider checked so the model will stop running when it reaches 2000. --------> 

11. **Record the things you notice that are now in the simulation but that were not there before. Did anything disappear that was there before?**

12. Repeat steps 2–6 as time permits.

Make sense of Investigation A.

With your class

13. Share your observations of what was in the plant cell at the start and at the end of the simulation and any interactions you saw happening between these inputs and outputs and the chloroplasts.

What was in the plant cell at the start? **(Inputs)**	**Interactions** <--- Between these ---> and the chloroplasts	What was in the plant cell at the end? **(Outputs)**

Make some predictions.

With a partner

14. Would increasing the amount of any of these inputs or structures affect the outputs?

15. Would reducing or removing them affect the outputs? Why?

Plan Investigation B.

With your group

16. Work as a team to decide which variable listed in column A in the table each group member will manipulate to help figure out these questions:
    - Would increasing the amount of any one of the inputs or structures in the simulation affect the outputs?
    - Would reducing or removing an input affect the outputs?

17. Individually complete your investigation B plan on *Planning and carrying out investigations,* using the table on the next page to help design your investigation.

Simulation Inputs Reference Table

A. Independent variable	B. Slider to change the amount of this	C. Minimum value you can set this to	D. Maximum value you can set this to
Number of chloroplasts		0	6
Initial number of carbon dioxide molecules		0	200
Rate of water flow through the leaf		0	50
Intensity of light shining on the leaf		0	100

Conduct Investigation B.

On your own

18. Create a data table on your student handout for recording the values of the independent variable and resulting values of the dependent variable(s) for each simulation run you plan to do.

Follow the procedure for Investigation B.

19. Change the slider for your independent variable to one of the values you wanted to test.

20. Press the SETUP/RESET button to restart the model with these new conditions. Press the GO/PAUSE button to test the effects of these changes.

21. Pause the model by pressing GO/PAUSE when the TIME monitor reaches the point that you planned to stop your test.

22. Record the value(s) of your dependent variable(s) at this point in time in your data table for investigation B.

23. Repeat the previous steps for the number of trials you wanted to do for each different value of the independent variable you wanted to test.

24. Complete the “Making sense” questions on your handout.

Share claims with your group.

With your group

Share your claims with your small group using the following discussion protocol:

25. Small-group talking stick protocol, round 1

- Pass around a pencil as a talking stick to take turns having each person share his or her claim(s) (one minute per person).
- As each person shares, think about how your claim connects to that person's claim(s), but do not add your own ideas yet.

26. Small-group talking stick protocol, round 2

- Pass the talking stick around again to have each person share what this tells them about what is needed for plants to produce sugar and oxygen.

Updating Our Progress Trackers

Scientists Circle

27. How does what we figured out help us understand and explain the question, "How are all these things interacting together in this part of the plant?"

28. Decide as a class what to add to your Progress Tracker.

Turn and talk

29. Why is sunlight needed, and what does it provide the chloroplast?

On your own

30. Compare the inputs and outputs of the photosynthesis diagram in *Making sense of the computer simulation* to the inputs and outputs you found in the simulation. Then evaluate the different strengths of each representation to help you understand and explain an answer to our lesson question.

Lesson 7: Why do plants need light?

Navigation

With your class

1. As you discuss what we figured out last class, consider these questions:
   a. In the simulation, where was sugar being made?
   b. What were the inputs (reactants) in our simulation?
   c. What were the products (outputs) made in our simulation?
   d. Based on what we saw happening in the simulation, what happens inside the chloroplasts in plant cells?

Why might plants need light?

Turn and talk

2. As you share with a partner about the following two questions, be sure to reference your Progress Tracker:
   a. Why do you think chloroplasts need light to make sugar and oxygen?
   b. Why do you think carbon dioxide and water, without light, aren't enough to make sugar and oxygen?

Read *How do scientists measure energy in food?*

On your own

3. As you read *How do scientists measure energy in food?,* use *Obtaining Information from Scientific Text Checklist* to help you gather information from the text and images.
4. Answer the questions on *How do scientists measure energy in food?.*

Examine food labels for evidence our inputs provide energy.

With your group

5. Use the *Nutrition Labels: What is in food?* to see which inputs and outputs contain calories.
6. Record your findings on your *How much energy for food do water, carbon dioxide, glucose, and oxygen provide?* handout.

Build understanding and argue from evidence.

With your class

7. As you discuss what we figured out last class, consider these questions:

a. Now that we have analyzed some food labels for the inputs that we know plants need to make food molecules that can provide our body energy, what is the issue we are trying to account for between the inputs and outputs?

b. How do carbon dioxide and water along sunlight interact in a plant to help it be able to make sugar, which contains matter and energy?

c. Where do you think the energy comes from for the chemical reaction to occur and rearrange the atoms to create new (or) different molecules?

d. Can we still make these claims even though we were not able to examine a food label for oxygen?

e. Can we still make these claims even though we were not able to examine a food label for oxygen?

Update our Progress Trackers.

On your own

8. Draw a 3-box Progress Tracker in the Progress Tracker section of your notebook:

a. Write the lesson question in the top left box: *Why do plants need light?*

b. In the right box, list the source(s) of evidence.

c. In the bottom box, use words and/or pictures to document what we have figured out in relation to the lesson question.

Lesson 8: Where are plants getting food from?

Navigation

With your class

1. Open your science notebooks to your *HOW Plants Get Food Initial Model.*
2. Discuss:
   a. What are we trying to figure out about maple trees and plants in general?
   b. What have we figured out so far in our investigations?

Return to our initial model and driving questions.

In your notebook

3. Look at your initial model of food molecules in plants from Lesson 1. Think about the investigations you have done since then.
   a. Highlight the parts of the model where you think you know more now because you have collected more evidence about where food molecules in plants come from.

Create a Gotta-Have-It Checklist.

With your group

4. Make your Gotta-Have-It Checklist. It lists the important ideas you need to include in your new model to explain how plants get their food molecules and where food molecules in plants are coming from.

Revisit classroom norms.

With your class

5. Pick one of the classroom norms that you feel personally connected with to work on today.

Revise the class consensus model.

With your class

6. Discuss our questions: *HOW do plants get their food molecules? Where do the food molecules come from?*
   a. What ideas should we include in the consensus model?
   b. How should we represent those ideas?
   c. Do we have evidence to support them?

Update our Progress Trackers (optional).

With your class

7. Draw a 3-box Progress Tracker in the Progress Tracker section of your notebook:

a. Write the lesson question in the top left box: *How do plants get their food molecules? Where do the food molecules come from?*

b. In the right box, list the source(s) of evidence.

c. In the bottom box, use words and/or pictures to document what we have figured out in relation to the lesson question.

Revise a model and argue from evidence assessment.

On your own

8. Individually complete *Individual Midpoint Assessment.*

Lesson 9: Where do the food molecules in the maple tree come from?

Navigation

In your notebook

1. Select two questions from the Driving Question Board (DQB) to answer.
2. Record your answers to the questions in your notebook.
3. Be prepared to share your answers with your classmates!

With Your Class

4. Share your ideas with the whole class.
5. Move any questions that we have answered to the section on the DQB labeled "Questions we have answered".

Applying Our Models to Explain Why Sugar Is Found in Maple Trees

Turn and talk

6. Last time, we developed a model to explain where food molecules in plants come from. Let's use our models now to explain the maple tree example.
7. Turn and talk with your partner: What are some of your initial ideas about how our models can be used to explain why sugar is found in maple trees?

With your class

8. In your science notebook, create a table:

Notice	Wonder

9. Rewatch the video of the maple tree being tapped.
10. Record your noticings and wonderings in the table.

On your own

11. Read *Reading: The History of Maple Tree Tapping.*
12. Add any new noticings and wonderings to your t-chart.
13. Share your noticings and wonderings with your class.

Developing Initial Explanations for Why Sugar Is Found in Maple Trees

With your class

14. Share your ideas about the question, "How can we apply our models to explain why sugar is found in maple trees?"

15. Answer the following questions:

a. What do our models help us explain?

b. What do our models not help us explain?

c. What alternative explanations do you have to answer this question?

16. Develop an initial explanation for the following questions:

a. How can plants have food molecules in them when all the inputs or structures needed to make food molecules aren't present?

b. Why do plants need food molecules?

Add to our Driving Question Board.

On your own

17. Our new questions are: "How can plants have food molecules in them when all the inputs and structures needed to make food molecules aren't present? Why do plants need food molecules?"

18. Write one or two questions on sticky notes with large, bold writing so everyone can see. Write only one question per sticky note.

19. Share your questions with your partner.

With your class

20. Follow these steps to add your questions to the DQB:

a. The first student reads their question aloud to the class, then posts it on the DQB.

b. Students who are listening should raise their hands if they have a question that relates to the question that was just read aloud.

c. The second student reads their question and posts it on the DQB. This student also says what other question on the board it relates to and why or how. The student selects the next student.

d. We will continue until everyone has at least one question on the DQB.

Navigation

Turn and talk

21. Turn and talk with your partner about the following questions:

a. Can they (trees/plants) be making food at this time of the year (spring) with no leaves?

b. What about other times of the year when they have leaves but no light, like at night?

22. Share your ideas with the class.

Lesson 10: Why don't plants die at night?

Navigation

We know plants are making food molecules. Last time, we started wondering why. We had a lot of new questions to explore.

On your own

1. Refer to our consensus model and your initial explanations about how plants can have food molecules in them when all the inputs or structures needed to make food molecules aren't present. Stop and Jot responses to the following questions in your science notebook:

a. What would happen to a plant if it stopped making food molecules?

b. Could a plant stop making food molecules? What can our model tell us about what might cause a plant to stop making food molecules?

Using the Consensus Model to Make Predictions

With your class

2. Discuss what the consensus model can tell us about what might cause a plant to stop making food molecules.

a. Do these conditions ever happen in the real world?

b. How do plants respond?

Ideas for Investigating Photosynthesis in the Dark

Turn and talk

3. Discuss the following questions with a partner:

a. How could we test what is happening with photosynthesis at night?

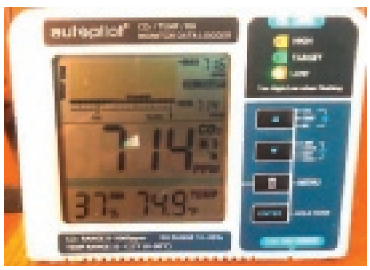
b. Have we done any investigations in the past where we monitored what was going into or out of plant leaves?

With your class

4. As a class, discuss how we could investigate what is happening with photosynthesis at night.

Measuring Gases in the Air

We can use the carbon dioxide/relative humidity (water) detector from Lesson 4. We will put the detector we used in a ziplock bag (a closed system) where we can take our measurements. We want the detector to stabilize, so we will put it in the bag and take an initial reading after 5 minutes.



In your notebook

5. Tape *Data Table for Leaves in the Dark* into your science notebook and fill in the gases we will be monitoring in the "Substance" column.
6. Predict what will happen to the amounts of carbon dioxide and water in the closed system in the dark and why. Record your predictions under part A of *Data Table for Leaves in the Dark* in your science notebook.
7. Record the gas levels for each substance in part B after the detector has been in the closed ziplock bag for 5 minutes.

Measuring Gases in the Air Around Plants in the Dark

Now that we have recorded the starting levels of carbon dioxide and water in the air in the ziplock bag, we will place 10-12 loose spinach leaves from the store into the bag with the detector and reseal it. We will use loose spinach leaves from the store so we do not damage our hydroponic plants. We want to see what happens with photosynthesis in the dark so we will cover the bag with aluminum foil to keep the light out and leave a small opening so we can read the detector.

In your notebook

8. After 10 minutes, record the ending time and the gas levels for each substance in part C. Record what happened to the amount of each substance in part D.

Comparing Data from Leaves in the Light and the Dark

In your notebook

9. Create the table shown below in your science notebook,

	Light (Lesson 4)	Dark (Lesson 10)
Carbon dioxide		
Water		

With your group

10. With your group, compare what's happening with plants in the light (Lesson 4) and the dark (Lesson 10). Consult the Lesson 4 section of your science notebook for reference. Record the patterns you saw in the table you just created.

Making Sense of Our Results

In your notebook

11. Record your responses to the questions in the "Making sense of our results" section of the *Data Table for Leaves in the Dark* handout in your science notebook.

With your class

12. Discuss the following questions with your class:

a. What is happening with photosynthesis in the dark? What claims can you make based on evidence from this investigation and our previous investigation in Lesson 4?

b. What are you unsure of or what new questions does this raise for you?

Navigation

Turn and talk

13. Discuss the following questions with a partner:

a. What question were we trying to answer with our investigation in the last class? What are we trying to figure out?

b. What did we say we needed to know more about?

Reading About Another Class's Experiment

With your class

14. Read *Another Plant Experiment in the Dark* in the student edition. Discuss similarities and differences in how their data were produced compared to our data.

In your notebook

15. Based on what we saw happen in the class investigation we did, what do you predict about how carbon dioxide, water vapor, and oxygen levels will change? For each substance, record whether you think it will increase (+), decrease (–), or stay the same (=). Record your predictions in a T-chart in your notebook using the following example.

My Predictions	
Gases	How they will change

Analyzing Data with the Identify and Interpret (I^2) Strategy

With your group

16. Tape *Secondhand Data for Leaves in the Dark* into your science notebook.

17. Use the Identify and Interpret (I^2) strategy to analyze the data tables and graphs.

a. First, make observations:

i. Point to something you notice in the tables or graphs.

ii. Talk with your group using "What I see" (WIS) comments.

b. Second, interpret what these observations mean:

i. Think about what each observation means.

ii. Talk with your group about "What it means" (WIM) for each of your observations.

Comparing Light and Dark Conditions

In your notebook

18. Add a row for oxygen to the table you created in step 9.

	Light (Lesson 4)	Dark (Lesson 10)
Carbon dioxide		
Water		
Oxygen		

With your group

19. In your group, discuss what's happening with plants in the light (Lesson 4) and the dark (Lesson 10). Record your observations and what they mean in the table.

Communicating Our Findings

In your notebook

20. Tape *Communicating Information from Scientific Text Checklist* into your science notebook.

With a partner

21. Work with a partner to plan and create a 1-minute news release to explain what you think is happening with photosynthesis in the dark to the principal and/or other teachers. Your 1-minute news release must fit on a notecard.

a. Use *Communicating Information from Scientific Text Checklist* to plan your 1-minute news release.

b. For the communication medium you choose, include inputs and outputs (matter and energy) and an explanation.

c. Include at least one new question you have.

Building Understandings Discussion

With your class

22. Bring your notebook and 1-minute news release to the Scientists Circle.

23. Have a Building Understandings Discussion with your class using evidence about what is happening with photosynthesis in the dark.

24. Discuss what could be happening if it's not photosynthesis.

Turn and talk

25. Turn and talk to a partner and discuss what is happening inside cells in our bodies when we breathe in oxygen and breathe out carbon dioxide and why.

26. Record our consensus model of the human cell in your notebook after we come to an agreement. It is important to record this model as it will be added to in Lessons 11, 12, and 13. You should open your notebooks to the next blank two pages so that both the left and right hand pages are blank. Record this model on the top half of the right hand page. The left page will be blank at this point. We will be developing more of a model as we go through the next series of lessons.

In your notebook

27. Discuss the following questions with your class:

a. Could plants be doing cellular respiration like we do? Could they be "breathing" like we breathe? Why or why not? What evidence do we have?

Next Steps

On your own

28. On an exit ticket, record ideas about how to investigate whether plants are using stored food as fuel when they don't have leaves or don't have any water. Think about:

a. How could we investigate if plants are using food as fuel like we do in cellular respiration?

b. How would we know? What evidence would we look for?

Lesson 11: Why don't plants die when they can't make food?

Navigation

Turn and talk

1. Open your science notebooks to your Progress Tracker and turn and talk with a partner:

a. When are times that plants have no leaves, but still might need energy to grow or survive?

Watch a time-lapse video of chili seeds sprouting.

Turn and talk

2. Turn and talk with a partner.

a. What did you observe happening in the video?

b. What are some plant structures that are missing from the sprouts shown here that we would expect to see on a fully grown plant?

3. Discuss the following question with your whole class:

a. What happens in cellular respiration that we could measure or observe?

Plan our investigation.

With your class

4. Remember from our previous investigations that the substance bromothymol blue (BTB) is an indicator that turns a different color when it mixes with carbon dioxide (CO_2).

a. Discuss how we could use BTB to test whether sprouting bean seeds are doing cellular respiration.

b. Why would we want to do this test in a closed system?

c. What control conditions should we include?

d. Record the color that BTB changes in the presence of carbon dioxide.

Set up your data table and make predictions.

In your notebook

5. Tape *Beans and BTB Investigation Data Table* into your science notebook.

a. Fill in what color BTB is at the beginning of each setup.

b. Record your predictions about what will happen to the BTB in each case.

With your group

6. Follow the instructions on *Sprouting Seeds Procedure for BTB Test.*

a. Record your day 1 observations in your science notebook after 5 minutes.

b. Store your experimental setup in the appropriate place so you can come back to the experiment next class.

Navigation

With your class

7. Discuss the following questions:

a. Why did we put bean sprouts in BTB? What are we testing?

b. What did we say we should be looking for when we make observations of our three bags?

Record day 2 observations.

With your group

8. Finish your observations on *Beans and BTB Investigation Data Table.*

a. What does the final color of BTB tell you?

Make a claim based on your BTB experiment results.

On your own

9. Record your response to these questions in your science notebooks:

a. What claim can you now make about the question *How does a plant get energy when it has no leaves to do photosynthesis?*

b. What evidence do you have to support your claim?

With a partner

10. Swap your written argument with your elbow partner.

a. Take one minute to individually read your partner's argument.

b. Discuss with your partner about whether your arguments are the same or different.

c. Resolve any differences between your two arguments (which might include either revising one or both of them, or merging them).

11. Share your revised arguments with the whole class.

Make connections to the Inside Our Bodies unit.

With your class

12. Discuss the following questions:

a. How is what the plant is doing similar to what our bodies do, as we saw with M'Kenna?

b. When do the cells in our bodies do cellular respiration?

c. What do the cells in our bodies use to do cellular respiration?

d. Where is the seed sprout getting its food from to use as fuel?

Read the article *How do plant (and animal) cells use food?*

On your own

13. Follow the steps on *Close Reading Strategies* to read *How do plant (and animal) cells use food?*

a. Make sure to write the lesson question, "How do plants use their food for fuel compared to us?" at the top of *How do plant (and animal) cells use food?*.

Revise our model.

Scientists Circle

14. Go to the Scientists Circle to discuss what we've figured out about plants.

a. What are some claims we think we can say about how plants can stay alive when they can't make food?

15. Open your notebook to the page with your human cell model.

a. Draw a line down the left page margin, and reserve this space for a key.

b. Draw your plant cell model on the top of the left-hand page.

c. Add to your human cell model as needed.

Update your Progress Tracker.

On your own

16. Create a 3-box Progress Tracker.

a. Write the lesson questions in the top left box:

"Why don't plants die when they can't do photosynthesis?"

"How do plants use their food for fuel compared to us?"

b. In the right box, list the source(s) of evidence.

c. In the bottom box, use words and/or pictures to document what we have figured out in relation to the lesson question. Reference the page that your model is on so you don't have to redraw it.

Record observations about a related phenomenon.

In your notebook

17. Make a space in your notebook to record observations from a five-year time-lapse video of a maple tree.

18. Analyze the time-lapse video https://youtu.be/HGuQ3EXfBFI :

a. Watch the video once and record your observations.

b. Then underline the ones that are evidence of the plant using energy to do something.

c. Put a star (✶) near the ones that are evidence of the plant using matter to grow.

Use our model to explain this phenomenon.

On your own

19. Using your Progress Tracker, model, and any evidence we've collected, complete *Maple Tree through the Seasons Explanation.*

a. Why didn't the tree in the video die after it lost its leaves? Where is it getting energy from to stay alive?

   Where is it getting its matter to grow new leaves?

b. Construct an explanation about where a maple tree seed sprout is getting its energy and matter at the beginning of spring during the day when it does not have any leaves.

Lesson 12: Where does the rest of our food come from?

Navigation

Turn and talk

Turn and talk with a partner:

1. Discuss the following questions and be prepared to share with the class:

a. What are we trying to figure out about our food?

b. What have we figured out so far in our investigations?

c. What have we not figured out yet?

d. How could we investigate the question: Where does the rest of our food come from?

How does sap become syrup?

The maple tree contains sap and that somehow this can be made into syrup. Though these two substances can be traced back to the maple tree, are these the same substance?

What categories do our foods fit in?

In your notebook

2. Draw three circles on the next page in your notebook. Label one “plants”, one “animals”, and one “not sure”.

3. Think about where sap comes from and then record sap inside one of the circles.

4. Think about where syrup comes from and then record syrup inside one of the circles.

How is syrup made from sap?

In your notebook

5. Make a Notice and Wonder chart in your notebook..

6. As you watch the video, record what you notice and any wonderings you have about what is done to sap to make syrup.

Analyze data from an investigation.

You and a partner will be provided a copy of data from an investigation done to see what happens to maple sap when it is boiled and then water is added back to it.

With a partner

7. Use *What happens when sap is boiled?* to analyze data collected when some students boiled sap to see if they could make syrup. Then they added water back to the sap to see if syrup is really just watery sap. As you read through the data and analyze the images, add to your Notice and Wonder chart.

8. As you analyze the data, pause when you reach a question and answer it in your notebook on the same page or the next page if you don't have room.

Natural vs. Synthetic Foods

Turn and talk

9. Talk with a partner about the following questions:
    a. What does it mean for a food to be natural or synthetic?
    b. Is 100% maple syrup a natural or artificial food?

In your notebook

10. In your notebook, draw two more circles on your three-circle notebook page underneath the three circles.
11. Label one "Natural" and label the other "Synthetic".
12. On your own, record maple sap in the circle where you think it belongs natural or synthetic. Then record maple syrup in one of the circles as well.
13. Your teacher will show you the label of another type of syrup, corn syrup. Record corn syrup in one of the circles for where it comes from: plants, animals, or not sure.
14. Then predict whether you think it is a natural or synthetic food by recording it in one of the two circles at the bottom of the page.

Read about other types of sweeteners.

You and your small group will be provided one of 6 different articles to read about a type of sweetener.

With your group

15. Read the article you are provided with your group.
16. Discuss the following questions together after finishing the article:
    a. Is this a natural or synthetic food? What is your evidence?
    b. Where does it come from?
    c. How is it made?

In your notebook

17. In your notebook, record the name of your sweetener in one of the three circles to note that it comes from a plant, an animal or if you are not sure.
18. Next record whether this sweetener is a natural or synthetic food in one of the two circles in your notebook.

Home Learning

Home learning

19. For home learning read, *Where else does our food come from?.*

20. Be ready to argue in class the next day whether the sweetener you read about is a natural or synthetic food. You will need to be ready to support your argument with evidence from the articles you have read.

Scientists Circle

With your class

21. With your small group, you will have 3 minutes to share what you read about your sweetener and to argue whether it is a natural or synthetic food.

22. When your group presents, the following questions should be answered:

a. What is the name of your sweetener?

b. Is your sweetener a natural or synthetic food? What is your evidence?

c. What are the prevalent molecules your sweetener is made of?

Investigate ingredients of packaged foods.

In your notebook

23. Open up to a new page in your notebook and title it "Food Label Ingredients".

24. Your teacher will give you a food label from one of the foods on the "not sure" category of the breakfast food poster.

25. Record the first two ingredients from the food label.

With a partner

26. Discuss with a partner the following questions:

a. Where did these ingredients come from?

b. Are they natural or synthetic?

Whole-Class Discussion

With your class

27. With your class, discuss the following questions:

a. Where are the main ingredients in these "not sure" foods coming from?

b. Where does flour come from? What is it made from? What about vegetable oil?

Nutrition Facts for Foods from Animals

In your notebook

28. In your notebook, create a chart to make sense of food that comes from animals.

Food item	What part of the animal are we eating?	What is the type of food molecule?	Where did that matter come from?

With a partner

29. With a partner, review the nutrition facts for three food items from animals. Use *Food Molecule Cards* as a reference if needed.

30. Discuss each food item and record your findings in the chart.

With your class

31. Share with the class what you have figured out about the foods that we eat that come from animals.

32. Be ready to answer the following questions about the food you investigated that comes from an animal:

a. What parts of the animal do we eat?

b. What is in the food items from animals?

c. Where did these food molecules come from?

Investigate chicken and cow diets.

With your group

33. Divide into groups of 4 and then split into 2 pairs. Determine which pair will be Group A and which pair will be Group B.

34. You will be provided with *Chicken and Cow Diets* to read. Group A will read about chickens and Group B will read about cows.

With a partner

35. With your partner, read your section.

36. When you both have finished, answer the following questions:

a. What does the animal eat?

b. Categorize the foods the animal eats. Where do they come from? (animals, plants, or not sure)

With your group

37. Share what you and your partner have figured out with the other pair in your small group.

38. Group A will share about chickens and Group B will share about cows.

39. Compare what you have learned about cow and chicken diets.

With your class

40. Be prepared to share with the whole class.

41. Share with your class: How are cow and chicken diets similar and different?

42. Discuss as a class what happens to food molecules from plants or other animals that an animal or human eats.

Revise our model of where all our food comes from.

With your class

43. With your class, develop a model summarizing what we have figured out about where the rest of our food comes from. We already have plants and humans as part of our model. Now let's add in other animals.

44. This model should be drawn on the bottom half of the right-hand page.

45. It should represent where animals get their food molecules and what they do with them.

Add to Progress Tracker.

With your class

46. Draw a three-box Progress Tracker in the progress tracker section of your notebook.

47. Record the question "Where does the rest of our food come from?".

48. Record the source(s) of evidence in the right-hand box.

49. Once the class has come to consensus about what has been figured out, record this in the bottom box using words and/or pictures.

Navigation

Turn and talk

50. Turn and talk with a partner about what happens to the parts of plants that we don't use or eat.

Lesson 13: What happens to food that doesn't get eaten?

Navigation: Where does the food go next?

Turn and talk

1. As you share with a partner about the following two questions, be sure to reference your Progress Tracker:
   a. What did we figure out about where our food comes from?
   b. Where do you think that food goes if it doesn't get eaten?
   c. Where does food go next?

Why might plants need light?

In your notebook

2. Draw a Notice and Wonder T-chart in your notebook with the title "What happens to food that does not get eaten?"

With your class

3. Watch time-lapse videos of what happens to plants and animals when they don't get eaten.
4. Record your noticings and wonderings in your notebook and collectively with your class.

Examine data for old bread in the light and in the dark.

With your group

5. Make noticings and wonderings about the handout *What changes are happening around food that does not get eaten?*.
6. Fill out the data table and work together to make sense of the questions.
7. When you are finished, tape *What changes are happening around food that does not get eaten?* into your science notebook.

Building Understandings Discussion

Scientists Circle

8. As you discuss what we figured out consider these questions:
   a. What did you notice about the old bread investigation?
   b. What do you think could be going on in these organisms to cause the carbon dioxide and water to go up and oxygen to go down in both the dark and the light?
   c. What else would we want to know about these organisms to figure out what is going on inside of them?

Navigation

Turn and talk

9. As you share with a partner about the following two questions, be sure to reference *What changes are happening around food that does not get eaten?:*

a. What did we figure out about bread mold the last class?

b. What are we wondering about these types of organisms?

10. Be prepared to share with the class.

Read about *Organisms that use food that doesn't get eaten.*

On your own

11. Read about your assigned organism on *Organisms that use food that doesn't get eaten.*

a. Make notes on your copy of the fact sheet.

b. Complete the *Obtaining and Communicating Information from Scientific Text Checklist* as you read. You will complete the Communicating Information Checklist next.

With a partner

12. Find a partner who read about the same organism.

a. Share and compare your Obtaining Information Checklist notes.

b. Integrate any new information into your checklist.

Communicate information about the role of these organisms.

With a partner

13. With a partner who read about the same organism:

a. Use your reading to complete the Communicating Information Checklist.

With your class

14. Conduct an oral gallery walk in 3 rounds.

a. For 1 minute, share about your decomposer with a new partner. Have your partner share for 1 minute.

b. Repeat 2 more times with new partners.

Revise our model to include decomposers.

In your notebook

15. Open to the 2 pages with our previous plant, human, and animal models.

a. Draw your model on the bottom half of the left-hand page.

b. As you are adding to your model, think about where leftover food molecules go and what happens to them.

With your class

16. Develop a model summarizing what we've figured out about where the parts of our food that we don't eat goes.

a. For 1 minute, share about your decomposer with a new partner. Have your partner share for 1 minute.

b. Repeat 2 more times with new partners.

Navigation: What have we figured out?

Turn and talk

17. As you share with a partner about the following 2 questions, be sure to reference your revised model of the system containing producers, consumers, and decomposers:

Home Learning

Turn and talk

18. Prepare for home learning:

a. Look for evidence of decomposers in your life.

b. If possible, photograph, video, or draw any evidence of decomposers that you find.

c. Before you leave, share an idea of where to look with an elbow partner.

Lesson 14: Where does food come from and where does it go next?

Navigation: Update Your Progress Tracker.

In your notebook

1. Create a 3-box Progress Tracker.
   a. Write the lesson question in the top left box:
   "What happens to food that does not get eaten?"
2. In the right box, list the source(s) of evidence.
3. In the bottom box, use words and/or pictures to document what we have figured out in relation to the lesson question. Reference the page that your model is on so you don't have to redraw it.

Share home learning.

With your class

4. Share what you found during your Home Learning.
   a. What evidence of decomposers did you find at home and in your community?
   b. What else did you notice besides your decomposer? Were there any producers or consumers in the environment the decomposer was found in?

Update our consensus model.

Scientists Circle

5. Gather in the Scientists Circle with your notebook.
   a. Looking at the model you have created in your notebook, where do you think plants get carbon dioxide and water they need to be able to do photosynthesis and make food?
   b. So if our outputs of carbon dioxide and water are inputs for the plant, then how could we represent that in our model?
   c. What about the outputs from animals and decomposers? Where might they be used?
   d. How can we distinguish between matter and energy?
   e. What are some things you notice about your model now?

Could an atom that a decomposer took in end up in us?

Turn and talk

6. As you discuss this with your partner, consider this question:

a. Could one of the atoms in the foods decomposers can eat but we can't end up back in the foods we can eat?

With a partner

7. Work with a partner to track an atom from inputs of decomposers to inputs of humans.

a. Trace the path of an atom that was once part of a decomposer to being a part of your body.

b. Use the model in your notebook and be ready to share with the class.

Progress Tracker: What have you figured out?

In your notebook

8. Draw a line to add another row to your Progress Tracker.

a. Write the question we are working on in the left column: *What happens to the outputs of decomposers after they take in food that does not get eaten in the system?*

b. Write what you have figured out so far in the column on the right. You can write in pictures or words. Take as much space as you need to record your thoughts.

Create a Gotta-Have-It Checklist.

With a partner

9. Using your Progress Tracker and your investigation notes, create a Gotta-Have-It Checklist for everything we figured out since we last made a checklist. List only the important ideas you need to include in your new model to explain: *Where does all of our food come from and where does it go next?*

With your class

10. Share out some of the ideas you thought were most important and why you think we need them.

11. Add any ideas that others shared that you think are important to your own Gotta-Have-It Checklist.

Write the story of your breakfast.

Writing in Science

12. Complete *Story of a Food Atom* using your model and Gotta-Have-It Checklist.

a. You were rushing to get to school on time and dropped your breakfast food! Choose one atom in that food item and explain the story of how it got there in the first place and what happened to it next, if no human picks it up and it remains in the system.

i. Follow your atom through at least one plant, one animal, and one decomposer.

ii. There are possibly multiple paths your atom can take, but you only need to choose one for your story.

iii. Explain how your atom gets from one point to the next.

iv. You can use evidence from your notebook to help you tell your story.

v. You can use words and pictures to tell your story.

Provide and receive feedback.

With a partner

13. Work with a partner and give each other feedback on *Story of a Food Atom*.

a. 1 min: Use your *Story of a Food Atom* to explain how the atoms from your breakfast food move through the system.

b. 1 min: Receive feedback from your partner. Take notes about what they say.

i. Use *Peer Feedback Guidelines* to help frame the feedback you give your partner.

c. Switch.

Respond to feedback.

On your own

14. We use peer feedback to improve our work, making it clearer, more accurate, and better supported by evidence.

a. Review your notes about the feedback your partner provided.

b. Decide if you agree or disagree with the feedback.

c. Revise your work to address the feedback.

Lesson 15: Where does food come from, and where does it go next?

Navigation: Evaluate our Driving Question Board (DQB) questions.

With a partner

1. Turn and talk with a partner. Discuss which questions you think we've answered on our DQB. Mark any questions you think the class has answered on *Reviewing Our Driving Question Board* with the following symbols:
   - We did not answer this question or any parts of it yet: O
   - Our class answered some parts of this question, or I think I could answer some parts of this question: ✓
   - Our class answered this question, or using the ideas we have developed, I could now answer this question: ✓ +

What questions have we made progress on?

On your own

2. Bring *Reviewing Our Driving Question Board* and 10 sticky dots over to the DQB.
3. Place your sticky dots on the sticky notes that match questions you think we've made progress on.
4. Once you have placed your 10 dots, move to the Scientists Circle.
5. As you are waiting for others to place their sticky dots,
   - Be prepared to share out your evidence for what the answers to the questions might be.
   - Notice and wonder about which questions have the most sticky dots.

Scientists Circle

6. As a class, discuss the answers to the questions that have the most sticky dots.

Add to our Progress Trackers: What have you figured out?

During your time revisiting the DQB, new ideas that you want to include on your Progress Trackers may have surfaced.

In your notebook

7. Individually update your 2-column Progress Tracker:
   - Write the question we are working on in the left column: *What questions on our DQB can we now answer?*
   - Add any additional ideas you want to review in the column on the right. Go back and revise any previous rows as well. You can write in pictures or words. Take as much space as you need to record your thoughts.

Demonstrate understanding on an assessment task.

In 1982, the International Whaling Commission placed a moratorium on the hunting of whales. Many people initially wondered why it was such a big deal to protect these animals. The video you will watch shows an underwater science expedition that came across the dead remains and bones of a whale, called a *whale fall,* on the bottom of the ocean while looking for something else.

With your class

8. Before watching the video, take a few minutes to think about what is different in this system compared to the other systems we have been working with.

9. Watch https://youtu.be/F5tJZfV2Xgc with the sound on.

- Keep track of your noticings and wonderings in your science notebook as you watch the video.

On your own

10. Use what you've figured out to demonstrate your learning on *Whale Fall Task (End of Unit Assessment).*

Quick Write: Reflect on our experiences.

On your own

11. Answer the following questions in your science notebook:

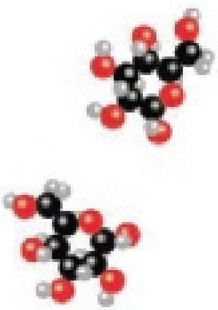
- What was most challenging in this unit?
- What was most rewarding?
- Think about how you engage in sensemaking discussions with classmates. How would you want to engage in those experiences the next time around?
- What would you do the same?
- What would you do differently?

12. Be prepared to share your thoughts with your class.

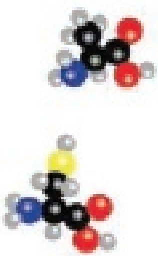
Food Molecule Cards

KEY	Type of atom	Symbol
	carbon	C
	oxygen	O
	hydrogen	H
	nitrogen	N
	sulfur	S

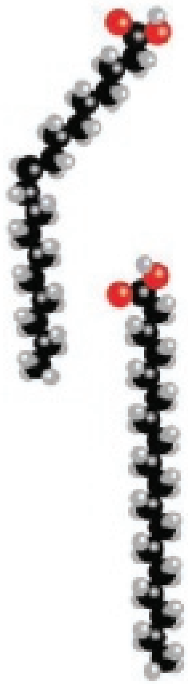
two glucose molecules



two kinds of amino acid molecules

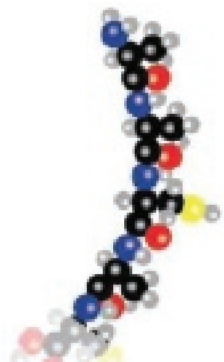


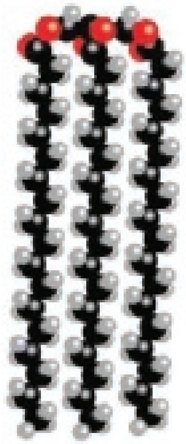
two kinds of fatty acid molecules



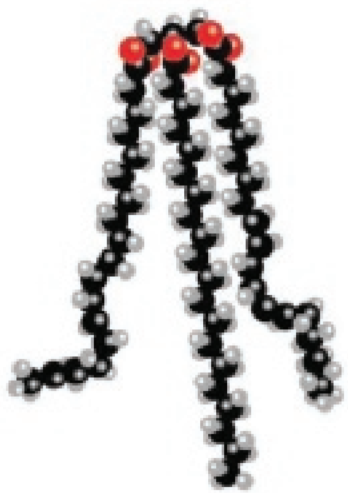
the tail end of one kind of complex carbohydrate (starch) molecule

the tail end of one kind of protein molecule





two kinds of fat molecules



Nutrition Labels: What is in food?

Acai Berry

Nutrition Facts
Serving Size: frozen fruit pulp (100g)

Amount Per Serving	
Calories 70	
	% Daily Value*
Total Fat 5g	0%
Saturated Fat 1.5g	0%
Total Carbohydrate 4g	0%
Dietary Fiber 2g	0%
Sugars 2g	
Protein 1g	
Vitamin A: 15% of the RDI	
Calcium: 2% of the RDI	

Almonds

Nutrition Facts
Serving Size: ¼ cup

Amount Per Serving	
Calories 170	
	% Daily Value*
Total Fat 15g	23%
Saturated Fat 1g	5%
Cholesterol 0mg	0%
Sodium 1mg	0%
Total Carbohydrate 6g	2%
Dietary Fiber 3.5g	13%
Sugars 1.5g	
Protein 6g	

Apple

Nutrition Facts
Serving Size: 1 medium apple, with skin (182g)

Amount Per Serving	
Calories 100 Calories from Fat 0	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 0mg	0%
Total Carbohydrate 25g	8%
Dietary Fiber 4g	18%
Sugars 19g	
Protein 0g	

Banana

Nutrition Facts
Serving Size: 1 banana (118g)

Amount Per Serving	
Calories 105	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 0mg	0%
Total Carbohydrate 26.9g	9%
Dietary Fiber 3.1g	11%
Sugars 14.4g	
Protein 1.3g	

Beef

Nutrition Facts
Serving Size: 3 ounces (85g) cooked beef roast

Amount Per Serving	
Calories 290 Calories from Fat 80	
	% Daily Value*
Total Fat 8g	13%
Saturated Fat 3g	16%
Trans Fat 0g	
Cholesterol 65mg	22%
Sodium 30mg	1%
Total Carbohydrate 0g	0%
Dietary Fiber 0g	0%
Sugars 0g	
Protein 27g	

Black Beans

Nutrition Facts
Serving Size: ½ cup (127g) black beans, low-sodium, canned

Amount Per Serving	
Calories 114 Calories from Fat 0	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 140mg	6%
Total Carbohydrate 20g	9%
Dietary Fiber 7.5g	30%
Sugars 0g	
Protein 7.62g	

Blueberries

Nutrition Facts
Serving Size: 1 cup (148g)

Amount Per Serving	
Calories 82	
	% Daily Value*
Total Fat 0.5g	1%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 1mg	0%
Total Carbohydrate 21g	7%
Dietary Fiber 3.5g	13%
Sugars 14.4g	
Protein 1.1g	

Bread (Whole Wheat)

Nutrition Facts
Serving Size: 1 slice (32g)

Amount Per Serving	
Calories 81 Calories from Fat 10	
	% Daily Value*
Total Fat 1.1g	2%
Saturated Fat 0.2g	1%
Trans Fat 0g	
Polyunsaturated Fat 0.5g	
Monounsaturated Fat 0.2g	
Cholesterol 0mg	0%
Sodium 146mg	6%
Potassium 81mg	2%
Total Carbohydrate 14g	5%
Dietary Fiber 1.9g	8%
Sugars 1.4g	
Protein 4g	

Broccoli

Nutrition Facts
Serving Size: 1 cup chopped

Amount Per Serving	
Calories 29	
	% Daily Value*
Total Fat 0.3g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 29mg	1%
Total Carbohydrate 5.8g	2%
Dietary Fiber 2.3g	8%
Sugars 1.5g	
Protein 2.5g	

Brown Sugar

Nutrition Facts
Serving Size: 2 tsp (8g)

Amount Per Serving	
Calories 30	
	% Daily Value*
Total Fat 0g	0%
Sodium 0mg	0%
Total Carbohydrate	3%
Total Sugars 8g	
Includes 8g Added Sugars	16%
Protein 0g	

Not a significant source of saturated fat, trans fat, cholesterol, dietary fiber, vitamin D, calcium, iron and potassium.

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higer or lower depending on your calorie needs.

Cabbage

Nutrition Facts
Serving Size: ½ cup (75g) cooked cabbage drained and chopped

Amount Per Serving	
Calories 20 Calories from Fat 0	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 20mg	1%
Total Carbohydrate 5g	2%
Dietary Fiber 2g	8%
Sugars 2g	
Protein 0g	

Carbonated Water

Nutrition Facts
Serving Size: 1 cup

Amount Per Serving	
Calories 0	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 0mg	0%
Total Carbohydrate 0g	0%
Dietary Fiber 0g	0%
Sugars 0g	
Protein 0g	
Vitamin A 0 IU	0%
Vitamin C 0mg	0%
Calcium 0mg	0%
Iron 0mg	0%

Carrots

Nutrition Facts
Serving Size: ½ cup (64g) fresh carrots

Amount Per Serving	
Calories 25 Calories from Fat 0	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 45mg	2%
Total Carbohydrate 6g	2%
Dietary Fiber 2g	8%
Sugars 3g	
Protein 1g	

Cauliflower

Nutrition Facts
Serving Size: 1 cup

Amount Per Serving	
Calories 25	
	% Daily Value*
Total Fat 0.1g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 30mg	1%
Total Carbohydrate 5.3g	2%
Dietary Fiber 2.5g	9%
Sugars 2.4g	
Protein 2g	

Cherries

Nutrition Facts
Serving Size: 21 cherries (140g)

Amount Per Serving	
Calories 100	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 0mg	0%
Total Carbohydrate 26g	9%
Dietary Fiber 1g	4%
Sugars 16g	
Includes 0g Added Sugars	0%
Protein 1g	

Chicken

Nutrition Facts
Serving Size: 3 ounces (85g) cooked chicken without skin

Amount Per Serving	
Calories 160 Calories from Fat 60	
	% Daily Value*
Total Fat 7g	11%
Saturated Fat 2g	10%
Trans Fat 0g	
Cholesterol 70mg	23%
Sodium 60mg	3%
Total Carbohydrate 0g	0%
Dietary Fiber 0g	0%
Sugars 0g	
Protein 22g	

Corn

Nutrition Facts
Serving Size: 1 ear (90g) fresh corn

Amount Per Serving	
Calories 80 Calories from Fat 10	
	% Daily Value*
Total Fat 1g	2%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 10mg	0%
Total Carbohydrate 17g	6%
Dietary Fiber 2g	10%
Sugars 3g	
Protein 3g	

Corn Bread

Nutrition Facts
Serving Size: 1 piece (46g)

Amount Per Serving	
Calories 100	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 210mg	9%
Total Carbohydrate 22g	7%
Dietary Fiber 1g	4%
Sugars 3g	
Protein 3g	

Cucumber

Nutrition Facts
Serving Size: ½ cup (52g) fresh cucumber with peel

Amount Per Serving	
Calories 10 Calories from Fat 0	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 0mg	0%
Total Carbohydrate 2g	1%
Dietary Fiber 0g	0%
Sugars 1g	
Protein 0g	

Doritos

Nutrition Facts
Serving Size: 1oz (28g)

Amount Per Serving	
Calories 147 Calories from Fat 70	
	% Daily Value*
Total Fat 7.8g	12%
Saturated Fat 1.1g	6%
Trans Fat 0.1g	
Polyunsaturated Fat 3.5g	
Monounsaturated Fat 2.6g	
Cholesterol 0mg	0%
Sodium 196mg	8%
Potassium 63mg	2%
Total Carbohydrate 17g	6%
Dietary Fiber 1.4g	6%
Sugars 0.7g	
Protein 2.1g	

Eggs

Nutrition Facts
Serving Size: 1 large, raw egg (50g)

Amount Per Serving	
Calories 70 Calories from Fat 45	
	% Daily Value*
Total Fat 5g	8%
Saturated Fat 1.5g	8%
Trans Fat 0g	
Cholesterol 210mg	71%
Sodium 70mg	3%
Total Carbohydrate 0g	0%
Dietary Fiber 0g	0%
Sugars 0g	
Protein 6g	

Fish (Salmon)

Nutrition Facts
Serving Size: 3 ounces (85g) canned salmon, packed in oil, drained

Amount Per Serving	
Calories 120 Calories from Fat 40	
	% Daily Value*
Total Fat 4g	6%
Saturated Fat 0.5g	4%
Trans Fat 0g	
Cholesterol 70mg	23%
Sodium 340mg	40%
Total Carbohydrate 0g	0%
Dietary Fiber 0g	0%
Sugars 0g	
Protein 20g	

Glucose Tabs

Nutrition Facts
Serving Size: 1 tablet (4.6g/0.2oz)

Amount Per Serving	
Calories 20	
	% Daily Value*
Total Fat 0g	0%
Sodium 0mg	0%
Total Carbohydrate 4g	1%
Sugars 4g	
Protein 0g	

Grapefruit

Nutrition Facts
Serving Size: ½ medium grapefruit (½ cup)

Amount Per Serving	
Calories 40 Calories from Fat 0	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0.5g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 0mg	0%
Total Carbohydrate 10g	3%
Dietary Fiber 1g	5%
Sugars 9g	
Protein 1g	

Green Beans

Nutrition Facts
Serving Size: ½ cup (78g) green beans, low-sodium, canned, drained

Amount Per Serving	
Calories 14 Calories from Fat 0	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 140mg	5%
Total Carbohydrate 3g	1%
Dietary Fiber 2g	8%
Sugars less than 1g	
Protein 1g	

Green Pepper

Nutrition Facts
Serving Size: ½ cup (75g) fresh green peppers, chopped

Amount Per Serving	
Calories 15 Calories from Fat 0	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 0mg	0%
Total Carbohydrate 3g	1%
Dietary Fiber 1g	4%
Sugars 2g	
Protein 1g	

Hafragrautur (oatmeal)

Nutrition Facts
Serving Size: ¼ cup (38g)
Servings Per Container About 16

Amount Per Serving	
Calories 140	
	% Daily Value*
Total Fat 2.5g	3%
Saturated Fat 0.5g	3%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 0mg	0%
Total Carbohydrate 25g	9%
Dietary Fiber 3g	11%
Total Sugars 0g	
Includes 0g Added Sugars	0%
Protein 4g	
Vitamin D 0mcg	0%
Calcium 13mg	2%
Iron 1mg	6%
Potassium 130mg	2%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higer or lower depending on your calorie needs.

Hibiscus

Nutrition Facts
Serving Size: 1 can (340mL)

Amount Per Serving	
Calories 25	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 0mg	0%
Total Carbohydrate 6g	2%
Dietary Fiber 0g	0%
Total Sugars 4g	
Includes 0g Added Sugars	0%
Protein 0g	
Vitamin D 0mcg	0%
Calcium 26mg	2%
Iron 0.4mg	2%
Potassium 0mg	0%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higer or lower depending on your calorie needs.

Kiwi

Nutrition Facts
Serving Size: 2 kiwis

Amount Per Serving	
Calories 100	
	% Daily Value*
Total Fat 1g	2%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 0mg	0%
Total Carbohydrate 24g	8%
Dietary Fiber 4g	14%
Sugars 16g	
Protein 2g	

Lemon

Nutrition Facts
Serving Size: 1 lemon

Amount Per Serving	
Calories 16	
	% Daily Value*
Total Fat 0.2g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 1mg	0%
Total Carbohydrate 5.4g	2%
Dietary Fiber 1.6g	6%
Sugars 1.5g	
Protein 0.6g	

Lettuce (Romaine)

Nutrition Facts
Serving Size: 2.5 cups

Amount Per Serving	
Calories 15	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 5mg	0%
Total Carbohydrate 3g	1%
Dietary Fiber 2g	7%
Sugars 1g	
Protein 1g	

Lime

Nutrition Facts
Serving Size: 1 lime

Amount Per Serving	
Calories 15	
	% Daily Value*
Total Fat 0.1g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 1mg	0%
Total Carbohydrate 5.6g	2%
Dietary Fiber 1.9g	7%
Sugars 1.1g	
Protein 0.3g	

Maple Syrup

Nutrition Facts
Serving Size 4 tbsp (60mL)
Servings 32

Amount Per Serving	
Calories 200	
	% Daily Value
Total Fat 0g	0%
Sodium 7mg	0%
Total Carbohydrate 53g	18%
Sugars 53g	
Protein 0g	0%

Maple Water

Nutrition Facts
Serving Size 1 Bottle

Amount Per Serving	
Calories 30	
	% Daily Value*
Total Fat 0g	0%
Sodium 0g	0%
Potassium 35mg	1%
Total Carbohydrate 8g	2%
Protein 0g	
Calcium 4% • Iron 0%	
Manganese 50%	

INGREDIENT: Organic maple water

Milk (1%)

Nutrition Facts
Serving Size: 1 cup (244g) 1% UHT milk

Amount Per Serving	
Calories 100 Calories from Fat 20	
	% Daily Value*
Total Fat 2.5g	4%
Saturated Fat 1.5g	8%
Trans Fat 0g	
Cholesterol 12mg	4%
Sodium 110mg	4%
Total Carbohydrate 12g	4%
Dietary Fiber 0g	0%
Sugars 12g	
Protein 8g	

Mushrooms

Nutrition Facts
Serving Size: 1 cup (110g)

Amount Per Serving	
Calories 15	
	% Daily Value*
Total Fat 0.2g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 3mg	0%
Total Carbohydrate 2.3g	1%
Dietary Fiber 0.8g	3%
Sugars 1.3g	
Protein 2.2g	

Natto

Nutrition Facts

Serving Size: 1 oz (28g)
Servings Per Container 3.5

Amount Per Serving	
Calories 60	
	% Daily Value*
Total Fat 3g	5%
Saturated Fat 1g	1%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 2mg	0%
Total Carbohydrate 4g	1%
Dietary Fiber 2g	6%
Sugars 1g	
No Added Sugars	
Protein 5g	
Vitamin D 0 mcg •	*Iron 2mg 13%
Calcium 60mg 6% •	*Potassium 204mg 5%

*The % Daily Values (DV) tells you how much a nutrient in serving of food contributes to a daily diet. 2,000 calorie a day is used for general nutrition advice.

Oatmeal

Nutrition Facts

Serving Size: ½ cup (117g) rolled oats, cooked in water

Amount Per Serving	
Calories 80 Calories from Fat 15	
	% Daily Value*
Total Fat 1.5g	3%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 5mg	0%
Total Carbohydrate 14g	5%
Dietary Fiber 2g	8%
Sugars 0g	
Protein 3g	

Olives

Nutrition Facts

Serving Size: 10 large olives

Amount Per Serving	
Calories 60	
	% Daily Value*
Total Fat 6g	9%
Saturated Fat 1g	5%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 750mg	33%
Total Carbohydrate 5g	2%
Dietary Fiber 2g	7%
Sugars 0g	
Protein 1g	

Onions

Nutrition Facts

Serving Size: ½ cup (80g) cooked onion drained and chopped

Amount Per Serving	
Calories 30 Calories from Fat 0	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 0mg	0%
Total Carbohydrate 7g	2%
Dietary Fiber 1g	4%
Sugars 3g	
Protein 1g	

Orange

Nutrition Facts

Serving Size: 1 medium orange, peeled (128g)

Amount Per Serving	
Calories 60 Calories from Fat 0	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 0mg	0%
Total Carbohydrate 15g	5%
Dietary Fiber 3g	12%
Sugars 12g	
Protein 1g	

Orange Juice

Nutrition Facts

Serving Size: 1 cup (248g)

Amount Per Serving	
Calories 112 Calories from Fat 5	
	% Daily Value*
Total Fat 0.5g	1%
Saturated Fat 0.1g	0%
Polyunsaturated Fat 0.1g	
Monounsaturated Fat 0.1g	
Cholesterol 0mg	0%
Sodium 2mg	0%
Potassium 496mg	14%
Total Carbohydrate 25.8g	9%
Dietary Fiber 0.5g	2%
Sugars 20.8g	
Protein 1.7g	

Palm Oil

Nutrition Facts

Serving Size: 1 Tbsp (15ml)
Servings Per Container: About 30

Amount Per Serving	
Calories 130	
	% Daily Value*
Total Fat 14g	21%
Saturated Fat 6g	32%
Trans Fat 0g	
Polyunsaturated Fat 1.5g	
Monounsaturated Fat 6g	
Cholesterol 0mg	0%
Sodium 0mg	0%
Total Carbohydrate 0g	0%
Protein 0g	
Vitamin A 80% •	Vitamin E 10%

Not a significant source of vitamin C or calcium.

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higer or lower depending on your calorie needs.

Peaches

Nutrition Facts

Serving Size: ½ cup (77g) sliced fresh peaches

Amount Per Serving	
Calories 30 Calories from Fat 0	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 0mg	4%
Total Carbohydrate 7g	2%
Dietary Fiber 1g	5%
Sugars 6g	
Protein 1g	

Peanut Butter

Nutrition Facts

Serving Size: 2 tablespoons (32g) smooth peanut butter

Amount Per Serving	
Calories 188 Calories from Fat 140	
	% Daily Value*
Total Fat 16g	24%
Saturated Fat 3g	15%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 152mg	6%
Total Carbohydrate 8g	3%
Dietary Fiber 2g	8%
Sugars 2g	
Protein 7g	

Pears

Nutrition Facts

Serving Size: 1 medium pear, with skin (178g)

Amount Per Serving	
Calories 100 Calories from Fat 0	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 0mg	0%
Total Carbohydrate 28g	9%
Dietary Fiber 6g	22%
Sugars 17g	
Protein 1g	

Pekmez

Nutrition Facts

Serving Size: 100G

Amount Per Serving	
Calories 192 Calories from Fat 0	
	% Daily Value*
Total Fat 1.5g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 200mg	0%
Total Carbohydrate 46.4g	0%
Dietary Fiber 5.4g	0%
Sugars 37.6g	
Protein 0.1g	

Pineapple

Nutrition Facts

Serving Size: 1 slice

Amount Per Serving	
Calories 37	
	% Daily Value*
Total Fat 0.1g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Sodium 1mg	0%
Total Carbohydrate 9.9g	3%
Sugars 7g	
Protein 0.5g	

Pizza Crust

Nutrition Facts
Serving Size: 1 12" crust (593g)

Amount Per Serving	
Calories 1412 Calories from Fat 276	
	% Daily Value*
Total Fat 31g	48%
Saturated Fat 4.3g	22%
Trans Fat 0g	
Polyunsaturated Fat 4.1g	
Monounsaturated Fat 20g	
Cholesterol 0mg	0%
Sodium 2377mg	99%
Potassium 393mg	11%
Total Carbohydrate 245g	82%
Dietary Fiber 10g	40%
Sugars 5g	
Protein 35g	

Pomegranate

Nutrition Facts
Serving Size: 1 pomegranate

Amount Per Serving	
Calories 104	
	% Daily Value*
Total Fat 0.5g	1%
Saturated Fat 0.1g	1%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 5mg	0%
Total Carbohydrate 26.4g	9%
Dietary Fiber 0.9g	3%
Sugars 25.5g	
Protein 1.5g	

Pork

Nutrition Facts
Serving Size: 3 ounces (84g) canned pork, drained

Amount Per Serving	
Calories 180 Calories from Fat 100	
	% Daily Value*
Total Fat 12g	18%
Saturated Fat 4.5g	18%
Trans Fat 0g	
Cholesterol 65mg	22%
Sodium 285mg	11%
Total Carbohydrate 0g	0%
Dietary Fiber 0g	0%
Sugars 0g	
Protein 17g	

Potato

Nutrition Facts
Serving Size: 1 medium red potato (173g), baked with skin

Amount Per Serving	
Calories 150 Calories from Fat 0	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 20mg	1%
Total Carbohydrate 34g	11%
Dietary Fiber 3g	16%
Sugars 4g	
Protein 4g	

Pumpkin

Nutrition Facts
Serving Size: ½ cup mashed

Amount Per Serving	
Calories 25	
	% Daily Value*
Total Fat 0.1g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 1mg	0%
Total Carbohydrate 6g	2%
Dietary Fiber 1.4g	5%
Sugars 1.3g	
Protein 0.9g	

Radishes

Nutrition Facts
Serving Size: 1 cup, slices

Amount Per Serving	
Calories 18	
	% Daily Value*
Total Fat 0.1g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 45mg	2%
Total Carbohydrate 3.9g	1%
Dietary Fiber 1.9g	7%
Sugars 2.5g	
Protein 0.8g	

Raisins

Nutrition Facts
Serving Size: 1 small box (1.33oz), (43g), (¼ cup) seedless raisins

Amount Per Serving	
Calories 129 Calories from Fat 0	
	% Daily Value*
Total Fat 0.2g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 5mg	0%
Total Carbohydrate 34g	11%
Dietary Fiber 1.6g	6%
Sugars 25g	
Protein 1.3g	

Raspberries

Nutrition Facts
Serving Size: 1 cup

Amount Per Serving	
Calories 63	
	% Daily Value*
Total Fat 0.8g	1%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 1mg	0%
Total Carbohydrate 14.7g	5%
Dietary Fiber 8g	29%
Sugars 5.4g	
Protein 1.5g	

Refried Beans

Nutrition Facts
Serving Size: ½ cup (120g)

Amount Per Serving	
Calories 110	
	% Daily Value*
Total Fat 2.5g	4%
Saturated Fat 1g	5%
Trans Fat 0g	
Cholesterol 3mg	1%
Sodium 440mg	19%
Total Carbohydrate 16g	5%
Dietary Fiber 6g	21%
Sugars 0g	
Includes 0g Added Sugars	0%
Protein 5g	

Rice

Nutrition Facts
Serving Size: ½ cup cooked (98g)

Amount Per Serving	
Calories 110 Calories from Fat 10	
	% Daily Value*
Total Fat 1g	1%
Saturated Fat 0g	1%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 5mg	0%
Total Carbohydrate 22g	7%
Dietary Fiber 2g	7%
Sugars 0g	
Protein 3g	

Vitamin A 0% • Vitamin C 0%
Calcium 0% • Iron 2%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higer or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Saturated Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carb		300g	375g
Dietary Fiber		25g	30g

Snap Peas

Nutrition Facts
Serving Size: 11 pods

Amount Per Serving	
Calories 40	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 10mg	0%
Total Carbohydrate 7g	2%
Protein 2g	

Spinach

Nutrition Facts
Serving Size: 1 cup (30g)

Amount Per Serving	
Calories 7	
	% Daily Value*
Total Fat 0.1g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 24mg	1%
Total Carbohydrate 1.1g	0%
Dietary Fiber 0.7g	3%
Sugars 0.1g	
Protein 0.9g	

Squash (Winter)

Nutrition Facts
Serving Size: ½ cup (57g) cubed, cooked winter squash

Amount Per Serving	
Calories 40 Calories from Fat 0	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 0mg	2%
Total Carbohydrate 9g	3%
Dietary Fiber 3g	12%
Sugars 3g	
Protein 1g	

Strawberries

Nutrition Facts
Serving Size: 1 cup

Amount Per Serving	
Calories 48	
	% Daily Value*
Total Fat 0.5g	1%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 2mg	0%
Total Carbohydrate 11.7g	4%
Dietary Fiber 3g	11%
Sugars 7.1g	
Protein 1g	

Sugar Beets

Nutrition Facts
Serving Size: 82g sugar beets

Amount Per Serving	
Calories 35 Calories from Fat 1	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat	
Cholesterol 0mg	0%
Sodium 64mg	3%
Total Carbohydrate 8g	3%
Dietary Fiber 2g	9%
Sugars 6g	
Protein 1g	

Sunflower Seeds

Nutrition Facts
Serving Size: 1 oz

Amount Per Serving	
Calories 164	
	% Daily Value*
Total Fat 14.1g	22%
Saturated Fat 1.5g	8%
Cholesterol 0mg	0%
Sodium 1mg	0%
Total Carbohydrate 6.8g	2%
Dietary Fiber 3.2g	11%
Sugars 0.8g	
Protein 5.5g	

Sweet Potato

Nutrition Facts
Serving Size: 200g

Amount Per Serving	
Calories 180 Calories from Fat 3	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 72mg	3%
Total Carbohydrate 41g	14%
Dietary Fiber 7g	26%
Sugars 13g	
Protein 4g	
Vitamin A 769% • Vitamin C 65%	
Calcium 8% • Iron 8%	

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higer or lower depending on your calorie needs.

Tahini

Nutrition Facts
Serving Size: 2 Tbl (30g)
Servings Per Container 15

Amount Per Serving	
Calories 170 Calories from Fat 132	
	% Daily Value*
Total Fat 16g	24%
Saturated Fat 2g	12%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 3mg	0%
Total Carbohydrate 7g	2%
Dietary Fiber 2g	7%
Sugars 0g	
Protein 5g	
Vitamin A 0% • Vitamin C 0%	
Calcium 14% • Iron 10%	

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higer or lower depending on your calorie needs.

Tapioca Flour

Nutrition Facts
Serving Size: ¼ cup (30g)
Servings per Container about 8

Amount Per Serving	
Calories 100 Calories from Fat 0	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 10mg	0%
Total Carbohydrate 26g	9%
Dietary Fiber 0g	0%
Sugars 0g	
Protein 0g	
Vitamin A 0% • Vitamin C 0%	
Calcium 0% • Iron 2%	

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higer or lower depending on your calorie needs.

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Saturated Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carb		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Tomato

Nutrition Facts
Serving Size: ½ cup (90g) fresh tomato, chopped or sliced

Amount Per Serving	
Calories 15 Calories from Fat 0	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 0mg	0%
Total Carbohydrate 4g	1%
Dietary Fiber 1g	4%
Sugars 2g	
Protein 1g	

Vegetable Oil

Nutrition Facts
Serving Size: 1 teaspoon (4.5g) vegetable oil

Amount Per Serving	
Calories 40 Calories from Fat 40	
	% Daily Value*
Total Fat 4.5g	7%
Saturated Fat 0.5g	3%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 0mg	0%
Total Carbohydrate 0g	0%
Dietary Fiber 0g	0%
Sugars 0g	
Protein 0g	

Water

Nutrition Facts
Serving Size: 12 fl oz

Amount Per Serving	
Calories 0	
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 0mg	0%
Total Carbohydrate 0g	0%
Dietary Fiber 0g	0%
Sugars 0g	
Protein 0g	

Watermelon

Nutrition Facts
Serving Size: 1 cup (140g)

Amount Per Serving	
Calories 45 Calories from Fat 0	
	% Daily Value*
Total Fat 0.2g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 2mg	0%
Total Carbohydrate 11.5g	4%
Dietary Fiber 0.6g	2%
Sugars 9.4g	
Protein 0.9g	

Zucchini

Nutrition Facts
Serving Size: 1 cup

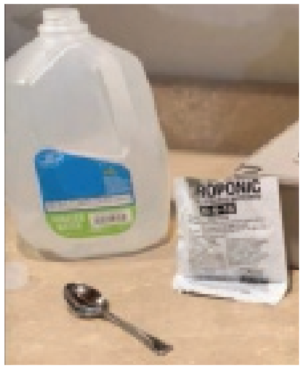
Amount Per Serving	
Calories 18	
	% Daily Value*
Total Fat 0.2g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 11mg	0%
Total Carbohydrate 3.8g	1%
Dietary Fiber 1.2g	4%
Sugars 2g	
Protein 1.4g	

Details of the Hydroponic Plant System

Contents in the hydroponic planting box	
reservoir tray	top-off bottle with cap
top plate lid (8 holes)	8 net cups
8 clone collars	6 drain plugs
grow light	Grow More hydroponic nutrients

1. Insert the 6 drain plugs into the 6 drains on the side of the reservoir tray.

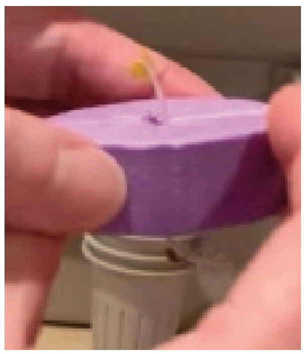
2. Combine 1 teaspoon plant nutrients with 1 gallon distilled water.



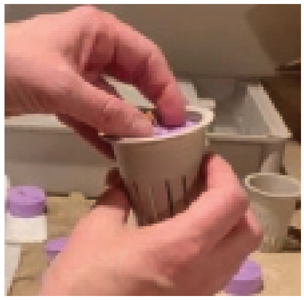
3. Pour the nutrient solution into the reservoir tray.

4. Place the lid with the 8 holes on top of the reservoir tray. Be sure the side with the cylinder tube at the bottom is on the open side of the tray.

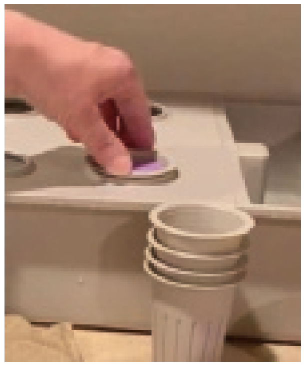
5. One at a time, place a seedling inside a foam clone collar. The roots should be extending out the bottom and the leaves should be extended out the top.



6. Place foam clone collar with the sprout into a net cup and push the collar down towards the bottom of the cup so the roots are close to the bottom of the cup. This will ensure the roots will reach the water in the reservoir.



7. Place the net cup into one of the 8 slots in the lid of the hydroponic kit.



8. Follow steps 5–7 for the remaining net cups.

9. Using a second bottle of distilled water, fill the top off bottle and secure the lid. Then turn this upside down on the side of the reservoir where the cylinder plug is located. You should hear the water begin to slowly flow and then stop. This will slowly release water and bubbles as needed.

10. Place the hydroponic system box under the grow light.

11. When the plants grow bigger, increase the concentration of plant food to 1 tablespoon per gallon of water.

Lab experiment using food indicators to test hydroponic plant food

Part 1: Designing our Experiments

Work with your class to figure out the answer to these questions:

- What should our negative control group be? (a substance that we know would NOT change color/appearance)
- What is our "experimental" group? (the substance we are interested in seeing whether its color/appearance changes)
- How could we make sure our food indicators are working properly (+control group)? (substance we *know* should change color/appearance)

Part 2: Data Collection

Your group will be investigating the hydroponic plant food solution for only one type of food molecule. Once your group knows which type of food molecule you are investigating, highlight that section so you will know which steps to follow for your investigation.

Wear goggles while running your experiments.

Group A: Complex Carbohydrates

You are going to work with an indicator that changes color when it interacts with a starch (a complex carbohydrate):

Tube label	**(–)**	**Ex**	________	________
Tube contains	(–) control group	Experimental group	(+) control group	(+) control group
Substance tested (Fill tube halfway with substance to be tested. Then add water to solid food pieces, crush, and shake to mix.)	Water	(What is the candidate you are testing?)	(Label what your group decided to use that you know should change color.)	(Label what your group decided to use that you know should change color.)
Indicator added to tube (Add 1 drop of this indicator.)	Iodine	Iodine	Iodine	Iodine
Color prediction				
Results				

Iodine solution will turn a different color when it interacts with any starch it touches. In the steps below, you will gather data on these color changes.

1. Decide how your group is going to label the tubes for your experimental and (+) control groups. Write in the substance your group is testing for in the table in **part 2** of your *Which food molecules are in the hydroponic plant food?*
2. Label four different microcentrifuge tubes as your group decided.
3. Create the "substance tested" liquids in each tube.
   a. If you are testing a solid piece of food, make sure to add water to the tube until it's about halfway full then crush the food piece with a utensil or wooden coffee stirrer.
   b. Add 10 drops of iodine.
   c. Make sure not to put the eyedropper into the tube, to prevent contamination of the eyedropper tip.
   d. Cap the tube and shake to mix the water, crushed-up food pieces, and iodine.
4. While you are waiting to see whether the color changes, make predictions about what color you expect each tube to be and record these in the "Color predictions" row in **part 2** of your *Which food molecules are in the hydroponic plant food?*
5. After three minutes, check the color of the tubes.
6. Record the colors you observe in the results row of the table in **part 2** of *Which food molecules are in the hydroponic plant food?*
7. Dispose of the microcentrifuge tubes and clean up your lab area.

Group B: Simple Carbohydrates

You are going to work with an indicator that changes color when it interacts with a simple sugar:

Tube label	**(–)**	**Ex**	___________	___________
Tube contains	(–) control group	Experimental group	(+) control group	(+) control group
Substance tested (Fill tube halfway with substance to be tested. Then add water to solid food pieces, crush, and shake to mix.)	Water	(What is the candidate you are testing?)	(Label what your group decided to use that you know should change color.)	(Label what your group decided to use that you know should change color.)

Tube label	**(–)**	**Ex**	____________	______________
Indicator added to tube (Add this indicator until tube is three-quarters full, or almost to the top but with enough room to close the lid.)	Benedict's solution	Benedict's solution	Benedict's solution	Benedict's solution
Color prediction				
Results				

Benedict's solution will turn a different color when it interacts with any simple sugar it touches. Benedict's solution and the sugar it comes in contact will need to be heated for five minutes in water that is almost boiling before a color change shows up.

In the steps below, you will gather data on these color changes.

1. Decide how your group is going to label the tubes for your experimental and (+) control groups. Write in the substances your group is testing for in the table in **part 2** of your *Which food molecules are in the hydroponic plant food?*
2. Label four different microcentrifuge tubes as your group decided.
3. Create the "substance tested" liquids in each tube.
   a. If you are testing a solid piece of food, make sure to add water to the tube until it's about halfway full then crush the food piece with a utensil or wooden coffee stirrer.
   b. Add 2–3 drops of Benedict's solution.
   c. Make sure not to put the eyedropper into the tube, to prevent contamination of the eyedropper tip.
   d. Cap the tube and shake to mix the water, crushed-up food pieces, and Benedict's solution.
4. Fill a coffee cup with boiling hot water. It is important to keep the water very hot. Add all the microcentrifuge tubes to it.
5. While you are waiting to see whether the color changes, make predictions about what color you expect each tube to be and record these in the "Color predictions" row in **part 2** of your *Which food molecules are in the hydroponic plant food?*
6. After five minutes, scoop out the tubes with a plastic spoon from the coffee cup and place them on a paper towel.
7. Record the colors you observe in the results row of the table in **part 2** of *Which food molecules are in the hydroponic plant food?*
8. Empty the coffee cup, dispose of the microcentrifuge tubes, and clean up your lab area.

Group C: Fats

You are going to work with an indicator that changes color when it interacts with a fat (or lipid):

Tube label	**(–)**	**Ex**	___________	___________
Tube contains	(–) control group	Experimental group	(+) control group	(+) control group
Substance tested (Using a pipette, pick up a sample of the substances you are testing and smear a small amount on the paper bag.)	Water	(What is the candidate you are testing?)	(Label what your group decided to use that you know should change color.)	(Label what your group decided to use that you know should change color.)
Indicator	Paper Bag	Paper Bag	Paper Bag	Paper Bag
Color prediction				
Results				

Certain kinds of paper such as a piece of brown paper bag can readily absorb lipids and can be used to test for the presence of lipids (or fats).

1. Take a piece of brown paper and using a pipette to pick up a sample of each substance, smear each one on the paper.
2. Label each substance you tested on the paper.
3. Wait 2 to 3 minutes for the samples to dry. If a mark is left after a sample has completely dried, then that is a positive test for fats. You may need to hold the paper up to the light.
4. While you are waiting to see whether the color of the bag changes, make predictions about what you expect to see and record these in the "Color prediction" row in **part 2** of your *Which food molecules are in the hydroponic plant food?*
5. Once the paper is dry, check results for the paper bag test.
6. Record the changes you observe in the results row of the table in **part 2** of *Which food molecules are in the hydroponic plant food?*

Group D: Proteins

You are going to work with an indicator that turn colors when it interacts with a protein:

Tube label	(–)	Ex	________	________
Tube contains	(–) control group	Experimental group	(+) control group	(+) control group
Substance tested (Fill tube halfway with substance to be tested. Then add water to solid food pieces, crush, and shake to mix.)	Water	(What is the candidate you are testing?)	(Label what your group decided to use that you know should change color.)	(Label what your group decided to use that you know should change color.)
Indicator added to tube (Add 1 drop of this indicator.)	Biuret	Biuret	Biuret	Biuret
Color prediction				
Results				

Biuret solution will turn a different color when it interacts with any protein it touches.

In the steps below, you will gather data on these color changes.

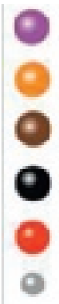
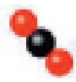
1. Decide how your group is going to label the tubes for your experimental and (+) control groups. Write in the substances your group is testing for in the table in **part 2** of your *Which food molecules are in the hydroponic plant food?*
2. Label four different microcentrifuge tubes as your group decided.
3. Create the "substance tested" liquids in each tube.
   a. If you are testing a solid piece of food, make sure to add water to the tube until it's about halfway full then crush the food piece with a utensil or wooden coffee stirrer.
   b. Add 10 drops of Buiret solution.
   c. Make sure not to put the eyedropper into the tube, to prevent contamination of the eyedropper tip.
   d. Cap the tube and shake to mix the water, crushed-up food pieces, and Buiret solution.
4. While you are waiting to see whether the color changes, make predictions about what color you expect each tube to be and record these in the "Color predictions" row in **part 2** of your *Which food molecules are in the hydroponic plant food?*

5. After three minutes, check the color of the tubes.
6. Record the colors you observe in the results row of the table in **part 2** of *Which food molecules are in the hydroponic plant food?*
7. Dispose of the microcentrifuge tubes and clean up your lab area.

Record Class Data

When your group is finished with your experiment, come to the board and record your individual result by putting a “Y” if you saw a change in the hydroponic plant food water sample or an “N” if there was no change.

Composition of Air

Substance	***Chemical Formula***	***Molecular Structure*** *Atom type key*  Ar Argon He Helium N Nitrogen C Carbon O Oxygen H Hydrogen
Water	H_2O	
Oxygen	O_2	
Nitrogen	N_2	
Argon	Ar	
Carbon Dioxide	CO_2	
Helium	He	
Methane	CH_4	
Hydrogen	H_2	

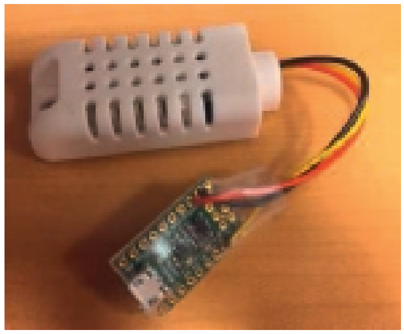
Another Plant Experiment

In October 2018, another group of students investigated how gas levels changed around leaves in a closed system. They produced data using the following leaves and four sensors.

Dandelion leaves in a plastic tub

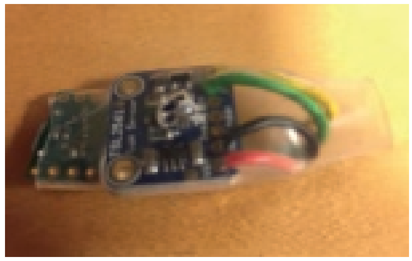
Carbon dioxide sensor

Humidity sensor



Oxygen sensor

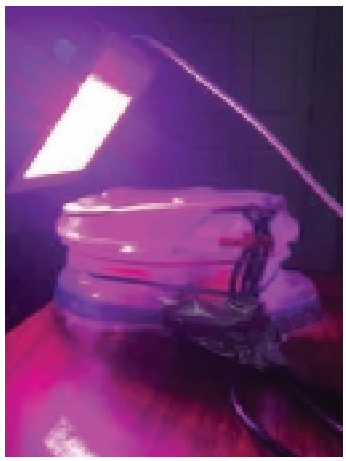
Light sensor



They connected the four sensors to a computer and placed the sensors in the container with the leaves (left image). They sealed the container in a ziplock bag (right image), placed it under a grow light, and recorded gas levels every second for 10 minutes.

Sensors attached to a computer

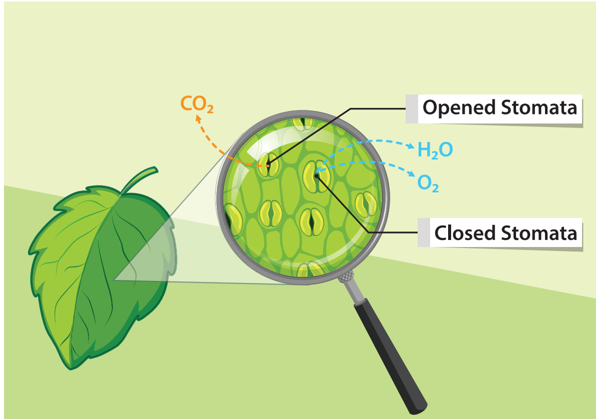
Sensors producing data in a sealed container under light



Microscopic Leaf Images

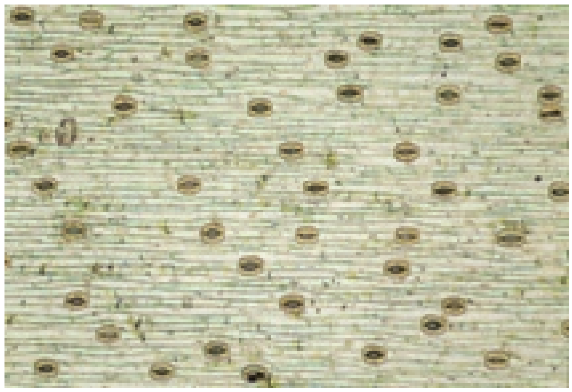
Data source B

Electron microscope image of a small spot from the surface of the underside of a leaf



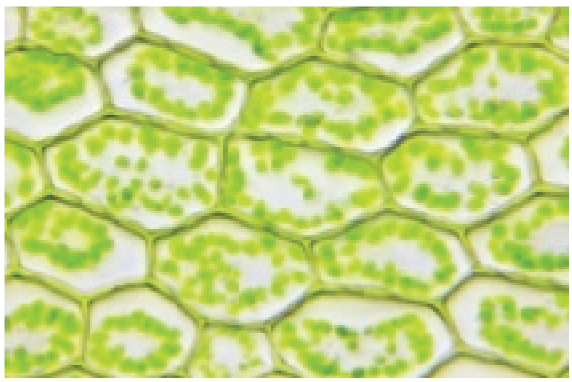
Data source C

400x microscope image of a slide made from the outer layer of tissue from the underside of a leaf



Data source D

400x microscope image of a slide made from a thin section of tissue from the inside of a leaf



Simulation Procedures

Procedure for investigation A

1. Open a web browser and go to the following address: https://www.openscied.org/Chloroplasts-and-Food

2. **Don't** change the sliders. Just press the SETUP/RESET button. 

3. **Record in your science notebook the things you notice that are now in the simulation before you go any further.**

4. Press the GO/PAUSE button. --------------------------> 

5. Keep the auto-stop slider checked so the model will stop running when it reaches 2000. ---------> 

6. Pause the model at this point by pressing GO/PAUSE again.

7. **Record the things you notice that are now in the simulation but that weren't there before. Did anything disappear that was there before?**

8. Repeat steps 2–6 as time permits.

Planning investigation B

Work as a team to decide which variable listed in column A in the table each group member will manipulate to help figure out these questions:

- Would increasing the amount of any one of the inputs or structures in the simulation affect the outputs?
- Would reducing or removing an input affect the outputs?

Individually complete your **investigation B plan** on *Planning and Carrying out Investigations,* using the table below as a reference to help design your investigation.

Simulation Inputs Reference Table

A. Independent variable	B. Slider to change the amount of this	C. Minimum value you can set this to	D. Maximum value you can set this to
Number of chloroplasts		0	6
Initial number of carbon dioxide molecules		0	200
Rate of water flow through the leaf		0	50
Intensity of light shining on the leaf		0	100

Procedure for investigation B

1. Change the slider for your **independent variable** to one of the values you wanted to test.
2. Press the SETUP/RESET button to restart the model with these new conditions. Press the GO/PAUSE button to test the effects of these changes.
3. Pause the model by pressing GO/PAUSE when the TIME monitor reaches the point that you planned to stop your test.
4. Record the value(s) of your **dependent variable(s)** at this point in time in your data table for investigation B.
5. Repeat the previous steps for the number of trials you wanted to do for each different value of the **independent variable** you wanted to test.
6. Complete the "Making sense" questions on your handout.

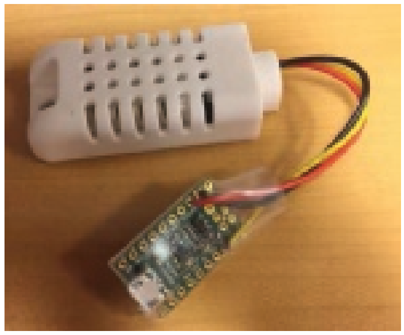
Another Plant Experiment in the Dark

In October 2018, another group of students investigated how gas levels changed around leaves in a closed system. They produced data using the following leaves and four sensors.

Dandelion leaves in a plastic tub

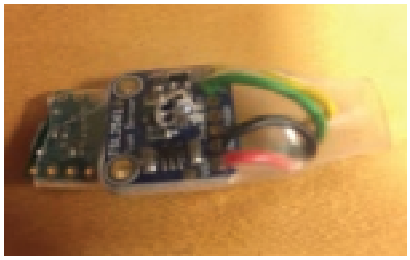
Carbon dioxide sensor

Humidity sensor



Oxygen sensor

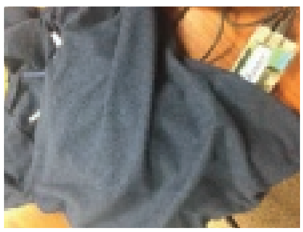
Light sensor



They connected the four sensors to a computer and placed the sensors in the container with the leaves (left image below). They sealed the container in a ziplock bag (right image below), placed it under a sweatshirt so no light could get in, and recorded gas levels every second for 10 minutes.

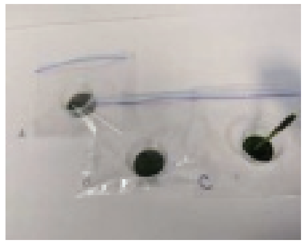
Sensors attached to a computer

Sensors producing data in a sealed container under light

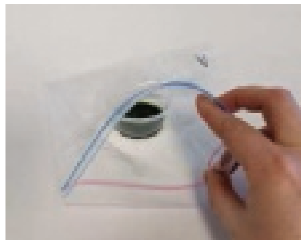


Sprouting Seeds Procedure for BTB Test

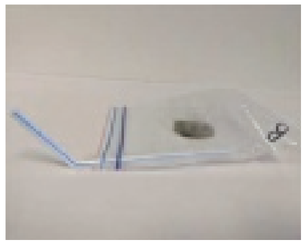
Label three zip top bags “A,” “B,” and “C.” Add 5 mL of BTB to each of 3 condiment containers, and then put one container in each bag.



For bag A: Pull the bag apart a bit to make sure it has air from our classroom in it before you seal it. Seal the bag.

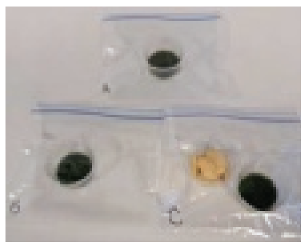


For bag B: Open the corner of the bag just a bit. Slide a straw into that corner and blow into the bag to inflate it with air that you exhale. Seal the bag to capture that air in it.



For bag C: Pull the bag apart a bit to make sure it has air from our classroom in it. Transfer the seeds from the wet paper towel to a fourth condiment container. Put that container in the bag. Seal the bag.

Observe your setup, and record what you see in day 1 of your data table.



Return to observe your setup again after one day, and record what you see in day 2 of your data table.

Close Reading Strategies

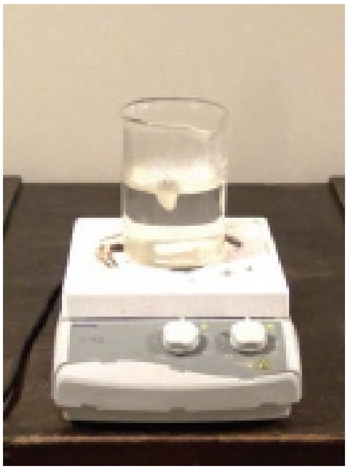
1.	Identify the question(s) you are trying to answer in the reading.
2.	Read once for understanding to see what the reading is about.
3.	Read a second time to highlight a few key ideas that help answer the questions you had.
4.	Summarize the key idea(s) in your own words, in diagrams, or both.
5.	Jot down new questions that this raises for you. Connect what you read to things you already know or have figured out.

What happens when sap is boiled?

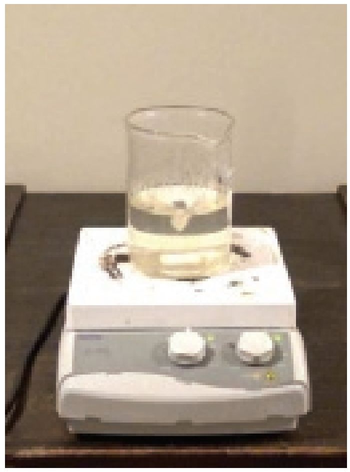
Open your science notebook to the next blank page and title it, "What happens when sap is boiled?" As you analyze the data and images in this reference, pause to answer the question in your notebook. We will use what you figure out to help us determine what happens to sap when it is boiled.

1. The first image below shows 300 mL of maple water (straight from the bottle) placed in a beaker with a magnetic stir bar (a magnet that spins in the liquid when the hot plate is on so the liquid is constantly moving). The beaker is on the hotplate, the stirring rod is stirring, and the heating has just been turned on.
2. The following images were taken over time while the hotplate was still on and the stirring rod was still stirring. What do you notice happens to the amount of liquid in the beaker over time? Why is this happening?

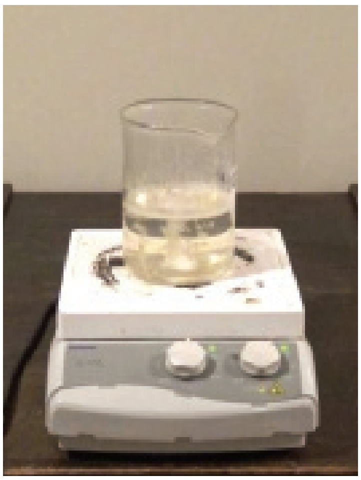
t = 0 min



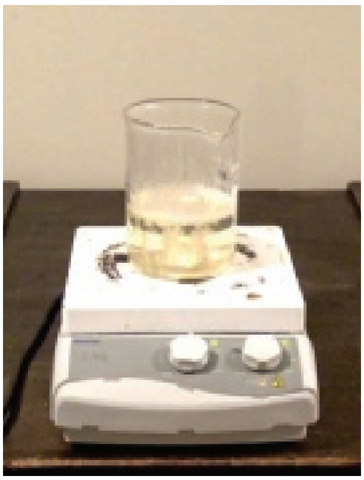
t = 36 min



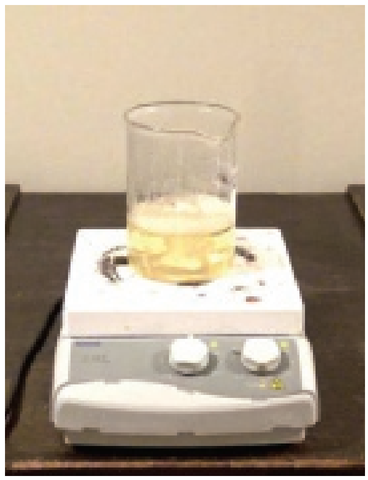
t = 72 min



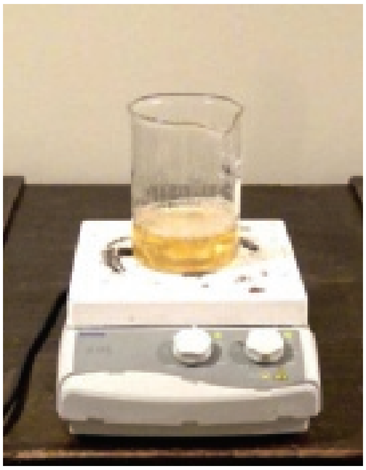
t = 75 min



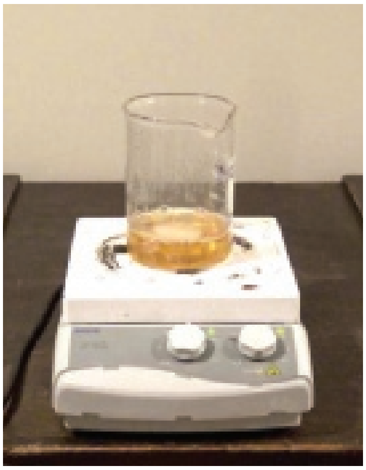
t = 84 min



t = 95 min



t = 109 min



t = 124 min

t = 134 min

3. A test tube is filled with 10 mL of the maple water poured right from the bottle. How would you describe the color of the liquid?

4. Now look at the image of what is left in the beaker after the maple water has been on the hot plate for a time. How would you describe this liquid?

5. Why do you think the liquid in the beaker looks different than the maple water out of the bottle?

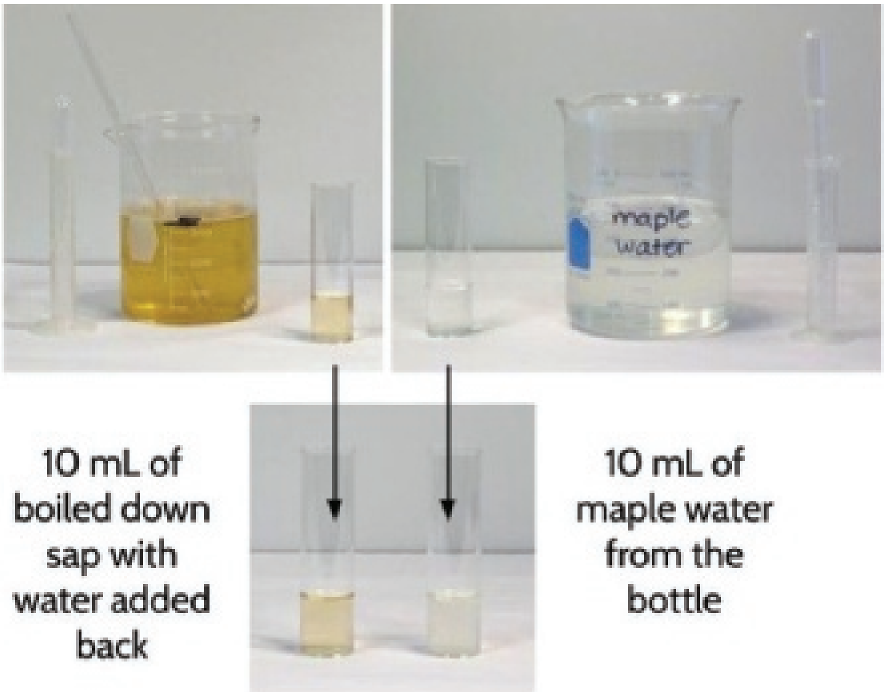
6. From the reading and the video, we learned that sap from the maple tree is boiled so the water evaporates and then maple syrup is left. We also know from earlier units that when water evaporates or is boiled, the water molecules go through a phase change from liquid to gas.

   So if syrup is just sap with the water boiled off, then shouldn't we be able to make sap by adding water back to maple syrup? Record your ideas in your notebook.

7. Water was added back to the beaker of sap that was boiled down so that the total was 300 mL again. Below are images 10 mL of this liquid in a test tube next to the 10 mL of maple water. Look closely at the two test tubes and use what you have learned about the properties of substances when you answer these questions:

   a. What can you conclude from the image?

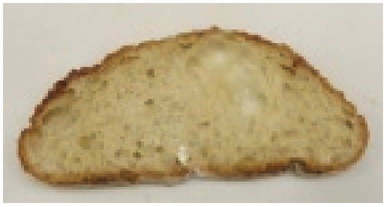
   b. Is sap the same thing as syrup with water added based on what you can see in the images below? Explain your thinking.



Data From Food That Did Not Get Eaten

In this investigation, two pieces of bread from the same loaf were each placed into quart size ziplock bags. Five sprays of water were added to each bag before they were sealed. One bag was placed by a window (In the Light) and one bag was placed in a nearby closed cabinet (In the Dark).

Photos of the bread kept in the light and in the dark were taken on days 1, 3, and 7.

In the Dark		
Bread Mold Day 1	**Bread Mold Day 3**	**Bread Mold Day 7**
		

In the Light		
Bread Mold Day 1	**Bread Mold Day 3**	**Bread Mold Day 7**
		

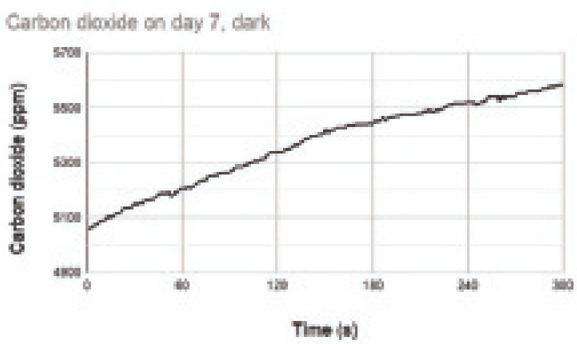
On day 7, each bread sample was placed into its own one-gallon ziplock bag with a relative humidity (RH) detector and the bags were sealed. Relative humidity values were recorded for each bread at 0 seconds and 300 seconds. This data is shown in the table below.

Changes in Percent (%) Relative Humidity		
Time (s)	**In the Dark**	**In the Light**
0	45% RH	40% RH
300	57% RH	61% RH

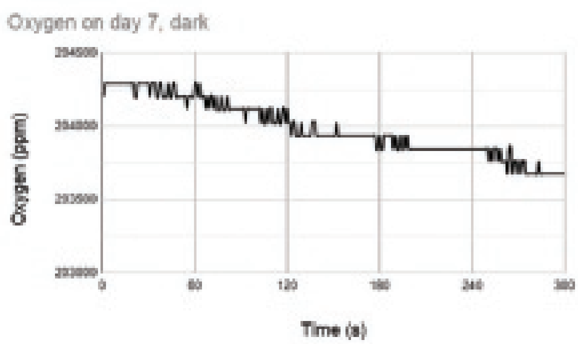
Each bread sample was also placed in a closed container with sensors capable of measuring carbon dioxide and oxygen levels over time. These data were collected for each bread sample over 300 seconds (5 minutes). These data are displayed graphically below.

In the Dark

Carbon Dioxide

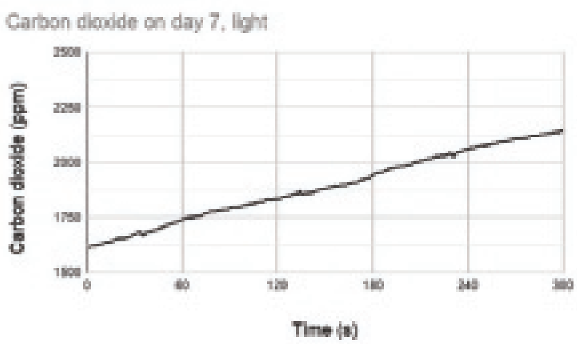


Oxygen

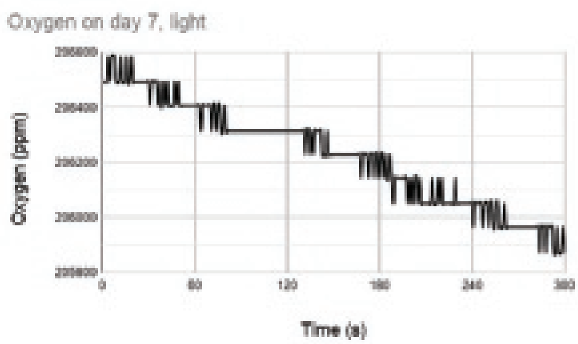


In the Light

Carbon Dioxide



Oxygen



Peer Feedback Guidelines

Giving Feedback to Peers

This tool was inspired by the Sticky Note Feedback resource originally developed by Ambitious Science Teaching at: https://ambitiousscienceteaching.org/sticky-note-student-feedback/

Feedback needs to be specific and actionable

That means it needs to be related to science ideas and have your own suggestions for improvement. Productive examples:

- "Your model shows that the sound source changes position when it is hit. I think you should add details about how the sound source moves back and forth after it is hit."
- "Your explanation said that plants are not able to live through the winter when they have no leaves, but we saw in the video of the maple tree that they can grow new leaves in the spring. We disagree and suggest reviewing the carbon dioxide data from the seedlings in the bag investigation."

Unproductive examples of feedback that do not help other students improve are:

- "I like your drawing."
- "Your poster is really pretty."
- "I agree with everything you said."

How to Give Feedback

Your feedback should give ideas for specific changes or additions the person or group can make. Use the sentence starters below if you need help writing feedback.

- The poster said _______________. We disagree because _______________. We think you should change _______________.
- I like how you _______________. It would be more complete if you added _______________.
- We agree that _______________. We think you should add more evidence from the _______________ investigation.
- We agree/disagree with your claim that _______________. However, we do not think the _______________ (evidence) you used matches your claim.

Receiving Feedback from Peers

The purpose of feedback is to get ideas from your peers about things you might improve or change to make your work more clear, more accurate, or better supported by evidence you have collected. It can also help you to communicate your ideas more effectively to others.

When you receive feedback, you should take these steps:

- Read it carefully. Ask someone else to help you understand it, if necessary.
- Decide if you agree or disagree with the feedback and say why you agree or disagree.
- Revise your work to address the feedback.

Reading: The History of Maple Tree Tapping

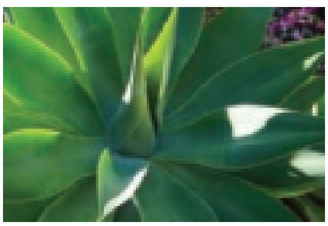
Maple Syrup

Maple syrup is frequently found on breakfast tables in North American households. The sweet liquid is plant-based, coming from maple trees. Sap is harvested from the tree in the period between winter and spring when the days are warm and the nights are cold. It is then boiled down until the liquid thickens and the flavor concentrates to turn it into maple syrup. You might be wondering, “Who came up with the idea to collect and boil tree sap?” Many historians have asked this question, and the answer is somewhat of a mystery.

Tree sap boiled in a kettle

The beginnings of syrup making are largely grounded in legends passed down by indigenous peoples. One commonly told story among tribe members in the Northeastern United States tells us that the first time sap was turned into syrup happened when a chief was preparing for a hunt one early spring morning long ago. The trees in the forest were still bare of leaves and the ground was still solid and hard. He took his tomahawk out from a cut he made with it in a nearby tree trunk where he had thrown it at the night before. As it was early spring, the weather was warm that day. A female member of his tribe noticed a clear liquid coming out of the tree trunk where the tomahawk had been stuck. She collected it, thinking it was plain water. She cooked their evening meal in that liquid, and found that the food had a sweet taste to it. She noticed boiling caused the liquid to turn to syrup. This flavored their food in a brand new way. This is said to have begun the tradition of maple syrup making.

While maple syrup is the most commonly used syrup on North American tables, there are many different varieties of syrup that can be made from the sap of different trees. In Alaska, for instance, birch trees are tapped for syrup making. Blue spruce syrup can be found in Utah, and black walnut syrup in Georgia. Regardless of the variety of tree, the same basic process is used to create all tree syrups. This syrup production has been done in North America for hundreds of years.

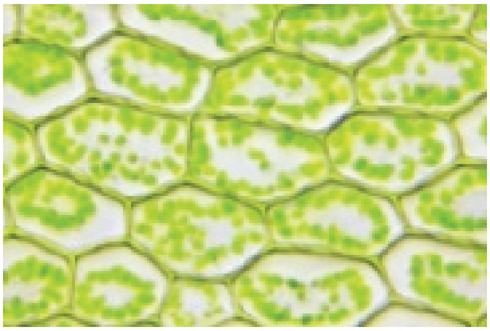


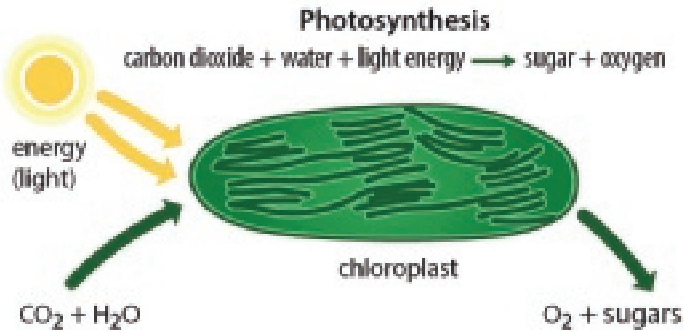
Blue Agave Plant

Today, Americans are also familiar with other plant-based syrups that are more popular in other parts of the world. Agave syrup, for example, is made primarily in Mexico. This syrup is made by extracting the liquid from the blue agave plant. It is then boiled down just like maple sap is boiled down to make maple syrup.

Reading: How do plant (and animal) cells use food?

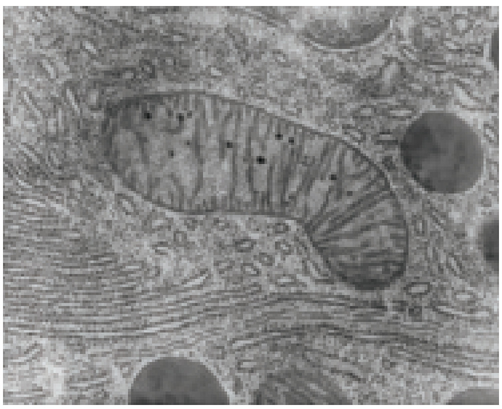
When plants have light, water, carbon dioxide, and chloroplasts available, they can produce glucose and oxygen through photosynthesis. The photograph below and to the left shows chloroplasts in leaf cells. The diagram to the right represents the inputs and outputs of photosynthesis.

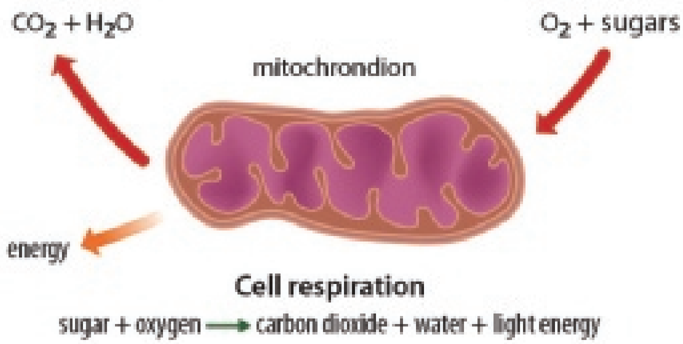




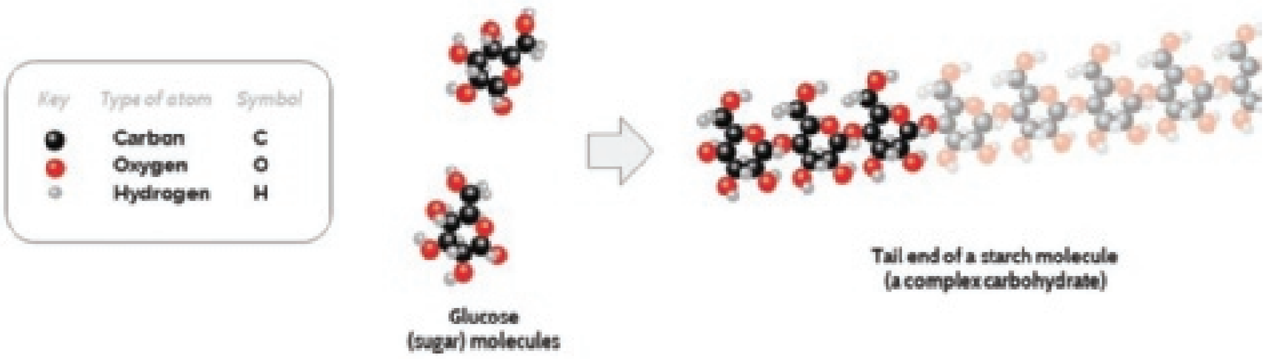
You've seen that when any one input is missing, the plant can no longer do this process. Another process, cellular respiration, which is how the cells of our bodies use food as fuel, is something that is happening in plant cells too. It is always happening in plant cells, even at times when photosynthesis is also going on. Photosynthesis is how plant cells produce fuel. Cellular respiration is how those cells use that fuel for energy to do things.

Cellular respiration happens inside specialized structures found within plant and animal cells, called **mitochondria**. Mitochondria are smaller than chloroplasts. Scientists have used electron microscopes to photograph these structures. They have found hundreds of them in each plant and animal cell. Notice the folds across the inside of each mitochondria shown in the photograph to the left below. This feature is common to all mitochondria. The diagram to the right shows the inputs and outputs of mitochondria in cellular respiration.





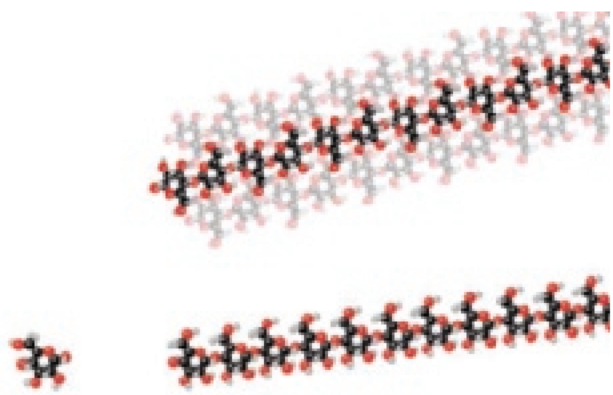
Plant and animals cells use cellular respiration all the time to get the energy they need to function. When plants are doing photosynthesis at a faster rate than their cells use it for fuel, they end up taking more carbon dioxide out of the air than they are putting back into it. When plants are producing sugar faster than they are using it, they convert extra sugar to starch and store it for later use. This is similar to how our bodies store extra food, by first converting it to a new substance through chemical reactions. Our bodies, though, store extra food as glycogen and fat molecules rather than as starch molecules. Plants typically store their extra food as starches, though in some cases, like in their seeds, they store some of it as fats too.



When needed for energy, plants can tap their stored food reserves by converting them back into sugar that reacts with oxygen in cellular respiration. Plants can also use those stored food molecules for building blocks to grow. When a plant grows, it does so by making more cells. To make more cells, it must first build more cell parts.

How does the plant do that? Let's use an example of the two substances that make up most of the mass of a plant. Cellulose makes up about 33 percent of the mass of a plant. It is the main substance in cell walls. We refer to it as a type of dietary fiber. Water makes up about 50 percent of the mass of a plant. It is the main substance in cytoplasm (the liquid inside the cells). The plant doesn't need to make water to grow. It can absorb that through its roots from its environment. But it does need to make cellulose to build new cell walls.

A molecular model of cellulose is shown to the right. It shows the end of one cellulose molecule, interconnected with the ends of two other cellulose molecules.



To build cellulose molecules, plants break down stored food (e.g., starch molecules) and reassemble the atoms to make cellulose molecules through chemical reactions. Notice how similar the arrangement of atoms in cellulose molecules is to sugar and starch molecules. This is one example of how plants build one of the new molecules it needs to make new cells in order to grow.

Reading: Agave Syrup

What is it?

Agave syrup is made from a plant native to dry, desert climates. This succulent plant looks like a cactus or large aloe plant, but is not a cactus or even related to a cactus. Agave plants grow in Mexico and Southwest United States.

How it is harvested and what is done to it after it is harvested: In addition to the agave syrup that can be processed from this plant, other parts of the plant are used for other things as well. People eat parts of the leaves of the plant, the flowers, and even the fruits. Some cultures even use the spikes on the end of the leaves as writing utensils.

To make syrup from this plant, the leaves of the plant are cut off and then cut into smaller pieces. These small pieces are pressed to get the sugary sap out of them. The sugary sap is then heated until the water boils off and a thicker syrupy substance is left. This is the agave syrup. For commercial brands of agave syrup, an extra step is added to this processing. As the sugary sap is being heated to boil off the water, an enzyme is added that breaks down the sugar molecules even further.

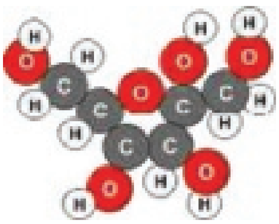
History of agave syrup:

The agave plant has been used back to early times for food, the sap, the leaves, the flowers, and the fruit. In addition to food, the agave plant has been used by many cultures in the south for other purposes. The Native Americans used the fibers of the inside of the leaves of the plant to make nets and rope. The Mexicans used the outer skin of the leaf of the plant to make paper.

What agave syrup is made of:

The type of sugars in agave syrup vary with the species of agave plant. Syrup made from blue agave mainly consists of two types of sugars: fructose (56-60%) and glucose (20%). The structures of these sugar molecules are shown below:

Fructose



Glucose

Sources:

1. "Agave Syrup." *Wikipedia,* Wikimedia Foundation, 14 Sept. 2019, en.wikipedia.org/wiki/Agave_syrup.

Reading: High Fructose Corn Syrup

What is it?

High fructose corn syrup is made from corn syrup. Corn syrup is made from the starch of corn. High fructose corn syrup is a sweetener used to make food sweeter, and it has a softer texture and longer shelf life. High fructose corn syrup is used in many of the commercial, processed foods we eat today, such as ice cream, sorbet, soft drinks, some cereals, cookies, hard and soft candies.

Where does it grow?

Corn is grown across the United States. There are different types of corn, but the type that corn syrup can be made from is grown in many states. Corn syrup is made from the starch of yellow corn. It goes through a process to break down the long chains of starch (linked sugars) into glucose. High fructose corn syrup is made from processing the corn syrup even further to rearrange the glucose into fructose.

How it is harvested and what is done to it after it is harvested:

When the corn is ready and has been harvested, it is transported to a mill by truck. Once at the mill, the multiple cobs of corn are cleaned. The cobs are added to a vat with water and this is heated. Next this is milled so the solid corn pieces, called corn germ, are separated from the liquid. The corn germ is further milled with water and poured through a sieve so the starchy liquid is collected separately from any fibers left in the solution. This starchy liquid is used to make corn syrup. To get the corn syrup that is a sweet, sugary liquid, the starch molecules need to be broken down. To make corn syrup, an acid called hydrochloric acid is added to this solution and heated. The result is a sweet, thick syrup whose prevalent sugars are based on glucose.

Amalyse, and other enzymes, can be added to this syrup to further alter the starch molecules (long chains of linked sugars) by converting them to shorter molecules and glucose. Another type of enzyme called an isomerase is then added to convert some of the glucose to fructose.

History of corn syrup:

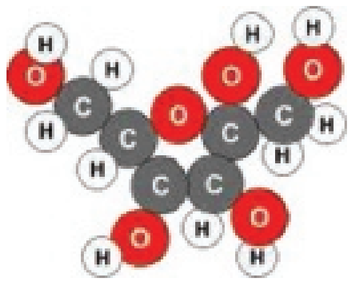
Corn syrup has also been referred to as glucose syrup due to the prevalent sugar in the syrup being glucose. But, the first glucose syrup was discovered long ago in Russia using potatoes. At the time, they discovered that if they added an acid to potatoes, the starch of the potato broke down into sugars, or glucose. As long ago as the 1800s corn syrup has been made from corn and used to make sweet foods. In 1812, a German chemist named Gottlieb Kirchoff came up with the process of adding hydrochloric acid to cornstarch to make corn syrup. Today, in addition to hydrochloric acid, enzymes, such as amylase, are added to the mixture of cornstarch and water to break the starch molecules down into sugars.

High fructose corn syrup was invented to help curb the cost of adding sugar to foods. As sugar was an ingredient added to more and more foods, scientists worked to create a more economical, stable type of sugar. In the 1960s, corn syrup production began, but it was not until 1983 that high fructose corn syrup was accepted by the Food and Drug Administration as safe for human consumption. Once this happened, high fructose corn syrup was added to many different food products because it was inexpensive to make and had a long shelf life. Today, it is still considered safe for human consumption, but it is becoming linked to health issues, such as diabetes. A person's body can only use, or break down, a small amount of fructose, one type of sugar that is in high fructose corn syrup. Any excess fructose a person consumes gets stored as fat, which can lead to many health issues if too much is consumed.

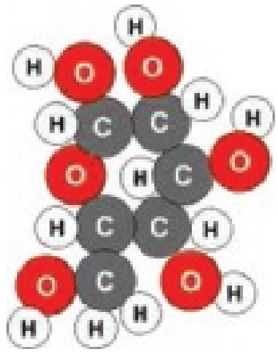
What corn syrup is made of:

High fructose corn syrup is made up of both glucose and fructose, usually with a fructose content of 42-65%. The chemical structure of the glucose and fructose molecules are shown below:

Fructose



Glucose



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2. *Corn Syrup - New World Encyclopedia,* www.newworldencyclopedia.org/entry/Corn_syrup.
3. McDowell, Erin. "Corn Syrup Isn't Evil (& Here's Why)." *Food52,* Food52, 26 Sept. 2018, food52.com/blog/13735-why-corn-syrup-isn-t-evil.
4. "What Is High Fructose Corn Syrup and Is It Bad For You?" *Health.com,* www.health.com/nutrition/high-fructose-corn-syrup-video.
5. "High-Fructose Corn Syrup." *Wikipedia,* Wikimedia Foundation, 9 Jan. 2020, en.wikipedia.org/wiki/High-fructose_corn_syrup.

Reading: Honey

What is it?

Honey is the sweet and thick substance made by bees from the nectar of flowers. The best-known varieties of honey are produced by honey bees. Although honey bees are native to Eurasia, humans have brought them to four other continents. In contrast to many other foods, honey does not spoil over time. Honey also has medicinal properties.

How honey is made:

Honey is produced by bees collecting nectar from flowering plants for use as food. Nectar is a sugar-rich liquid that plants produce to attract pollinators. Although bees use some sugars in nectar immediately for energy, the majority are converted to honey for long-term food storage. Collected nectar is stored in a forager bee's honey stomach where it is mixed with enzymes that turn larger sugars into smaller sugars like fructose and glucose. Back at the nest, the forager bee passes the contents of its honey stomach to house bees who regurgitate and re-drink it repeatedly for about 20 more minutes. The nectar is then deposited in wax structures called honeycombs. The house bees vigorously flap their wings to speed up the evaporation of water to a level of 17%. The bees then cap the cells of the honeycomb with wax.

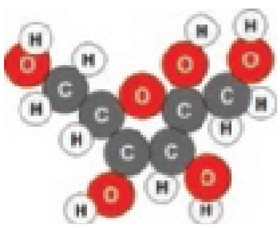
History of Honey:

Honey has been used by people all over the world for thousands of years for food, medicine, preservation, and as a cultural symbol. Indeed, an 8,000 year old rock painting in a cave in Spain shows people collecting honey from a bee nest. Prior to the widespread availability of sugar in the seventeenth century, honey was used to sweeten food.

What honey is made of:

Although the exact composition of honey depends on a number of factors, the major substances that make up honey are relatively constant. Honey is typically 38.5% fructose, 31.0% glucose, 17.1% water, 11.4% other carbohydrates, 1.5% sucrose, and 0.5% minerals, vitamins, enzymes, and acids. The types and amounts of minerals, vitamins, enzymes, and acids depend on the type of flowers from which the bees collect nectar. The chemical structures of the major components, glucose and fructose, are shown below.

Fructose



Glucose

Why doesn't honey spoil?

If honey is mostly sugar, why doesn't it spoil? One reason is the low water content; very few microorganisms like bacteria and fungi can survive in honey. As a result of chemical reactions between bee enzymes and glucose, acids are produced and make honey acidic. This is also what makes honey a hostile environment for bacteria and fungi. These features contribute to honey's medicinal properties as well.

Sources:

1. "Honey." *Wikipedia,* Wikimedia Foundation, 9 Jan. 2020, en.wikipedia.org/wiki/Honey.

2. Tanner, Russ, and Russell Flynn. "Why Doesn't Honey Spoil? – The Chemistry of Honey." *Compound interest,* 30 May 2016, www.compoundchem.com/2014/08/21/chemistryofhoney/.

3. User, Super. "A Brief History of Honey." *The Honey Association - Home,* www.honeyassociation.com/about-honey/history.

4. "All About Honey." *Localhoneyfinder.org* localhoneyfinder.org/AllAboutHoney.php.

5. "Honey, Recipes, Research, Information." *National Honey Board,* 9 Jan. 2020, www.honey.com/about-honey/honey-benefits.

6. Geiling, Natasha. "The Science Behind Honey's Eternal Shelf Life." *Smithsonian.com,* Smithsonian Institution, 22 Aug. 2013, www.smithsonianmag.com/science-nature/the-science-behind-honeys-eternal-shelf-life-1218690/.

Reading: Stevia

What is it?

Stevia is a zero-calorie sweetener that comes from the stevia plant, native to Brazil and Paraguay. It is 30–320 times sweeter than sugar and is commonly sold as Truvia. Although it is sweeter than sugar, some of its components have a bitter or licorice-like aftertaste.

How stevia is obtained from the stevia plant:

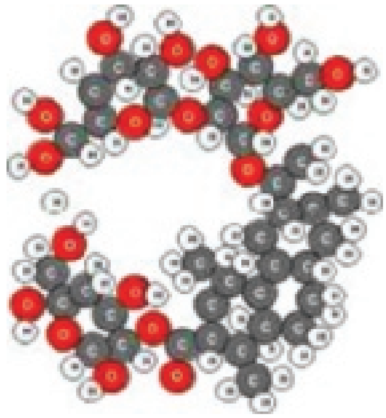
Once the leaves are harvested, they are dried, crushed, and then steeped in warm water (like making tea by heating leaves in hot water). This results in a dark brown liquid that goes through multiple purification steps to make a liquid solution of the sweet tasting molecules. When small droplets of this solution are sprayed into hot air, the liquid quickly evaporates and the dry stevia powder that looks like sugar is left behind.

History of Stevia:

The Guarani people of Brazil and Paraguay have used the stevia plant for over 1500 years to sweeten a type of tea called yerba mate that they drink as a sweet treat and medicine. The first scientific description of the stevia plant occurred in 1899 when a Swiss botanist wrote about its sweet taste. In the first half of the 20th century, chemists were able to isolate and characterize the molecules responsible for the stevia plant's sweet taste. However, the U.S. Food and Drug Administration only allowed it to be used as a dietary supplement in 1994 and it was not until 2008 that high-purity stevia extracts were approved for use in food. Stevia leaves and extracts made from the plant that have not been purified through multiple steps and are of lower purity are still not approved for use in food.

What stevia is made of:

The molecules that give stevia its sweet taste and that are present in high-purity stevia extracts are a class of substances known as steviol glycosides. All of these molecules have different types and numbers of sugars attached to a central structure consisting of C, H, and O called steviol. The main steviol glycoside in stevia (stevioside) is shown here:



What happens to stevia in our bodies?

Researchers have found that when the steviol glycosides are eaten, they pass through the stomach and small intestine unchanged. Once they reach the colon, the stevia is broken down, filtered by the liver, and excreted from the body in the urine.

Sources:

1. Ashwell, Margaret. "Stevia, Nature's Zero-Calorie Sustainable Sweetener: A New Player in the Fight Against Obesity." *Nutrition Today,* Lippincott Williams & Wilkins, May 2015, www.ncbi.nlm.nih.gov/pmc/articles/PMC4890837/.
2. Samuel, Priscilla, et al. "Stevia Leaf to Stevia Sweetener: Exploring Its Science, Benefits, and Future Potential." *The Journal of Nutrition,* U.S. National Library of Medicine, 1 July 2018, www.ncbi.nlm.nih.gov/pubmed/29982648.
3. "Stevia." *Wikipedia,* Wikimedia Foundation, 19 Dec. 2019, en.wikipedia.org/wiki/Stevia.

Reading: Sucralose

What is it?

Sucralose is an artificial sweetener that has zero calories. Splenda is the most commonly known sucralose product. Sucralose is used in lots of beverages and foods like soft drinks, candies, and breakfast bars.

Unlike some other artificial sweeteners, sucralose can be heated without breaking apart, so it can be used to make baked goods. It does not brown like sugar or feel like sugar in our mouth.

Where does it come from and what are its properties?

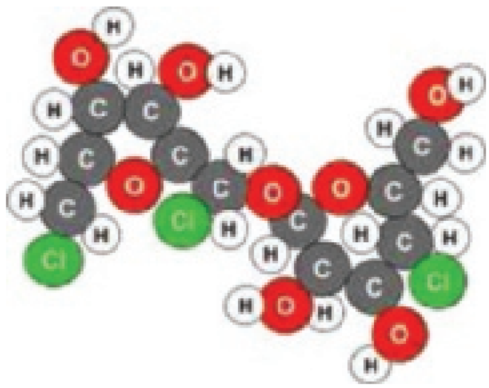
Sucralose is made from regular table sugar in a multi-step process where chemical reactions break apart the sucrose molecules and pieces of the molecule are replaced with chlorine (Cl) atoms to form a new type of substance. Sucralose is a white, odorless crystalline powder that dissolves in water, just like sugar. However, sucralose is 400-800 times sweeter than sugar! For this reason, it is usually blended with fillers that come from corn and are used to give sucralose products like Splenda the same level of sweetness per unit volume as sugar.

History of sucralose:

Similar to other artificial sweeteners like saccharin and aspartame, sucralose was discovered by accident in 1976 by a graduate student at King's College London. The graduate student was part of a team that was investigating new substances related to sucrose. The lead researcher told the graduate student to "test" the compounds, but he misunderstood and "tasted" them instead. Sucralose was first approved for use in foods by the U.S. Food and Drug Administration in 1998.

What is sucralose made of:

Sucralose is the scientific name of the sweet molecules in Splenda and the molecule looks like:



What happens to sucralose in our bodies?

Over a period of 20 years, more than 100 safety studies have shown sucralose to be safe for human consumption. It is safe for children, pregnant women, and people with diabetes. Researchers have found that 85% of the sucralose that people consume is not even absorbed by the body. Of the 15% that is absorbed by the body, none of it is broken down for energy since its chemical structure prevents enzymes from breaking it down.

Sources:

1. Insight, Food. "Everything You Need to Know About Sucralose." *IFICFoundation,* 20 Feb. 2019, foodinsight.org/everything-you-need-to-know-about-sucralose/.
2. "Sucralose." *Wikipedia* Wikimedia Foundation, 18 Dec. 2019, en.wikipedia.org/wiki/Sucralose.

Reading: Sugar

What is it?

Sugar is made from sugar cane, a plant that resembles bamboo. Sugar cane looks like a very tall, thick growing grass. It can grow up to 20 feet tall and the stalk can be as thick as 2 inches in diameter. There are many types of sugar that come from this plant or can be made from this plant. The stalks, or canes, themselves can chewed for a sweet treat after the skin has been peeled off. The inside of the stalk is very fibrous, so it can be chewed to get the sweet juice, but isn't usually eaten.

Where does it grow?

Sugar cane grows in tropical climates, such as southern United States, South America, Southeast Asia, and Northern Africa. In the United States, sugar cane is grown in only four states: Florida, Hawaii, Louisiana, and Texas. The sugar cane is harvested and processed in these four states in addition to California, Georgia, Maryland, and New York.

What it looks like when harvested:

When sugar cane is ready to be harvested, it looks like a tall grass with leaves that fan out at the top. The stalks will be straight and sturdy and tannish in color.

How is it harvested and what is done to it after it is harvested?

After sugarcane is harvested, or cut down, it is taken to a mill. In the mill, the stalks are cut into pieces and crushed to squeeze out the juice. The juice is strained to remove fibers, skin, leaves, or soil. Then the juice is collected in pans and placed in an evaporator. The evaporator is heated and the water in this sugarcane juice is boiled off. At this point, some small sugar crystals are added to the solution and heated longer so these crystals can grow larger. The resulting solution, which is a dark golden brown color, is put into a centrifuge, a machine that spins really fast like a washing machine, so any solid crystals can separate from the liquid syrup. The solid sugar crystals that separate out in the centrifuge are a high quality sugar and are collected and sent to a refinery. The liquid solution that seperated out in the centrifuge is also collected. This liquid is a darker brown in color and is called molasses. Molasses is used as a sweetener for some foods.

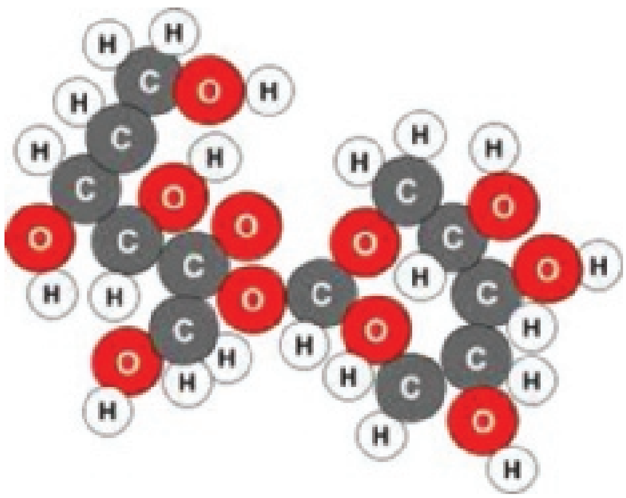
At the refinery, the sugar crystals are dissolved in water and then filtered through a fine strainer to remove any solids. The liquid that is left is made of pure sugar and water, so it is boiled to remove the water. A few sugar crystals are added to this solution to encourage larger sugar crystals. This solution is put in a centrifuge to separate out and collect the solid crystals. These are placed in a heated drum to dry, like your clothes dryer at home. Before packaging the sugar, it is sifted through different sized strainers to collect the different size and type of sugar crystals, such as fine refined sugar, raw sugar, etc.

History of sugar cane:

Sugar cane has been around for a long time. The earliest records of sugar cane date all the way back to New Guinea in 8000 BC. The first people to use sugar cane chewed it for the sugary juices. They would peel the skin off and chew the inside part of the plant. As long ago as 5th century AD, an Indian chemist figured out how to separate the crystals from the juice. This is the first recording of solid sugar, or sucrose.

What is sugar cane made of?

The white sugar, or brown sugar, you use today when cooking comes from sugar cane. The scientific name for this type of sugar is sucrose and the molecule looks like:



Sources:

1. "How Does Sugar Cane Become The Sugar We Use?" *Forbes,* Forbes Magazine, 6 Sept. 2017, www.forbes.com/sites/quora/2017/09/06/how-does-sugar-cane-become-the-sugar-we-use/#11fe840560f9.

2. "Sugar's Not the Only Product We Get From Sugarcane." *Food52,* Food52, 6 Dec. 2019, food52.com/blog/16601-sugar-s-not-the-only-product-we-get-from-sugarcane.

Reading: Where else does our food come from?

You may have heard people refer to different foods as natural, or whole foods. And, then they may refer to other foods as processed or even artificial or synthetic. When you think of these two words, natural and synthetic, what do they mean to you? When have you used them and what were you referring to? Now think about the foods you eat. Which ones would you call natural foods and which ones would you call synthetic or artificial foods?

Scientifically, a **natural** food is one that is made by a plant or animal. When you hear the term "natural foods" it seems pretty obvious that these foods come from nature, either from an animal or plant. Sometimes these naturally occurring foods get processed by boiling, freezing, heating, chemical reactions, or adding additional ingredients. This results in a **processed** food.

Natural foods can be processed either physically, chemically, or both. When a food is processed physically, the molecule(s) that make up the food have not been changed, but the amount, appearance, size, temperature or texture of the food might have been changed. Some ways natural foods can be physically processed are through boiling, grinding down into a powder, freezing, or chopping up. One example of this type of processing is when the maple sap is put in the evaporator so the water boils off. At this point the molecules of the sap have not been changed (it is still the same color), but the consistency has changed because there is less water. What are some other examples you can think of where natural foods have been physically processed to change the size or texture?

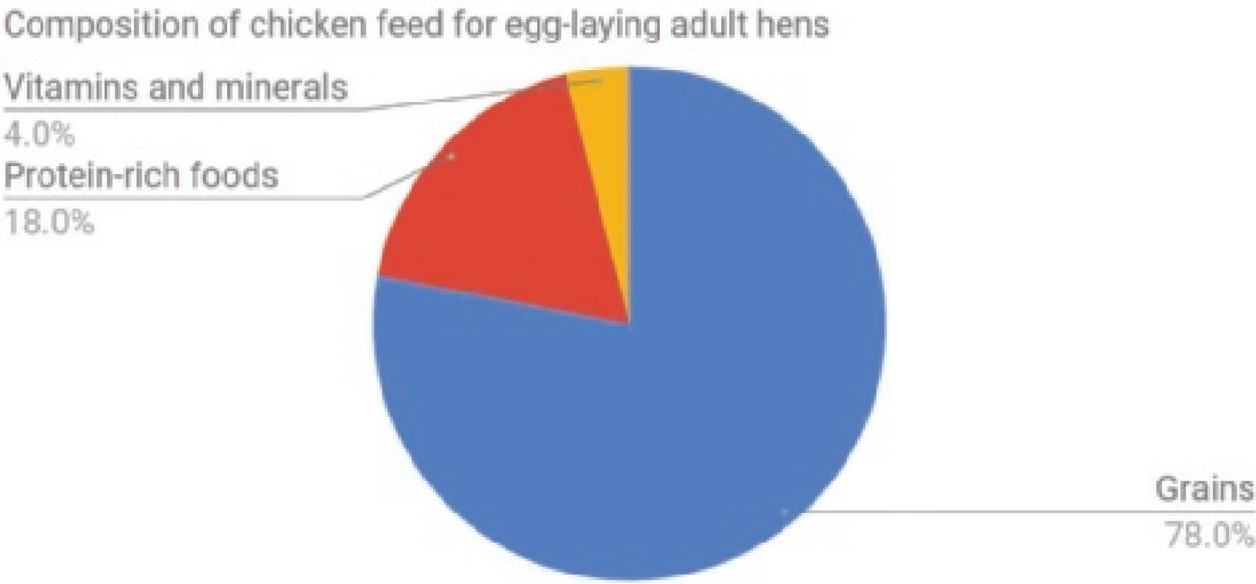
When a food is processed chemically, the molecules of the natural food change through a chemical reaction to form a new substance, a **synthetic** food. One example of this type of processing is when the sap that has had the water boiled off is placed over high heat. As this liquid continues to be heated the molecules of the sugar in the sap break apart and react with the atoms of the minerals and amino acids in the sap to make a new substance, maple syrup. What are some examples you can think of where a natural food has gone through a chemical process to make a new food?

Reading: Chicken and Cow Diets

Chicken diets:

Farmers often use chicken feed to make sure chickens get all the nutrition they need. Chicken feed primarily includes grains, such as corn, wheat, barley, oats, or rye. It also includes foods rich in protein such as soybeans or fish meal. Chickens also eat foods that give them vitamins and minerals, like seaweed or oyster shells. On some farms, chickens can also roam freely, where they will eat grass, insects, and worms.

Farmers change the composition of chicken diets, depending on the chickens' age and if they are being raised to lay eggs or raised to produce meat. Young chicks are fed diets with more protein than older chickens to support growth. Chickens being raised for meat have diets that are also higher in protein-rich foods. Chickens laying eggs are given extra calcium to strengthen the shells of their eggs.

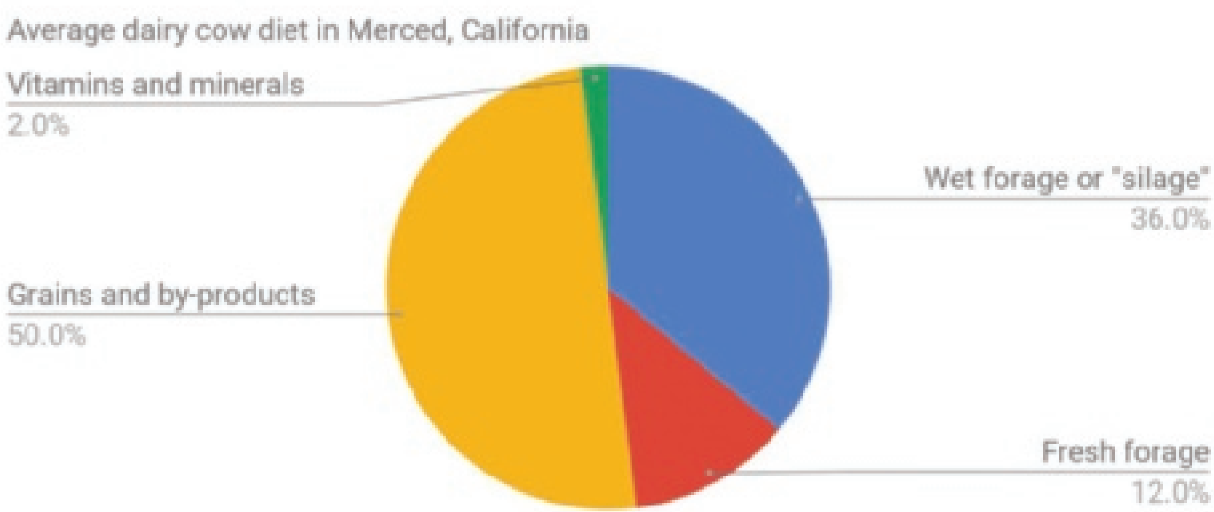


Chicken feed composition for an adult laying hen

Cow diets:

Farmers feed cows a combination of forage, grains, and vitamins, and minerals. Forage can include grass, alfalfa hay, ryegrass, or barley. Some forage is green fermented plants (wet forage or "silage"), and some forage is dried plants (dry forage). Forage makes up about half of an adult dairy cow's diet. The other half includes grains like corn, barley, wheat, or oats as well as other by-products from processing plants like corn or wheat. Cow diets also include a small amount of vitamins and minerals. On some farms, cows can also roam freely, where they will eat grass or other plants. Together, these foods provide dairy cows with the right balance of proteins, fats, and carbohydrates.

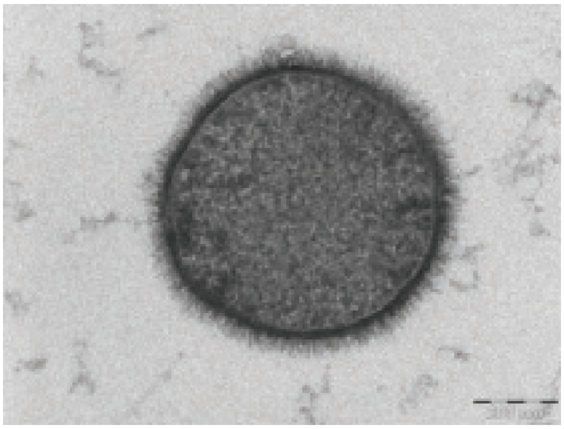
Farmers change the composition of cow diets, depending on the cow's age and if they are being raised for milk or to produce meat. For example, cows being raised for meat start out eating mainly forage. As they get older, some farmers will continue feeding them forage and add some grain to their diets. Other farmers will shift their diets to primarily grains like corn because corn allows the cows to put on weight more quickly.

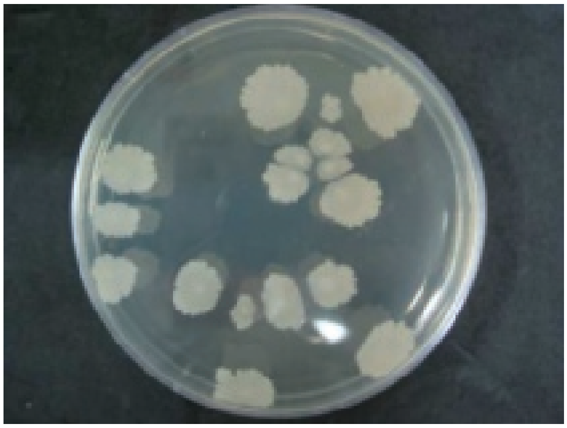


Average dairy cow diet from 40 dairies in Merced, California. Data adapted from the University of California Cooperative Extension. http://:cemerced.ucanr.edu/files/149683.pdf.

Reading: Organisms that use food that doesn't get eaten

Bacillus subtilis, or B. subtilis





B. subtilis is a bacterium that is often also known as hay bacillus or grass bacillus as it is commonly found in the upper layers of the soil. *B. subtilis* can also be found in healthy human digestive systems. *B. subtilis* lives on or inside the organisms it breaks down for food.

B. subtilis is tolerant of very harsh and unfavorable conditions, surviving when other bacteria cannot by going dormant. It can sustain such conditions as drought, high or low salt, extreme acid, radiation, and solvents.

One common use of *B. subtilis* is in the manufacturing of a fermented Japanese soybean product called *natto*. Soybeans contain a dozen isoflavones, a specific family of molecules that mimic hormones in the body. Some isoflavones in soybeans have glucose (sugar) groups attached to them to form glucoside molecules, which are poorly digested by humans. The other isoflavones that do not have sugar groups attached to them are more easily digested and are known as aglycones. When *B. subtilis* is introduced, it causes a chemical reaction that changes the glucosides into aglycones, therefore making the product more easily digestible. Although *B. subtilis* does not have mitochondria it can still do cellular respiration when in the presence of oxygen.

Sources:

- Bacillus subtilis. (2019, October 11). Retrieved January 22, 2020, from https://en.wikipedia.org/wiki/Bacillus_subtilis
- Hasim. (2015). Bacillus subtilis natto fermentation to improve aglycone isoflavones content of black soybean varieties. *International Food Research Journal, 22(6),* 2558–2564. Retrieved from http://www.ifrj.upm.edu.my/22 (06) 2015/(41).pdf

Dung Beetle

Dung beetles are a type of insect that can be found on all of the continents except Antarctica and in a variety of habitats such as farmlands, forests, grasslands, prairies, and deserts.

True to their name, dung beetles eat something that humans cannot–poop! Dung beetles consume the poop, or dung, of both herbivores, or animals that eat only plants, and carnivores, or animals that eat other animals. The beetles tunnel into the dung piles, create a ball, and roll the ball quickly away from the pile before it is stolen by another beetle. These small insects can roll up to ten times their weight.

Dung beetles help break down and eliminate poop all over the world. Imagine what it would be like if every time an animal pooped the pile remained there, not breaking down or disappearing. Dung beetles help decompose, or break down, this matter in the system, eliminating the dung piles from the surface. Since beetles are a type of animal, they have mitochondria in their cells. This means they are able to do cellular respiration to extract energy from the things they eat.

Sources:

- Dung Beetle. (2019, October 20). Retrieved October 27, 2019, from https://animals.sandiegozoo.org/animals/dung-beetle
- Dung beetle. (2019, October 20). Retrieved October 27, 2019, from https://en.wikipedia.org/wiki/Dung_beetle

Red Wiggler Worms

Red wiggler worms are a species of earthworm that are most commonly found in rotting vegetation, compost, and manure. This species is rarely found in soil. Red wigglers consume dead plant and animal matter, composting organic waste and returning nutrients to the soil.

Red wigglers, also known as tiger worms, are native to Europe, but they have been introduced on every continent except Antarctica. These invertebrates (animals without bones) have bristles on each segment of their bodies that grip surfaces to help them push forward or backward as they stretch and contract their muscles. Since red wigglers are animals, they have mitochondria in their cells and are able to do cellular respiration.

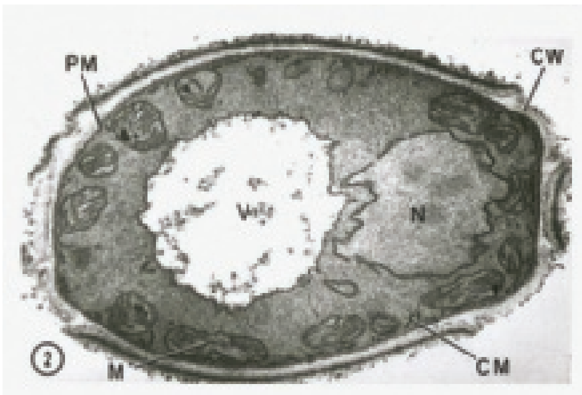
Because of their ability to break down matter that humans cannot, red wiggler worms are currently being tested for use in a flushless toilet system, which is being trialed in India, Uganda, and Myanmar.

Sources:

- Eisenia fetida. (2019, October 14). Retrieved October 27, 2019, from https://en.wikipedia.org/wiki/Eisenia_fetida

Fungi (Mushrooms)

Fungi, such as mushrooms, are commonly found in forests living on and feeding on dead plants and animals that are left behind by other organisms. While mushrooms are often considered to be plants by the average person, they are, in fact, fungi. Fungi, unlike plants, have mitochondria but do not have chloroplasts, even though they do not have a mouth or teeth to consume matter for energy.



Fungi use enzymes (a type of protein) to digest plant and animal remains into smaller pieces that they can absorb. After they take in this matter, they release nutrients back into the soil. Fungi can break down tough substances that other animals can't, such as wood and cellulose that is found in plant cell walls.

Sources:

- Retrieved January 22, 2020, from OpenStax, Biology. OpenStax CNX. May 8, 2019 http://cnx.org/contents/185cbf87-c72e-48f5-b51e-f14f21b5eabd@11.10.

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