Food Webs
Lesson 2a: Food for Plants

Grade 5	**Length of lesson:** 50 minutes	**Placement of lesson in unit:** 2a of 7 two-part lessons on food webs
Unit central question: How do living things depend on one another to get the food (matter and energy) they need to live and grow?		**Lesson focus question:** What is food for plants? (Part 1)
Main learning goal: Water, carbon dioxide, minerals in the soil ("plant food"), and soil are *not* food for plants because they don't contain energy (measured in Calories) that living things can use to live and grow.		
Science content storyline: Plants need food to live and grow. To be defined as food scientifically, materials must provide matter *and* energy for living things. Water, carbon dioxide, and minerals in the soil ("plant food") are *not* food for plants because they don't contain energy (measured in Calories) that living things can use to live and grow. Jan van Helmont's experiment shows us that soil is *not* food for plants because it doesn't provide the matter that allows plants to get bigger (increase in mass). *So what is food for plants?*		
Ideal student response to the focus question and the synthesize/summarize task: Plants don't take in food from the air or from the soil. The things they take in—like water, carbon dioxide, and minerals—are *not* food because they don't provide energy (from Calories) that plants need to live and grow. And soil isn't food either because we saw in Van Helmont's experiment that the tree grew big, but the weight of the soil stayed pretty much the same. So soil wasn't used as food to make the tree bigger.		

Preparation

Materials Needed	**Ahead of Time**
• Science notebooks • Packet of seeds or a seedling • Large green plant or large log (or photos of oak-tree and sequoia-tree seedlings and adult trees) • Large class-chart bulletin-board area for evidence chart • Sticky notes (3" × 5" or 2" × 2") • *Optional:* chart paper, markers • *Optional:* dry ice and work gloves to handle it **Student Handouts** • 2.1 What Is Food for Plants? (Investigations 1 and 2) (1 per student)	• Review the Food Webs Content Background Document: sections 2.3, 2.4, and 3.6 (focus on parts about photosynthesis). • Review the PowerPoint slides and modify them as you wish. • Set up a bulletin board or other large marking space as a chart titled How Do Plants Get Their Food, with three columns labeled "Our Ideas about What Is Food for Plants," "Evidence to Support Our Claims," and "Evidence to Challenge Our Claims." (See PowerPoint slide 7 for a model of this chart.) The evidence columns should have plenty of space for adding multiple sticky notes later on.

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Lesson 2a General Outline

Time	Phase of Lesson	How the Science Content Storyline Develops
2 min	**Link to previous lesson:** The teacher asks a question to assess student understanding of the scientific definition of *food*.	• To be defined as food scientifically, materials must provide matter *and* energy for living things. By this definition, water, carbon dioxide, and minerals in the soil ("plant food") are *not* food.
8 min	**Lesson focus question:** The teacher elicits student ideas about the focus question, *What is food for plants?*	• Plants need food to live and grow.
5 min	**Setup for activity 1:** The teacher asks, "Are water, carbon dioxide, and minerals in the soil food for plants?" and then challenges students to consider evidence that might help them decide whether these materials are food for plants.	• Plants need food to live and grow. • To be defined as food scientifically, materials must provide matter *and* energy for living things.
7 min	**Activity 1:** Students work with a partner to decide whether water, carbon dioxide, and minerals in the soil (plant food) are food for plants and provide supporting evidence (from the previous lesson).	• To be defined as food scientifically, materials must provide matter *and* energy for living things. • Matter can be measured in terms of its mass (e.g., grams). • Energy that living things can use to live and grow is measured in Calories.
8 min	**Follow-up to activity 1:** Students discuss and come to the conclusion that water, carbon dioxide, and minerals in the soil are not food for plants because they don't contain energy (measured in Calories).	• Water, carbon dioxide, and minerals in the soil aren't food for plants because they don't contain energy (measured in Calories) that plants can use to live and grow.
5 min	**Setup for activity 2:** The teacher elicits student ideas about evidence that supports or challenges the claim that soil is food for plants.	• To be defined as food scientifically, materials must provide matter *and* energy that living things can use to live and grow.
7 min	**Activity 2:** Students read about and analyze data from Van Helmont's experiment to consider whether soil is food for plants.	• We observed that Van Helmont's tree gained a lot of weight, but the weight of the soil stayed pretty much the same (just a tiny bit of weight was lost from the soil).
5 min	**Follow-up to activity 2:** The class discusses the results of Van Helmont's experiment.	• Van Helmont's experiment provided evidence that the matter a tree used to grow did *not* come from the soil. Therefore, soil wasn't food for the tree.
2 min	**Synthesize/summarize today's lesson:** Students summarize the evidence they've gathered so far to answer the focus question, *What is food for plants?*	• Living things need food that provides both matter and energy they can use to live and grow. • Plants can't use carbon dioxide (CO_2), water (H_2O), or minerals in the soil as food because those materials don't contain energy that living things can use to live and grow. • Plants don't use soil for food to grow bigger because Van Helmont's tree gained a lot of mass, but it didn't come from the soil.
1 min	**Link to next lesson:** The teacher links science ideas to the next lesson.	

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Time	Phase of Lesson and How the Science Content Storyline Develops	STeLLA Strategy	Teacher Talk and Questions	Anticipated Student Responses	Possible Probe/Challenge Questions
2 min	**Link to Previous Lesson** **Synopsis:** The teacher asks a question to assess student understanding of the scientific definition of *food*. **Main science idea(s):** • To be defined as food scientifically, materials must provide matter *and* energy for living things. By this definition, water, carbon dioxide, and minerals in the soil ("plant food") are *not* food.	Link science ideas to other science ideas.	**Show slides 1 and 2.** Who can name something that living things take into their bodies that is *not* food by the scientific definition? Be ready to give a reason for your choice. **ELL support:** If you're asking the question to get an idea of students' understandings of food, then ask for positive examples of food first (an example of what food is rather than what isn't). Also, the word *bodies* might be confusing for ELL students in relation to plants. You might use the word *organism* instead, since it's similar to the Spanish word. **ELL support:** Students should be able to differentiate the word *carbon dioxide* from *oxygen* and *air*. Draw out examples of energy and matter. **NOTE TO TEACHER ON MISCONCEPTIONS:** *Be aware that students may correctly state here that water, carbon dioxide, vitamin pills, and plant food* ***are not*** *food, but they may contradict themselves when you ask for their ideas about what* ***is*** *food for plants in the next section of the lesson plan. They may assert that water, air, and plant food* ***are*** *food for plants. Their reasoning may be that there are different criteria for what counts as food when we talk about plants.*	*Ideal responses:* • Water. • Carbon dioxide. • "Plant food" (fertilizers and minerals). • Vitamin pills. These are all matter, but they have no energy (Calories) that living things can use to live and grow. To be defined as food scientifically, materials must provide matter *and* energy for living things.	*Challenge questions:* What is your reasoning to support that idea? What ideas are you using from the scientific definition of *food*? Look back at what you wrote in your science notebooks in the last lesson. Does that give you any new ideas?

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		Highlight key science ideas and focus question throughout.	*They may also reason that water, for example, doesn't provide energy for people, but it does provide energy for plants.* **Show slide 3.** So we learned that according to the scientific definition, food supplies *both* matter and energy that living things need to live and grow. We also learned that some of the things organisms (living things) take in, such as water, carbon dioxide, vitamins, and plant food (or fertilizers and minerals in the soil) are **not** food by this definition because they don't contain energy living things can use in this way.		
8 min	**Lesson Focus Question** **Synopsis:** The teacher elicits student ideas about the focus question, *What is food for plants?* **Main science idea(s):** • Plants need food to live and grow.	Set the purpose with a focus question or goal statement.	**Show slide 4.** Today's focus question is *What is food for plants?* Write this question in your science notebooks and draw a box around it. **ELL support:** You could have a science talk to elicit student ideas about what plants use as food. **NOTE TO TEACHER:** *Make sure the focus question is written in a place that is visible to students throughout the lesson.* **Show slides 5 and 6.** **NOTE TO TEACHER:** *In addition to the*		

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		Ask questions to elicit student ideas and predictions.	*slides, you might want to display real seeds and a large plant or log. Or skip the slides and just show students the seeds and plant/log.* Let's start by observing the plants we looked at yesterday [*Show seeds and larger plant or log*.] How do these plants get the food they need to live and grow bigger? How does a tiny seed turn into a huge oak or sequoia tree? **ELL support:** Students could draw and write observations of seeds and plants in notebooks for multimodal expression. **Turn and Talk (30 seconds):** What ideas do you have about how plants get food? Turn to an elbow partner and talk about this question. **Whole-class discussion:** Now let's share the ideas you came up with, and we'll list them on a class chart. **Show slide 7** (for a model of what the chart should look like). Whenever we have reasons or evidence to support our ideas, we'll write on these sticky notes and attach them to our class chart. We're looking for evidence that supports and challenges our ideas. So what are your ideas about how plants get their food? Do you have any evidence to support them?		

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			ELL support: Model what a reason, or evidence, is. ELLs could use a model for presenting academic language and structure. **NOTE TO TEACHER:** *If students provide evidence to support their ideas, have them write it on a sticky note and attach it to the class chart. They might want to include their names or initials on the sticky notes. Don't expect them to have scientifically accurate ideas at this point, but push them to provide a good reason or some evidence to support their claims.*	*Ideas for how plants get their food:* • From the soil. • From water. • From the air. • From sunlight. • From carbon dioxide. • From fertilizers and minerals. • From things people put in the soil (plant food, coffee grounds, hair clippings). • From making their own food. *Evidence students may suggest:* I've seen my parents do things to help plants grow. I saw a plant die because it wasn't watered. I saw a plant die because it was in the dark. I learned about it in	*For each idea, ask these questions:* • Why do you think that? • Do you have any evidence to support that? What do you mean by "from making their own food"?

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				school. I heard it on a TV program.	
5 min	**Setup for Activity 1** **Synopsis:** The teacher asks, "Are water, carbon dioxide, and minerals in the soil food for plants?" and then challenges students to consider evidence that might help them decide whether these materials are food for plants. **Main science idea(s):** • Plants need food to live and grow. • To be defined as food scientifically, materials must provide matter *and* energy for living things.	Make explicit links between science ideas and activities **before** the activity. Engage students in communicating in scientific ways.	So we have a variety of ideas about how plants get their food. Today we're going to see if we can gather evidence to support or challenge some of these ideas. *[Point to class evidence chart.]* This will help us answer our focus question the way scientists answer questions—by supporting their ideas with evidence. So let's start with three ideas on our list of where plants get food—water, carbon dioxide, and plant food (or minerals in the soil). What evidence do we already have that can support or challenge the idea that water and carbon dioxide are food for plants?	Water isn't food for plants because the evidence shows that it has no Calories. Food has to give people energy, and we know something can provide energy if it has Calories. It's for animals and for plants, too, I think.	Say more about Calories. So Calories is a measure of food energy. Is that just for people? Does anyone agree or disagree. Do you

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					have anything to add about water?
				I disagree. I think water is food for plants because people water plants and they grow.	So we have evidence that water has no Calories, and it seems to help plants grow.
					What about evidence that carbon dioxide is or is not food for plants?
				Carbon dioxide is just air, and air is not food! You don't eat air!	But what is your evidence that air isn't food?
				It doesn't have Calories!	
				If you only had air to eat, you would die!	
			NOTE TO TEACHER: *Distribute handout 2.1, What Is Food for Plants?*		
			Show slide 8.		
			Together, let's read Investigation 1 on the first page of today's handout, What Is Food for Plants?		

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7 min	**Activity 1** **Synopsis:** Students work with a partner to decide whether water, carbon dioxide, and minerals in the soil (plant food) are food for plants and provide supporting evidence (from the previous lesson). **Main science idea(s):** • To be defined as food scientifically, materials must provide matter *and* energy for living things. • Matter can be measured in terms of its mass (e.g., grams). • Energy that living things can use to live and grow is measured in Calories.	Engage students in analyzing and interpreting data and observations. Make explicit links between science ideas and activities **during** the activity.	**Show slide 9.** Now work with a partner to provide evidence to support your ideas about whether water and carbon dioxide are food for plants. **Be sure to consider the data we gathered from the nutrition labels in yesterday's lesson.** **Option:** *You can have students write their ideas and evidence (in complete sentences) in their science notebooks or fill in the blanks on the handout (to save time). If time is really short, you can have students discuss their ideas rather than writing them down*. **Students work in pairs.** **NOTE TO TEACHER:** *Listen to students as they work together. If you don't hear them bringing up the data from yesterday about water, carbon dioxide, and plant food not containing Calories (energy), ask challenge questions to prompt them to revisit their data charts.*		*Challenge questions to ask pairs:* Look again at your data chart from the last lesson (on nutrition labels). Does it give you any ideas? Does anyone want to challenge the idea that water is food for plants? What do others think of this idea?
8 min	**Follow-Up to Activity 1** **Synopsis:** Students discuss and come to the conclusion that water,	Engage students in	**Show slide 10.** **Whole-class discussion:** Are water, carbon dioxide, and minerals in the soil food for		

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	carbon dioxide, and minerals in the soil are not food for plants because they don't contain energy (measured in Calories). **Main science idea(s):** • Water, carbon dioxide, and minerals in the soil aren't food for plants because they don't contain energy (measured in Calories) that plants can use to live and grow.	constructing explanations and arguments. Engage students in communicating in scientific ways. Make explicit links between science ideas and activities **after** the activity.	plants? Let's hear what you decided and what evidence you used to support your decisions. Let's start with **water**. I want you to engage in scientific argumentation by asking each other for evidence and stating whether you agree or disagree with someone's idea by giving your reasons or evidence. Can you support or challenge another pair's idea? **ELL support:** Model scientific argumentation. How many decided that water *is* food for plants? What is your evidence? **NOTE TO TEACHER**: *Don't be surprised if some students still insist that water is food for plants. Listen to their reasons and encourage their peers to agree or disagree.* What about those who decided water is *not* food for plants? What is your evidence?	*Evidence that water is food for plants:* Plants die if they don't get water. You have to water plants to keep them alive. Plants don't grow in really dry places. Maybe water provides energy for plants but not for animals. *Evidence that water isn't food for plants:*	Do others agree or disagree?

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				Water doesn't have energy because it doesn't have Calories, so it isn't food.	If you said that water *is* food for plants, what's your response to this evidence?
		Highlight key science ideas and focus question throughout.	Our evidence about plants dying without water suggests that plants need water. But our data about the lack of Calories in water is strong evidence that water is not, by itself, food for plants. It doesn't provide energy for plants.		
			Now let's think about **carbon dioxide**. How many decided that carbon dioxide *is* food for plants? What is your evidence?	*Evidence that carbon dioxide is food for plants:* We breathe in oxygen, and we need it to live. It's the same for plants: they need carbon dioxide to live.	
			How many decided that carbon dioxide is *not* food for plants? What is your evidence?	*Evidence that carbon dioxide isn't food for plants:* We saw that water with bubbles of carbon dioxide in it didn't have any Calories, so it can't	

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				be food for plants. Food has to supply energy for living things, and energy is measure in Calories, so if it has no Calories, it must not have any energy. Carbon dioxide doesn't have any mass and doesn't weigh anything because it's a gas, so it's not matter and can't be food for plants. [*Misconception*]	
			NOTE TO TEACHER ON USING DRY ICE AS EVIDENCE: *You could provide evidence that carbon dioxide has mass by bringing in some dry ice (frozen CO_2) and either weighing it on a digital food scale or allowing a few students to hold it (with gloves on!) to perceive that it has some mass.*	*Ideal student response to dry-ice question:* Carbon dioxide does have mass and is matter.	*See NOTE TO TEACHER about using dry ice as evidence. Then ask students this question:* If you said that carbon dioxide *is* food for plants, how do you respond to this evidence? Make sure to explain your reasoning.

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		Highlight key science ideas and focus question throughout.	Even though carbon dioxide is a gas, it does have mass. However, it has no Calories and therefore doesn't contain energy that plants can use to live and grow. So carbon dioxide isn't food for plants. Now let's think about **minerals in the soil**. Remember that minerals are also called *fertilizers* or sometimes *plant food*. How many decided that minerals in the soil *are* food for plants? What is your evidence? How many decided that minerals in the soil are *not* food for plants? What is your evidence?	*Evidence that minerals in the soil are food for plants:* We said that minerals are food for plants because when you add them to the soil, plants grow better. We've seen that on TV. We think plants suck in food from the soil just like we suck in milk shakes as food. *Evidence that minerals aren't food for plants:* We decided that minerals in the soil	Anyone want to disagree or challenge this idea?

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				aren't food for plants because we found out that they don't have Calories. I want to add on that Calories tell you if something has energy for living things. So minerals don't have energy for living things to use.	Does anyone want to disagree or add on to this idea?
		Highlight key science ideas and focus question throughout.	This is really interesting because sometimes minerals in the soil are called *plant food*, but by the scientific definition, they aren't food! So it's not really an accurate label. Minerals do help plants grow better, but they don't provide them with the energy they need to live and grow. We know this because there are no Calories listed on plant-food containers.		
5 min	**Setup for Activity 2** **Synopsis:** The teacher elicits student ideas about evidence that supports or challenges the claim that soil is food for plants. **Main science idea(s):** • To be defined as food scientifically, materials must provide matter *and* energy that living things can use to live and	Ask questions to elicit student ideas and predictions.	So now we've decided that water, carbon dioxide, and minerals in the soil (plant food) are *not* food for plants by the scientific definition. They don't provide both matter and energy that plants can use to live and grow. Now let's consider another popular idea on our class chart. What about **soil**? What evidence can we provide to support or challenge the idea that soil is food for plants?		

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	grow.		**Show slide 11.** **Turn and Talk (1 min):** Talk with a partner about this question. **Whole-class share-out:** Now let's share your ideas. Make sure you provide evidence to support your ideas and write it on a sticky note so we can post it on our class chart. **NOTE TO TEACHER:** *Throughout this lesson, you should encourage students to add sticky notes to the class chart as they come up with evidence to support or challenge each of their initial ideas (or if they have a new idea to add to the chart).*	Soil is food for plants because we always grow plants in soil. But my mom has grown some plants just in water, so I don't think they have to have soil. Maybe some plants use soil for food, and some use water. Or maybe plants use both water and soil for food. They sell soil at the garden store and say how good it is for plants, so it must have something	Anyone want to agree or disagree? Do you have any additional evidence? What do others think of this idea? What's your evidence that water could be food for plants?

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				good in it. Maybe it's not the soil; maybe it's just the stuff in the soil. Like the fertilizers you buy at the store. Oh yeah. They don't have Calories, so they can't be food. But they call it plant food! Does soil have Calories?	What "stuff" do you mean? That's like the plant food we looked at before. What did we learn about those fertilizers, or plant food? Excellent question! Why is that an important question to ask?
7 min	**Activity 2** **Synopsis:** Students read about and analyze data from Van Helmont's experiment to consider whether soil is food for plants. **Main science idea(s):** • We observed that Van Helmont's tree gained a lot of weight, but the weight of the soil stayed		**Show slide 12.** Now turn to Investigation 2 on your handout. We're going to read about an experiment that will help us answer the question, *Is soil food for plants?* **NOTE TO TEACHER:** *Have students work through page 2 of the handout in pairs, small groups, or as a class.*		

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	pretty much the same (just a tiny bit of weight was lost from the soil).	Engage students in analyzing and interpreting data and observations.	*Then give students time to look at the results on page 3 and work with a partner or in a small group to answer the analysis questions.* *Ask probe and challenge questions as students are working on the analysis questions, but don't "lead" them to the right answers.* *Students should figure out that the tree gained 164 pounds, and the soil lost 2 ounces.* **MATH NOTE:** *Students may need help understanding that there are 16 ounces in a pound.* **Students work on analysis questions in pairs or small groups**.	*Possible response to the first analysis question:* The weight gain didn't come from the soil, so it must have come from the water. Because that's the only other thing the plant "eats." Carbon dioxide. No, because CO_2 doesn't weigh anything. No, because we said CO_2 isn't food for plants, since it doesn't have energy.	*Probe and challenge questions to ask as students are working on the analysis questions:* Why do you think the weight gain came from the water? Do plants take in anything else? Could the weight gain have come from carbon dioxide? Why or why not? *[If you showed students the dry ice, remind them that CO_2 does in fact have mass and is matter.]*
5 min	**Follow-Up to Activity 2**		**Show slide 13.**		

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	Synopsis: The class discusses the results of Van Helmont's experiment. **Main science idea(s):** • Van Helmont's experiment provided evidence that the matter a tree used to grow did *not* come from the soil. Therefore, soil wasn't food for the tree.		How much mass did the tree gain? How much mass did the soil lose? How did the actual results of Van Helmont's experiment compare to your predictions? Did the results surprise you? **Show slide 14.** After seeing the actual results of Van Helmont's experiment, do you think all of the weight the tree gained came from the soil? What's your evidence? What do you think now about whether plants get their food from the soil? How many of you decided that soil *is* food for plants? How many decided that soil is *not* food for plants? What's your evidence? **CONTENT NOTE:** *The slight loss of mass in the soil can be explained in several ways. It could have been a measurement error, especially given that measurement tools in Van Helmont's day weren't very sensitive. It also could have been that some dust in the soil got blown out of the pot. Or it could have been due to the non-energy-containing matter (minerals) that plants take in and use to maintain health and build cell parts (like vitamins for humans). This matter is partly what decomposers*	The tree gained 164 pounds, 3 ounces. The soil lost 2 ounces. I thought the weight of the soil would go way down. We decided that soil is food for plants because the weight of the soil went down a little bit. I disagree, because where did the 164 pounds come from? Not from the soil! We disagree too. We decided that soil isn't food for plants because the weight of the soil went down just a tiny bit, and maybe that was just a little mistake in weighing the soil.	How many others thought that? Why? Does anyone agree or disagree?
		Engage students in constructing explanations and arguments.			

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			leave behind, but it isn't energy-providing food. The minerals from the soil add a tiny bit of mass to the plant, but they don't provide energy or account for the large growth in the plant's mass over time. Avoid going into these details with students; instead, emphasize the main point that plants don't get their food energy from the soil. Therefore, soil (and minerals in the soil) aren't food for plants. Van Helmont's experiment shows us that soil is *not* food for plants because the mass of the soil stayed essentially the same over a period of five years, while the mass of the tree increased a lot.		
2 min	**Synthesize/Summarize Today's Lesson** **Synopsis:** Students summarize the evidence they've gathered so far to answer the focus question, *What is food for plants?* **Main science idea(s):** • Living things need food that provides both matter and energy they can use to live and grow. • Plants can't use carbon dioxide (CO_2), water (H_2O), or minerals in the soil as food because those materials don't contain energy that living things can use to live and grow. • Plants don't use soil for food to grow bigger because Van Helmont's tree gained a lot of	Highlight key science ideas and focus question throughout. Engage students in making connections by synthesizing and summarizing key science ideas.	**Show slide 15.** Let's summarize where we are in our investigation of our focus question, *What is food for plants?* Today we investigated ideas about water, carbon dioxide in the air, minerals or plant food, and soil. I'm going to give you 30 seconds of think time to pick one of these four materials (water, CO_2, minerals, or soil) and be ready to tell what we know so far about whether it is or is not food for plants. Make sure to give evidence to support your claim. **As time allows:** • After your think time, I'm going to use the equity sticks to call on different students.		

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	mass, but it didn't come from the soil.		OR • We're going to do a round-robin, and everyone will share her or his idea. **Individual think time (30 seconds).** **Whole-class share-out and discussion:** Listen to your classmates' ideas about whether water, CO_2, mineral, or soil is or isn't food for plants. Be ready to disagree or add to the ideas. **NOTE TO TEACHER**: *Have as many students share as you have time for. Make sure that incorrect conclusions are challenged.*	*Possible responses:* We know water and CO_2 aren't food for plants because they don't provide energy. Same thing for minerals or plant food: They don't have any Calories, so they don't provide energy for living things. Soil isn't food for plants because Van Helmont's tree got really heavy, but the soil hardly lost any weight.	
		Summarize key science ideas.	So we have evidence that none of these four items is food for plants. None of them provide both matter and energy that plants can use to live and grow.		
1 min	**Link to Next Lesson** **Synopsis:** The teacher links science ideas to the next lesson.	Link science ideas to other science ideas.	**Show slide 16.** Now we have some good ideas about what is **not** food for plants. We know, for example, that water, carbon dioxide,		

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			minerals in the soil, and soil don't provide the matter and energy plants need to live and grow. *So what is food for plants?* Next time we'll gather more information to answer that question.		