

**SECTION 1.3 INTRODUCTION**

**1.3 Investigate**

1<sup>3</sup>/<sub>4</sub> class periods\* ▶

**How Does the Amount of Starch Vary Between Rice Varieties?**

**Overview**

Students learn that starch, a carbohydrate, is a main nutrient in rice. Students observe how rice samples react with iodine to estimate how much starch the rice samples contain. Using their measurements of the length and width of rice and their measurements of the amount of starch in rice, they develop claims about whether there is one variety of rice in the samples or many varieties of rice. They create explanations supporting their claims with the results of their investigations and the science knowledge from their reading.

\*A class period is considered to be one 40 to 50 minute class.

Targeted Concepts, Skills, and Nature of Science	Performance Expectations
Explanations are claims supported by evidence, accepted ideas, and facts.	Students construct explanations using their observations and what they have learned from their reading.
Scientific knowledge is developed through observations, recording and analysis of data, and development of explanations based on evidence.	Students make claims based on their observations and construct explanations to support them.
Scientists collaborate in their work and then share their findings. Sharing findings makes new information available and helps scientists refine their ideas and build on others' ideas.	Students work with their groups to test rice samples for starch content. They also work with their groups to create explanations and then share their explanations with the class.
Scientists must keep accurate and descriptive records of what they do so they can share their work with others and consider what they did, why they did it, and what they want to do next.	Students record their ideas and questions they have on the <i>Project Board</i> .

**Materials**

1 vial per group	iodine solution
2 tsp. per group	cornstarch
2 tsp. per group	wheat germ
4 tsp. per group	brown-grain rice
4 tsp. per group	white-grain rice (preferably jasmine rice)
4 tsp. per group	long-grain wild rice
4 tsp. per group	Carnaroli rice
4 tsp. per group	Cream of Rice
1 per group	dropper
3 per student	teaspoons
10-12 per group	toothpicks
4 sheets per group	wax paper
1 per student	<i>Variation in Rice Grains Data</i> page
1 per student	<i>Create Your Explanation</i> page
1 per student	<i>Amount of Starch</i> page

**Activity Setup and Preparation**

Prepare to give a demonstration of how iodine reacts with cornstarch and with wheat germ. You will need to make sure that all students can see how each substance changed when it reacted with the iodine.

Also, prepare a demonstration of how iodine reacts with samples of Rice A and Rice B. You will need to use a clean coffee grinder to grind an amount of each type of rice into a fine powder. You will need one teaspoon of rice powder for each type. You should clean the coffee grinder between each sample to ensure that none of the samples get contaminated. You can use Cream of Rice instead of white rice for your sample of Rice B to save time.

**Homework Options****Reflection**

- **Science Content:** How do you think knowing about other traits of the rice plants which produced your rice samples, such as leaf coloration or stem length, might change your conclusions? *(If some of the rice plants had traits that were very similar to each other and very different from the traits of other rice plants, then one might*



The substances students experiment with should not be eaten. The iodine can stain clothing and skin.



## SECTION 1.3 IMPLEMENTATION

◀  $1\frac{3}{4}$  class periods\***1.3 Investigate****How Does the Amount of Starch Vary Between Rice Varieties?**

Different varieties of rice have different traits. The size of the grain is one trait. Another trait of rice is how much **starch** it contains. Starch is a type of complex sugar, known as a **carbohydrate**, produced by plants. Plants use energy from the Sun, water, and carbon dioxide from the atmosphere to produce sugars in a process called **photosynthesis**. Some of the sugars plants make are used for growth and to support their life systems. The remaining sugars are stored as starch in the seeds or roots of the plants.

When humans and other animals eat plants, they consume the starch the plants produced. After the starch is eaten, the carbohydrates are digested, or broken down, in a form that the animal's body can use as energy. Starch from grains is a very important source of nutrition for people all over the world. Among the cereals, rice is the most important grain. Rice is the main food for more than half the world's population. Asia, where most people on Earth live, produces and consumes most of the world's rice. In addition to starch, rice is a good source of minerals, vitamins, and some proteins. All these compounds are essential for humans. Different kinds of rices have different amounts of these nutrients. Rice is easy to cook, easy to store, and is inexpensive and filling. It is also easy to digest. However, rice is not a complete food. For a healthy, balanced diet, rice needs to be consumed with meat or fish, and vegetables.

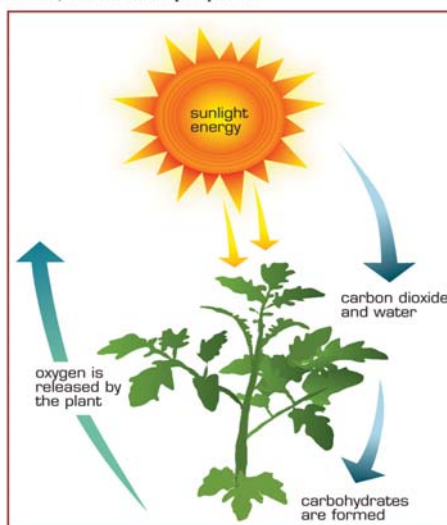
Today, millions of people in some areas of the world suffer from **malnutrition**. Because rice is the main food for most of the world's people, scientists want to find a rice variety that will grow in many different areas and that has the best possible nutritional value. If such a rice variety can be found, it will help improve the lives of many children and adults.

**starch:** a tasteless, odorless carbohydrate found in foods.

**carbohydrate:** a complex sugar.

**photosynthesis:** a process in which green plants use the sun's energy to change carbon dioxide into oxygen.

**malnutrition:** a condition resulting from not enough food or lack of the proper food.



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**1.3 Investigate****How Does the Amount of Starch Vary Between Rice Varieties?**

10 min.

*Explain the nutritional value of the starch in rice.*

**Engage**

Ask students for different kinds of nutrients. What kinds of nutrients do they get from vegetables?

**Guide**

Discuss how starch, a carbohydrate, or complex sugar, is a major nutrient in rice, and makes rice an important grain. Cereals, and in particular rice, are important sources of starch for people all over the world. Rice is easy to cook, store, and digest, and has many minerals, vitamins, and some proteins, although it lacks some nutrients and should be supplemented with meat or fish and vegetables. Starch is the main nutrient in rice.

**META NOTES**

It is important for students to understand that starch is the main nutrient in rice, and that the more starch there is in rice, the more nutritious it is.

\*A class period is considered to be one 40 to 50 minute class.

**TEACHER TALK**

“Starch is a carbohydrate, or complex sugar. There are a lot of carbohydrates in foods like bread and pasta, which are made from cereals. There are also a lot of carbohydrates in rice, which is another cereal. This is important, because carbohydrates are a very important nutrient. When you digest them, your body breaks them down into a form that it can use for energy. This is one reason that rice is an important food, and the more starch there is in rice, the more nutritious the rice is.”

Then, briefly discuss how plants produce carbohydrates. Plants use energy from the sun, water, and carbon dioxide to produce carbohydrates in photosynthesis. Point out the diagram of photosynthesis on page 29.

**TEACHER TALK**

“Plants require energy from the sun, water, and carbon dioxide to produce carbohydrates. Rice plants use energy from the sun, water, and carbon dioxide to produce starch.”

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Learning Set 1 • What Makes One Rice Different from Another?

**Demonstration**

Your teacher will first demonstrate how to test for starch in two samples of unknown substances. You cannot observe starch directly, so your teacher will use iodine to test the samples. Iodine is a chemical that reacts with starch and turns it a color so it can be seen.

**Observe**

As you watch the demonstration, answer the following questions. Be prepared to discuss your answers with your group.

- What happens when iodine mixes with a substance containing starch? Record on a piece of paper the changes you notice in the substance.
- What happens when iodine mixes with a substance that does not contain starch? Record any changes you notice.

**Stop and Think**

1. How could you use iodine to measure the amount of starch in a rice sample?
2. Make a prediction about the effect of iodine on two different rice samples.
3. Why is measuring the amount of starch in different rice varieties important in addressing the *Big Challenge*?

**amylose:**  
a carbohydrate.  
**amylopectin:**  
a carbohydrate.

Rice contains two different types of starch: **amylose** and **amylopectin**. Amylose starch reacts with iodine to form a blue/purple color. Amylopectin does not react with iodine. Other methods are used to test rice for amylopectin. The amount of amylose and amylopectin influence the texture of rice. Rice grains rich in amylose remain firm and separate when cooked. Rice with lots of amylopectin becomes soft and sticky when cooked. Some people prefer one type of rice over another.



Do not eat any of the samples you use in your investigation. Iodine can stain hands or clothing.

**Demonstration**

Your teacher will now demonstrate how to measure the starch content of two different varieties of rice: Rice A and Rice B. After your teacher mixes iodine with each of the rice powders, examine the color of each of the powders. In the table on your *Amount of Starch Data* page, record the color of each paste. Use the following terms to describe the colors: *brown*, *medium blue*, or *dark blue*.

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**Demonstration**

5 min.

*Demonstrate for students how two substances, one with starch and one without, react with iodine.*

**△ Guide**

Let students know that you will demonstrate how a substance with starch reacts with iodine and how a substance without starch reacts with iodine. Go over the *Observe* questions on page 30 with the class, and tell students to answer these questions as they watch your demonstration.

Then, set a piece of wax paper on a surface where students can see, and put a teaspoon of cornstarch and a teaspoon of wheat germ on it. Using a dropper, drop five to seven drops of iodine on each, and, using a different toothpick for each, mix the iodine in.

## Observe

5 min.

*Discuss the results of the demonstration with the class, using the Observe questions as a guide.*

starch and turns it a color so it can be seen.

### Observe

As you watch the demonstration, answer the following questions. Be prepared to discuss your answers with your group.

- What happens when iodine mixes with a substance containing starch? Record on a piece of paper the changes you notice in the substance.
- What happens when iodine mixes with a substance that does not contain starch? Record any changes you notice.

### △ Guide

After the demonstration, ask students what their answers to the *Observe* questions were. They should have noticed a more dramatic difference when iodine was mixed with the cornstarch than when it was mixed with the wheat germ.

## Stop and Think

5 min.

*Have students think about how to use iodine to measure the starch in rice samples and make predictions about what will happen.*



### Stop and Think

1. How could you use iodine to measure the amount of starch in a rice sample?
2. Make a prediction about the effect of iodine on two different rice samples.
3. Why is measuring the amount of starch in different rice varieties important in addressing the *Big Challenge*?

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### ◇ Get Going

Let students know that you will demonstrate how to measure the amount of starch in Rice A and Rice B. Give students a few minutes to write their answers to the *Stop and Think* questions on a sheet of paper.

### △ Guide

Before proceeding with the demonstration, briefly discuss students' answers to the questions. They should be prepared to estimate the amount of starch in rice samples (e.g., "a little," "none," or "a lot") by observing how the rice samples react with iodine. Students should see that the more starch there is in rice, the more similar the reaction of the rice with iodine will probably be to the reaction of cornstarch with iodine.

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a carbohydrate.  
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Do not eat any of the samples you use in your investigation. Iodine can stain hands or clothing.

**Demonstration**

Your teacher will now demonstrate how to measure the starch content of two different varieties of rice: Rice A and Rice B. After your teacher mixes iodine with each of the rice powders, examine the color of each of the powders. In the table on your *Amount of Starch Data* page, record the color of each paste. Use the following terms to describe the colors: *brown, medium blue, or dark blue.*

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**Demonstration**

5 min.

*Demonstrate how iodine reacts with the two rice powders.*

**△ Guide**

When students have answered the *Stop and Think* questions, distribute *Amount of Starch* pages. Then, set a piece of wax paper on a surface where students can see it. Place a teaspoon of ground brown rice on the wax paper and, separately, a teaspoon of ground white rice or Cream of Rice. Using a marker, write “Rice A” in front of the brown rice and “Rice B” in front of the white rice. Mix a small amount of water, up to one and a half teaspoons, into each teaspoon of rice. Alternatively, dilute the iodine with a small amount of water, up to one and a half teaspoons per six drops of iodine. It may help to form a depression in the mound of rice so that the iodine doesn’t run off the sides. It also helps to drop the iodine slowly, allowing the rice to absorb each drop. Then, using a separate toothpick for each pile, stir the iodine into the rice powder.

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## Analyze Your Data

10 min.

Have students discuss the Analyze Your Data questions with their groups and estimate the amount of starch in the samples of rice.

1.3 Investigate

Amount of Starch		
Name: _____		Date: _____
Use the space in the table below to record the results of the starch demonstration.		
Sample	Color	Presence of starch
Rice A		
Rice B		
Estimate the amount of starch in each sample of rice.		

### Analyze Your Data

- What color is the Rice-A paste? What does the color indicate? In the table on your data page, record whether or not you think the Rice-A paste has starch.
- What color is the Rice-B paste? Record in the table whether or not you think the Rice-B paste has starch.
- If you think the samples contain starch, use the colors you observed in the demonstration to estimate the amount of starch. You will not be able to tell exactly how much starch the rice contains, but you can estimate whether it has a little or a lot of starch.

In your group, discuss what each group member observed in the demonstrations. Come to an agreement on whether or not both rice samples contain starch. If they do contain starch, agree on which rice contains the most starch.

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### Get Going

Have students discuss and answer the *Analyze Your Data* questions with their groups. Give them about five minutes for this discussion.

### Assess

As groups discuss their answers to the *Analyze Your Data* questions with their groups, listen for ideas about how the colors of the cornstarch and wheat germ compare to the rice powder samples.



### Communicate Your Results

You will meet with the class to discuss your results. Present your group's conclusion on whether or not the rice powders have starch and how much starch they contain. Use the following questions to guide your discussion:

- How did your group come to an agreement of whether or not each of the rice samples contains starch?
- How did your group come to the most accurate conclusion on how much starch each rice sample contains?
- Now that you have the most accurate data from each sample of rice, are the differences between the four rice samples like the differences between two beagles or between a beagle and a German shepherd? Does your answer agree with your previous conclusion? Discuss your conclusion with the class.

**Create Your Explanation**

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Use this page to explain the lesson of your recent investigations.

Write a brief summary of the results from your investigation. You will use this summary to help you write your Explanation.

**Claim** – a statement of what you understand or a conclusion that you have reached from an investigation or a set of investigations.

**Evidence** – data collected during investigations and trends in that data.

**Science knowledge** – knowledge about how things work. You may have learned this through reading, talking to an expert, discussion, or other experiences.

Write your Explanation using the **Claim**, **Evidence**, and **Science knowledge**.

### Explain

You have investigated several traits in rice. You will now compare the types of rice to decide if there is only one kind of rice or many kinds. You will begin by making a claim about how many kinds of rice there are. Then, using a *Create Your Explanation* page, you will develop an explanation of your claim and support it with evidence. Your *Create Your Explanation* page helps you make sure your explanation connects your claim to your evidence and science knowledge.

Whether there is only one kind of rice or many kinds of rice is your claim. Your results from the investigations you carried out and the demonstration you observed are your evidence. You may have some science knowledge from your own experiences or from readings. Record all this information in the appropriate boxes. Then write a statement using your evidence and science knowledge to support your claim. This is your explanation.

## Communicate Your Results

10 min.

*Lead students to share their conclusions.*

### △ Guide

Ask each group to tell the class what their conclusions were. Their conclusions will probably be as simple as “Rice B has a lot of starch.” Tell students to take notes during the discussion.

Then pose the questions on page 32 to the class, making sure that students from each group respond.

**META NOTES**

As the class discusses their conclusions, encourage students to address questions and comments to each other, and try to keep the discussion centered on the students.

**Assess**

Listen for the following in students' answers:

- For both the first and second question, students should discuss how they compared the color of their iodine-rice powder mix to the color of the iodine-cornstarch and iodine-wheat germ mixes.
- Students should use the information they have now to decide whether the differences between the rice samples are like the differences between beagles or like the differences between beagles and German shepherds. Whether their conclusions agree or disagree with their previous conclusions, they should support them with their observations.

**Explain**

15 min.

Have groups create explanations saying whether there is one variety of rice or many varieties.

How did your group determine the most accurate data? How much starch each rice sample contains?

- Now that you have the most accurate data from each sample of rice, are the differences between the four rice samples like the differences between two beagles or between a beagle and a German shepherd? Does your answer agree with your previous conclusion? Discuss your conclusion with the class.

**Create Your Explanation**

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Use this page to explain the lesson of your recent investigations.

Write a brief summary of the results from your investigation. You will use this summary to help you write your Explanation.

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**Claim** - a statement of what you understand or a conclusion that you have reached from an investigation or a set of investigations.

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**Evidence** - data collected during investigations and trends in that data.

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**Science knowledge** - knowledge about how things work. You may have learned this through reading, talking to an expert, discussion, or other experiences.

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Write your Explanation using the **Claim**, **Evidence**, and **Science knowledge**.

**Explain**

You have investigated several traits in rice. You will now compare the types of rice to decide if there is only one kind of rice or many kinds. You will begin by making a claim about how many kinds of rice there are. Then, using a *Create Your Explanation* page, you will develop an explanation of your claim and support it with evidence. Your *Create Your Explanation* page helps you make sure your explanation connects your claim to your evidence and science knowledge.

Whether there is only one kind of rice or many kinds of rice is your claim. Your results from the investigations you carried out and the demonstration you observed are your evidence. You may have some science knowledge from your own experiences or from readings. Record all this information in the appropriate boxes. Then write a statement using your evidence and science knowledge to support your claim. This is your explanation.

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**Guide**

Have students rejoin their original groups and work with them to create explanations. First remind students what an explanation is—a claim or statement that is supported by evidence and science knowledge in a logical



## Share Your Explanation

15 min.

*Have students share their explanations with the class.*

1.3 Investigate

A good explanation can convince someone else that your interpretation is good. If your statement doesn't seem convincing, revise your claim so your evidence and the science you know support it. Because your understanding of rice and the traits of rice may not be complete, you may not be able to fully support your explanation. But you will use what you have read and what you know to develop your best claim and explanation. Scientists finding out about new things use the same procedure. When they only partly understand something, they cannot possibly form a "perfect" explanation. They do the best they can based on what they understand. As they learn more, they make more accurate or clearer explanations. You will explain your results the best you can based on what you now know. Then, after you learn more, you can make your claims and explanations more accurate.

### Share Your Explanation

Share your group's claim and explanation with the class. Tell the class what makes your claim accurate based on your evidence and science knowledge. Pay special attention to how the other groups have supported their claims with science knowledge. Ask questions or make suggestions if you think a group's claim is not as accurate as it could be or if the group has not supported their claim well enough with evidence and science knowledge.

### What's the Point?

Rice grains can be compared by the amount of starch they contain. Because starch is a main source of food energy, it is important to understand how much starch each type of rice contains. The more starch in a grain, the better its nutritional value.



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### ◻ Get Going

Have groups present their explanations to the class. Groups should point out their claims, their evidence, and their reasons. They should also be prepared to defend their explanations, and to discuss how they revised them.

### △ Guide

As groups present, students should ask questions to clarify and point out where something seems missing from an explanation. Model how you expect students to ask questions by asking about how the evidence in an explanation supports the claim.



## Assessment Options

Targeted Concepts, Skills, and Nature of Science	How do I know if students got it?
<p>Explanations are claims supported by evidence, accepted ideas, and facts.</p>	<p><b>ASK:</b> How did you support the claims in your explanations?</p> <p><b>LISTEN:</b> Students should have used observational data and scientific knowledge from their reading to support their claims.</p>
<p>Scientific knowledge is developed through observations, recording and analysis of data, and development of explanations based on evidence.</p>	<p><b>ASK:</b> How did you develop your claims about whether there is one variety of rice or many varieties of rice?</p> <p><b>LISTEN:</b> Students should have recorded and analyzed data and developed claims and explanations based on the data.</p>
<p>Scientists collaborate in their work and then share their findings. Sharing findings makes new information available and helps scientists refine their ideas and build on others' ideas.</p>	<p><b>ASK:</b> How did you use other students' observations to reach conclusions?</p> <p><b>LISTEN:</b> Students should have used other students' measurements of the starch content in their rice to confirm their results. They also should have used the measurements of students working with other types of rice to estimate the variation of starch content between types of rice.</p>
<p>Scientists must keep accurate and descriptive records of what they do so they can share their work with others and consider what they did, why they did it, and what they want to do next.</p>	<p><b>ASK:</b> How does recording your ideas and the question you have on the <i>Project Board</i> help you in your investigation?</p> <p><b>LISTEN:</b> Students should recognize that recording their ideas and questions on the <i>Project Board</i> helps them to consider what they have done and what they still need to do to meet the challenge.</p>

