



## Learning Set 1

### ***What Is Rice?***

In this Unit, you will make recommendations about developing a new rice plant. The rice from the plant will need to be nutritious, and the plants will have to be able to produce enough rice grains even when there is too much or not enough rain. You already know that rice is a grain and that it is an important food for people in the Philippines. But you might not know a lot about rice, how it is grown, or how rice plants are different from one another. To prepare to answer the *Big Question* and address the *Big Challenge*, you will learn more about rice in this *Learning Set*. The smaller question for this *Learning Set* is *What Is Rice?* To answer this question, you will explore the parts of a rice plant, how it is grown, how one type of rice plant is different from another, and who eats rice.



*Rice grows well in countries and regions with large populations and high rainfall because it requires a lot of people to cultivate it and plenty of water. Rice can be grown practically anywhere, even on a steep hill or mountain. On steep slopes, rice farmers often build a series of steps, called terraces, to make many flat surfaces for planting.*

## 1.1 Understand the Question

### *Think About the Question*

Begin by reading the following announcement from the *Rice for a Better World Institute*.



#### **Research Announcement**

**To:** All Collaborating Scientists

**From:** The Rice for a Better World Institute (RBWI)

**Subject:** Research Update

The scientists at the Rice for a Better World Institute are eager to have your help in developing rice plants that can provide more people around the world with enough good, nutritious food.

We suggest that you begin your research by looking at what makes one type of rice plant different from another. We have stored grains of many different types of rice plants. All the grains look different, so we can see that rice grains have a variety of traits. We need to understand more about their similarities and differences. Some might be more nutritious and some might need more water than others. We would like to find out which traits make each rice plant different from the others.

Please start your investigation by learning about rice grains and rice plants. To be successful at helping us develop new rice plants, you will need to know what rice is, how it is grown, and who eats it around the world.

We are looking forward to hearing about your investigations of traits of different types of rice plants.

## Conference

The *RBWI* scientists have collected many kinds of rice grains that all look different. However, the scientists do not know a lot about the traits of the rice plants. They do not know which ones are more nutritious than others or in what kinds of weather each of them grows best. With your group, discuss what you think you know about different kinds of rice plants and how rice is grown. Based on your discussion, develop four questions you need answered to learn more about how rice plants are grown and what makes rice plants alike and different from one another.

## Update the *Project Board*

Your class started a *Project Board* to help you keep track of your investigations and questions about how to develop a new rice plant. To update the *Project Board*, share the questions your group developed. Record what you think you know about rice and differences among rice plants in the *What do we think we know?* column. Record your questions about rice and rice plants in the *What do we need to investigate?* column.

## What's the Point?

The *RBWI* scientists want you to use genetics to develop new kinds of rice plants that will produce nutritious rice and grow when there are different amounts of rainfall. To do that, you have to understand more about rice plants and how they grow. You have generated questions about rice, and you will work on finding answers to those questions in this *Learning Set*.



## 1.2 Explore

### *What Is Rice and Who Eats Rice?*

For many people in the United States, rice is not a staple food, so you might not know a lot about rice. You will need to know exactly what rice is to make your recommendations.

In the next two explorations, you will find out more about rice, how it is grown, and where in the world it is a food staple. You will work with your group on both explorations, and then the class will get back together to discuss all the things you found out and thought about.

#### Materials

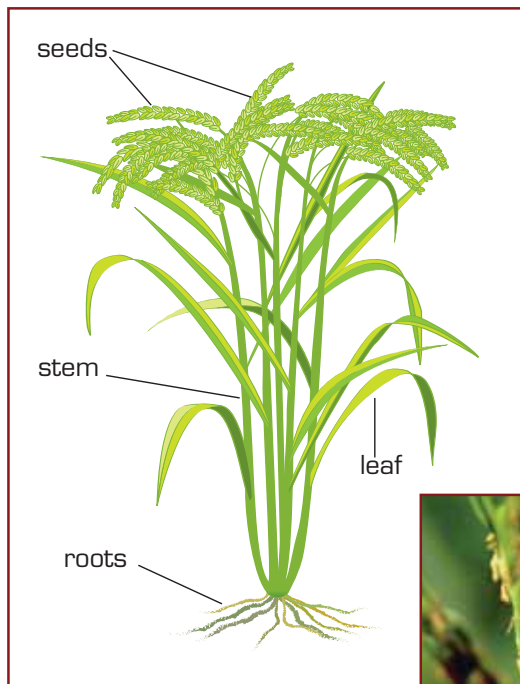
- paper and pencil for drawing
- colored pencils
- paper

### Exploration 1: What Is Rice?

In this exploration, you will read about rice plants and how they are grown. You will make some drawings of rice plants with colored pencils based on pictures.

#### Procedure

1. Begin by reading about the parts of rice plants. As you read, think about how the rice plant is similar to other plants you have read about or seen. Similarities and differences among plants will help you understand the traits of the rice plant.



#### Rice Plants

##### Parts of a Rice Plant

The rice plant is a grass. It is related to wheat, oats, and barley. Like other grass plants, a rice plant has roots and stems. Leaves grow from joint-like parts along the stems. Small flowers grow on branch-like spikes at the ends of the stems. Each rice plant produces about 100 to 150 tiny blossoms. These blossoms produce rice seeds.



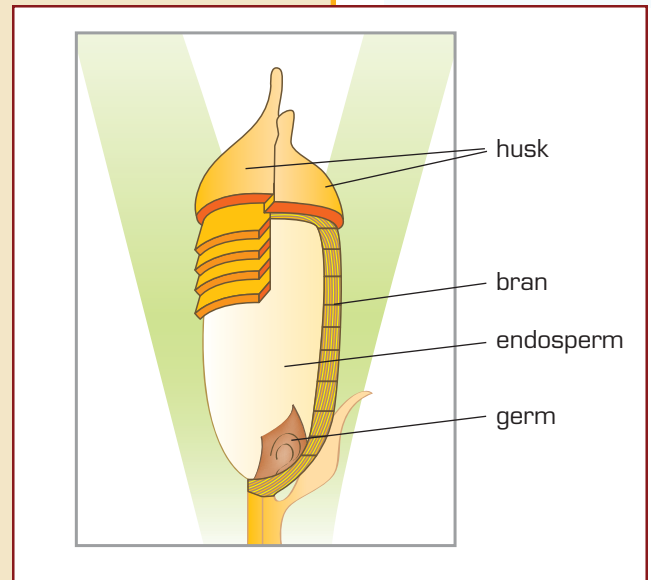
- Before you read more, stop and sketch the roots, stems, and leaves of the rice plant. Use the picture as a guide. Make your sketch as accurate as possible. Label each part of the plant. If time permits, use pencils to color your plant to match the drawing.
- Read about rice grains. As you read, think about the types of rice you eat.

### Rice Grains

When you eat rice, you are eating the seeds of the rice plant. Rice seeds are a kind of grain. When a grain is edible, it is called a **cereal**. Rice grains are a kind of cereal.

Each rice grain is fairly complex, with several layers. On the outside is a tough **husk**, or **hull**. Under the hull are two more layers. First is the **bran** that protects the **endosperm**, the largest part of the rice grain. The endosperm is the food-rich part that provides the most nutrition. Finally, deep inside each grain is the **germ (embryo)**, the part of the seed from which a new plant grows.

When you eat rice, you always eat the endosperm. Other parts of the rice grain are removed in some types of rice. Brown rice still contains the bran and germ. Because of the tough outer layers, brown rice must be cooked longer than white rice. White rice is processed to remove the bran and germ, leaving only the endosperm. White rice can be stored longer and cooks more quickly than brown rice. For these reasons, most of the rice produced is processed and sold as white rice. But white rice has one important disadvantage—it is less nutritious than brown rice. Brown rice has more vitamins, minerals, and fiber.



**cereal:** the edible seed of a grass plant; a grain.

**husk (hull):** the tough outer layer on a seed.

**bran:** the skin of a grain.

**endosperm** nourishment that surrounds the germ (embryo) of a seed.

**germ (embryo):** the part of the seed from which a new plant grows.

- Add rice grains to your rice sketch. Make sure the grains are at the end of each stem, and label the rice grains. Use the picture of the rice plant to guide your drawing.
- Read about how rice is grown. Then use the information you have read to answer the *Stop and Think* questions.

*Rice requires a lot of water throughout its growth. When first planted, rice plants need to be submerged in water to fight weeds, so the fields must be flooded.*

## How Is Rice Grown?

Like other grass plants, rice has an annual cycle. Rice seeds are planted each year, generally during the spring. The seeds produce new rice plants. After about five or six months, the plants reach a height of 50–150 cm (20–60 in). During the summer, blossoms appear. Each blossom can produce a rice seed. When the rice seeds mature, they can be harvested. To produce good, nutritious seeds, most rice plants require great amounts of water, especially early in the growing cycle. Rice requires warm conditions, around 20°C (72°F) throughout the growing season. Rice also needs light for extended periods. The ideal growing conditions can be found near the Equator.

Farmers must make sure that rice plants have the correct nutrients to

grow and must help protect the growing plants from pests. Farmers will often spray nutrients and pesticides on the rice plants.

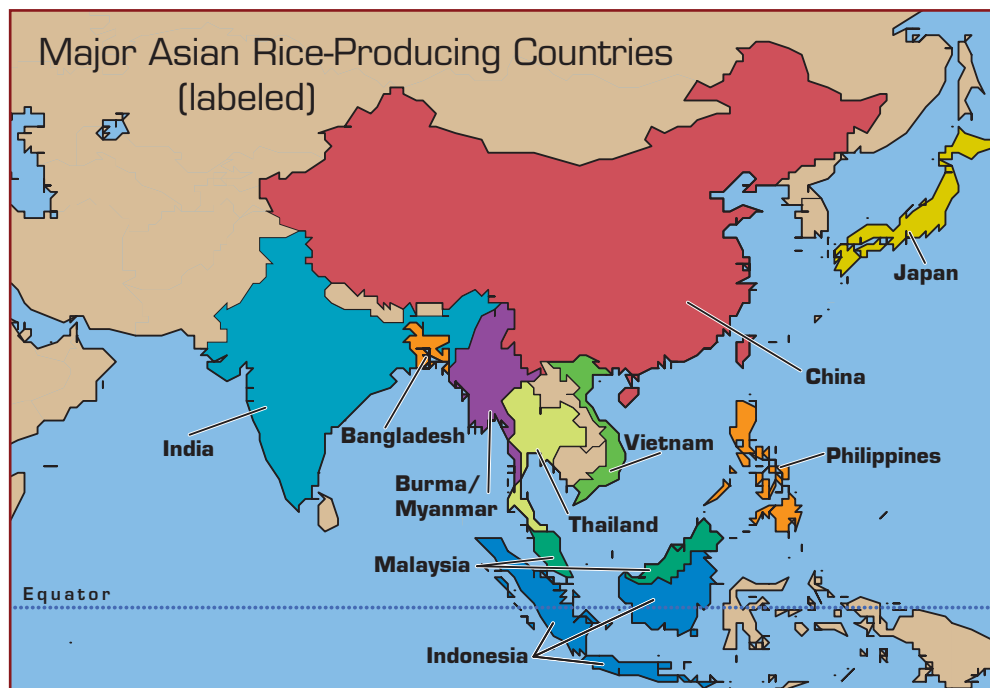
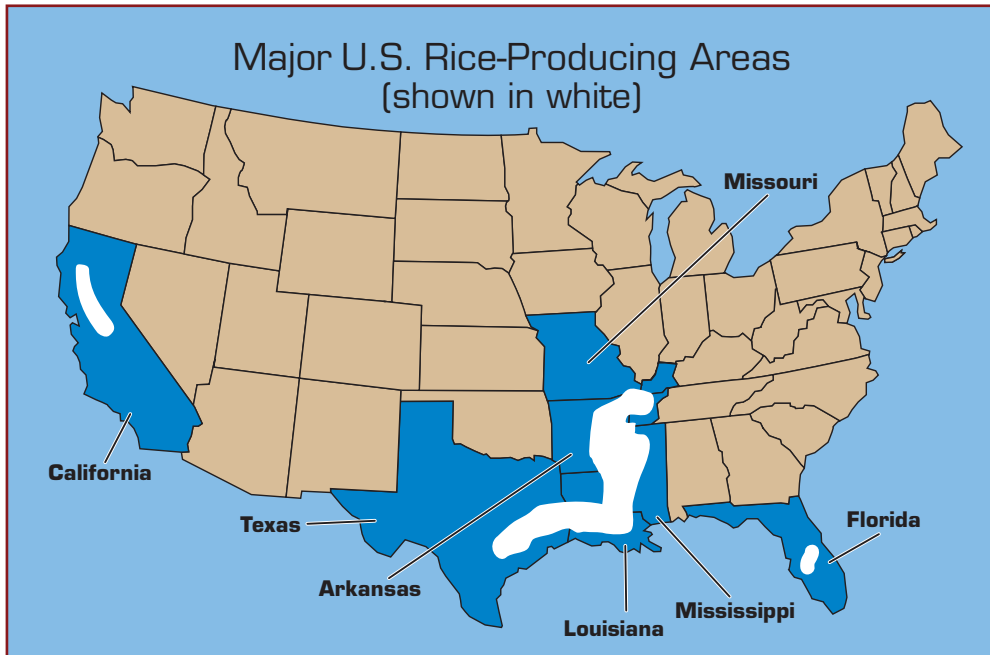
Growing and harvesting rice is a difficult and complicated process involving much hard work. Machines do this work in some places, but in many places people have to do the work by hand.



## Stop and Think

1. What part of the rice plant do you eat when you eat rice?
2. Could a grain of white rice grow into a rice plant? Justify your answer.
3. Planting and harvesting rice are very difficult processes. Describe how it might feel to be someone who has to plant or harvest the rice by hand. Use the photograph above to help answer this question.

- Using your knowledge of how rice is grown, describe what you think is the ideal environment for growing rice.
- Using the maps of the United States and Asia, identify the places where rice is grown.



### How Much Rice Do People Eat?

Rice is a staple food in most of the world, and it is the most important source of energy for much of the world's population. Much rice is consumed in the country in which it grows—for example, most of the rice grown in China is eaten in China.

This table shows the amount of rice consumed per million people in a number of countries and the amount of rice eaten per person per year in each of those countries.

### How Much Rice Do People Around the World Eat?

Country	Total amount of rice eaten (per million people per year 2002-2003)	Amount of rice eaten per person (per year 2002-2003)
Bangladesh	183,000 metric tons	183 kg (403 lb)
Burma/Myanmar	217,000 metric tons	217 kg (478 lb)
China	103,000 metric tons	103 kg (227 lb)
India	79,000 metric tons	79 kg (174 lb)
Japan	68,000 metric tons	68 kg (150 lb)
Philippines	110,000 metric tons	110 kg (243 lb)
South Africa	15,000 metric tons	15 kg (33 lb)
United States	13,000 metric tons	13 kg (29 lb)
Vietnam	212,000 metric tons	212 kg (467 lb)

**bar graph:** a type of graph that uses either vertical (up and down) bars or horizontal (across) bars to show data. Data can be in words or numbers.

## Exploration 2: Who Eats Rice?

In this exploration, you will read about how much rice is grown in different countries around the world. You will also compare the amount of rice each person eats in the different countries that grow rice. You will design a graph to display this data.

1. Look at the data table above. Think about the amount of rice eaten in the countries listed.
2. Using the data provided in the table, draw a **bar graph** showing how much rice is eaten per person in each country. Make sure you title your

graph, label each axis, and carefully draw in the bar for each country's data. You will need to decide on a scale to use for your vertical axis.

- Use the table and your graph to answer the *Stop and Think* questions.

## Stop and Think

- Which country has the highest per person consumption of rice? Which country has the lowest?
- Where in the world are the countries that consume the most rice located?
- Which questions were easier to answer using the data table? Which were easier to answer using the bar graph? Give the reasons for your answers.



## Update the Project Board

You have started to explore rice, how it grows, and who eats it. Throughout the rest of this Unit, you will use this information to make recommendations. You will also find out more about rice. Before continuing, record what you have discovered about rice, how it is grown, and who eats it, in the *What are we learning?* column of the *Project Board*. Be sure to add your evidence to the *What is our evidence?* column. Sometimes evidence can come from your reading. You can also use data from the tables and graphs as evidence.

These readings may also have brought more questions to mind. Record those questions in the *What do we need to investigate?* column so you can come back to them later.

## What's the Point?

Rice grows on rice plants. When you eat rice, you are eating the seed of the rice plant. The seed of the plant is also used to grow more rice. Rice plants need a climate with lots of sunlight, water, and warm temperatures to grow well. The process of preparing the ground, planting, growing, and harvesting rice plants can be very difficult.

People around the world eat rice. It is a staple food for most people in Asia. For these people, most of their food energy comes from rice.



## 1.3 Explore

# How Do Organisms Differ From One Another?

**variation:** the differences among individuals in a group.

Rice grains are all harvested and processed in a similar way, but not all rice grains are exactly the same. To address the challenge, it will be important for you to understand differences among kinds of rice and **variations** even in the grains of rice plants of the same type.

Because the idea of variation is complicated, before examining the differences among rice grains, you will start by looking at differences among an organism that is familiar to you, humans. Later, you will use what you find out about differences among humans to examine differences among rice grains.

## Get Started

Many physical traits are similar across people. Other physical traits may make you different from your classmates. Working with your class, you will identify these traits and record the similarities and differences.

On a piece of paper, make two columns, one for similarities among humans and the other for differences. Discuss with your class how human beings are similar to one another in their physical characteristics.

Now, think about your physical characteristics. Try to identify traits that human beings have in common. These can be how many legs or how many eyes you have. List those in the similarities column.

Work with your class to identify traits that are different among human beings. What makes you different from your classmates? Record those in the differences column.



## Conference

Working as a group, look at the photos shown on the next page. Each photo shows one human trait and two different ways that trait might appear. As you look at the traits, think about which ones you have. Can you roll your tongue? Do you have attached or detached ear lobes? Look at the photos on the page to understand how each trait varies among humans. In the My Traits row of your *Inventory of Traits* page, make a check mark in the boxes that match your traits.

Work with your group to complete the second part of the *Inventory of Traits* page. For each of the traits you investigated, record how many members of your group have each variation of that trait. Record your data in the space for My Group's Traits. Suppose two members of your group have the trait attached ear lobe. If they do, write the number 2 in the corresponding space on the page. If none of the members of your group have a specific trait, write 0 on the page.

Inventory of Traits		
Name: _____		Date: _____
<b>My Traits</b>		
In the table below, mark the checkbox next to each trait you have.		
Trait	My Traits	
<b>Ear lobe</b>	_____ Attached	_____ Detached
<b>Rolling tongue</b>	_____ Can roll tongue	_____ Cannot roll tongue
<b>Thumbs when clasping hands</b>	_____ Left thumb over right thumb	_____ Right thumb over left thumb
<b>My Group's Traits</b>		
Record the number of students in your group who have each of the traits.		
Trait	Number of students in my group with this trait	
<b>Ear lobe</b>	_____ Attached	_____ Detached
<b>Rolling tongue</b>	_____ Can roll tongue	_____ Cannot roll tongue
<b>Thumbs when clasping hands</b>	_____ Left thumb over right thumb	_____ Right thumb over left thumb
<b>My Class's Traits</b>		
Record the number of students in your class who have each of the traits.		
Trait	Number of students in my class with this trait	
<b>Ear lobe</b>	_____ Attached	_____ Detached
<b>Rolling tongue</b>	_____ Can roll tongue	_____ Cannot roll tongue
<b>Thumbs when clasping hands</b>	_____ Left thumb over right thumb	_____ Right thumb over left thumb

### Human Traits



*Detached ear lobe*



*Attached ear lobe*

←  
**Which variation?**  
→



*Can roll tongue*



*Cannot roll tongue*

←  
**Which variation?**  
→



*Right thumb over left thumb*



*Left thumb over right thumb*

←  
**Which variation?**  
→

## Analyze Your Data

Discuss the results with your group. As you look at the data, think about the following questions:

- Which variations of each trait are shared by all your group members?
- Are there variations of the traits that none of your group members have? Which ones? Why might this be so?
- Suppose you collected data from all the students in your class instead of only from your group. How do you think your results would change with data from a larger group?
- Does any other member of your group have exactly the same combination of traits as you? Do you expect to have exactly the same combination of traits as another student? Why or why not?
- Which other traits do your group members have that might make them different from others?
- Which of the human traits you investigated do you think are common among human beings? Which ones do you think are less common?

As you discuss your answers to the questions, listen carefully as others present their ideas. Pay attention to the evidence presented by your group members to support their conclusions. Take notes during the discussion. Be prepared to present your group's data and conclusions to the rest of your class.

## Communicate Your Results

Each group will have a chance to present its data to the class along with its answers to the questions. As you listen to other groups' presentations, compare your group's data with the data of other groups. How are the data similar or different? Listen carefully to other groups' answers to the questions. Groups may not agree with one another. Keep track of the variation in traits across other groups, and record data about the class on your *Inventory of Traits* page.

After all the groups have shared their data, revisit the answers to the questions. Which traits are more common or less common across the class? Is there more or less variation in traits in your class as a whole compared to your group? Using all the data you have now, work with the class to answer the questions.



## Reflect

Think about rice—it also has many traits. What do rice and human traits have in common? What traits does rice have? Identify two questions about the traits of rice or rice plants. How might you investigate the answers to your questions?

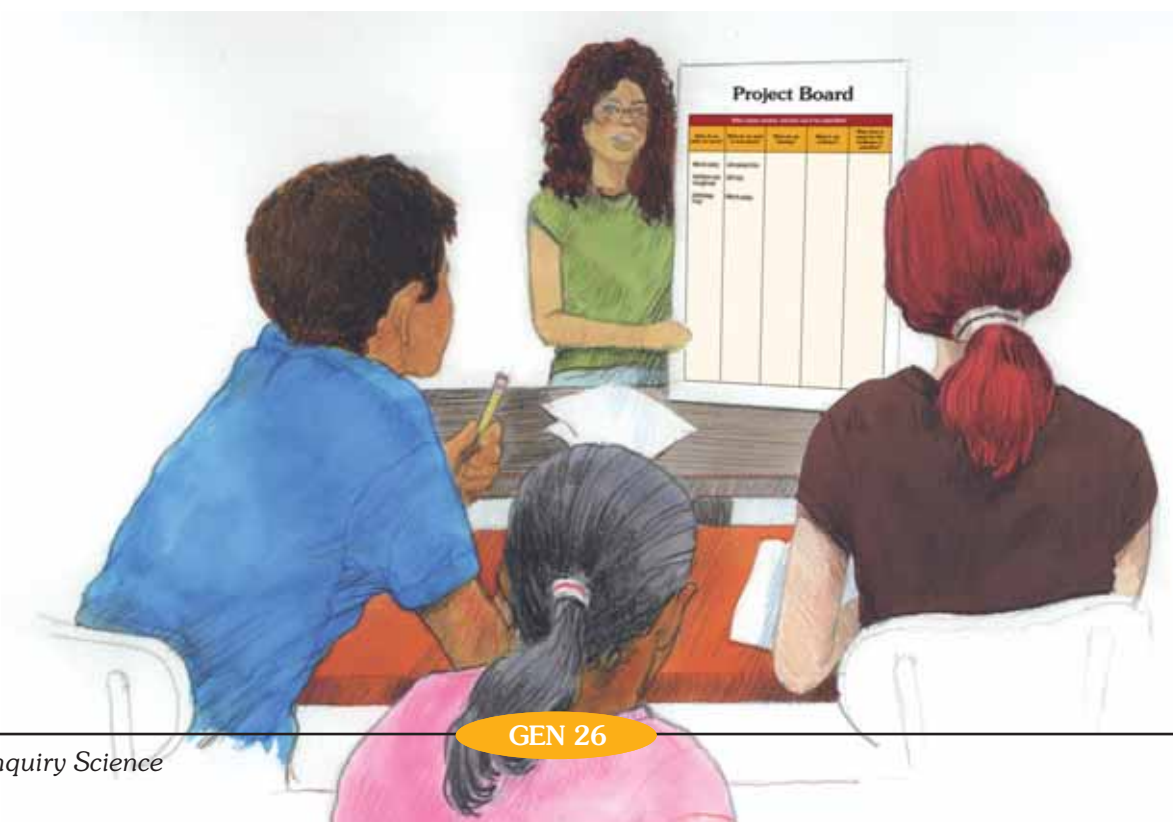
## Update the Project Board

Your class started a *Project Board* to help you keep track of your investigations and questions about developing a new rice plant. To prepare for updating the *Project Board*, share your group's questions. Based on the different human traits you have examined, update the *Project Board*. Record what you think you know about traits and differences in the *What do we think we know?* column. Record your questions about differences in types of rice and rice plants in the *What do we need to investigate?* column.



## What's the Point?

Traits are individual characteristics that can be passed on to the next generation. Humans have many traits in common as well as many differences. These differences make each person unique. Like humans, rice plants show variations in traits. Scientists and farmers have asked for help in growing more rice and more nutritious rice. To develop better rice plants, scientists will need to examine many different rice traits. It will be important to understand these traits and find out how one rice plant differs from another.



## 1.4 Investigate

# What Are Some Differences Among Rice Grains?

You have just looked at some of the differences among human beings. Now that you understand more about the variations in humans, you can begin to investigate differences among rice grains. You will do two investigations, one in which you observe rice grains to notice their similarities and differences, and one in which you measure rice grains to identify their similarities and differences.

### Investigation 1: Observe Differences Among Rice Grains

#### What Are Some Rice-grain Traits that Can Be Observed?

Some types of rice have long grains and some have short grains. There are also other differences among types of rice. Some you can easily observe. You will be examining the grains of four different types of rice. You will examine the similarities and differences among grains of the same type of rice, and then identify the similarities and differences among grains of different types of rice.

#### Procedure

Work with your group to identify the traits of the rice in each container. The containers are marked A, B, C, and D, and each container has a different kind of rice grain. Use an *Observing and Comparing Rice Grains* page to record your observations.

Follow this procedure as you make your observations.

1. Fold a piece of paper into four equal parts. Label the rectangles A, B, C, and D. Put one scoop of the matching rice in each rectangle.



#### **Materials**

- 4 containers of rice labeled A, B, C, and D
- spoon
- paper and pen
- hand magnifying lens

Observing and Comparing Rice Grains				1.4.1
Name: _____		Date: _____		
Record your rice grain data from each cup.				
	Rice description	Similarities among rice grains	Differences between rice grains	Possible reasons for similarities and differences
Rice A				
Rice B				
Rice C				
Rice D				
Compare the rice grains across different cups.				
	Similarities among rice grains across different piles	Differences between rice grains across different piles	Possible reasons for similarities and differences	

2. Look at the grains in each pile of rice. Within each pile, identify similarities and differences among the grains. On your *Observing and Comparing Rice Grains* page, record the similarities and differences you observe.
3. Now look at similarities and differences among rice grains in different piles. What similarities do you see? What differences do you notice? On your *Observing and Comparing Rice Grains* page, record the similarities and differences you observed.

## Analyze Your Data

1. Review your observations of rice grains from containers A, B, C, and D. How different from one another are the rice grains in the A sample? How different from one another are the rice grains in samples B, C, and D?

**sample:** a piece or part taken from a group, whose properties are studied to gain information about the whole group.

**sampling:** the process of selecting a suitable sample, or representative part, of a whole group.

2. Review your observations of rice grains to identify differences in the grains between containers A, B, C, and D. How large or small are the differences across the rice samples? Use evidence from your observations to support your claims.
3. What traits of rice are similar across rice types? What traits of rice are different across rice types?

### Be a Scientist

#### **Sampling**

A **sample** is a piece or part taken from the whole group. When scientists investigate something, such as the size of rice seeds, they cannot possibly measure every item in the set. Instead, they measure a sample, a small number of items chosen at random. From this they can estimate the size of others. In science research, selecting a suitable sample, or representative part of the whole group, is called **sampling**.

## Investigation 2: Measure Differences in Rice Grains

### What Are Some Rice-grain Traits that Can Be Measured?

Looking at differences in rice grains and documenting them is one way of getting evidence. You can obtain more precise evidence of similarities and differences in rice grains by measuring the length and width of different rice-grain samples.

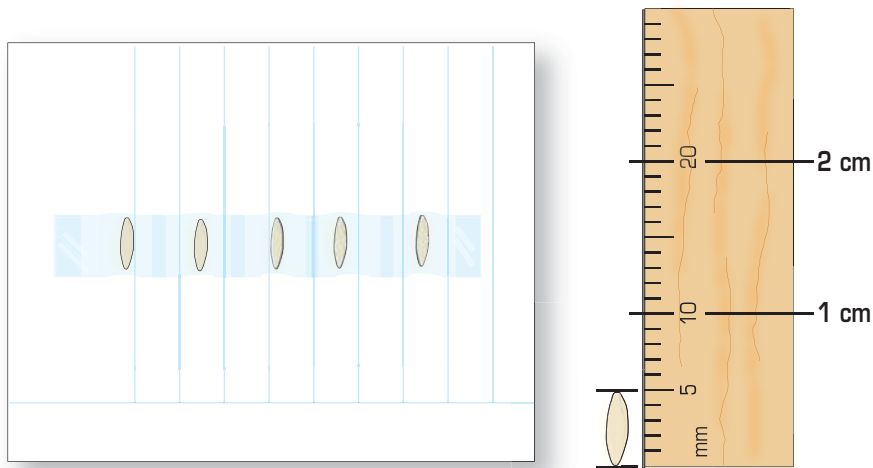
### Procedure

Using a ruler, first measure differences in size among grains in a single rice sample. Each member of your group will analyze a different rice sample: A, B, C, or D. You will then share your data with your group and use this data to answer questions.

1. Select five grains of rice from the container assigned to you (A, B, C, or D). Select grains that are whole and not broken or chipped.
2. Tape each grain you selected to paper so it will not move while you measure it. Leave enough space between the grains so you can easily measure the length and width of each.
3. Use the ruler to measure the length and width of each of the five grains. Measure each grain to the nearest millimeter. Measure carefully by making sure you have the ruler at one end or side of the rice grain. Record these measurements on a *Variation in Rice Grains* page.

### Materials

- 4 labeled containers of rice (A, B, C, and D)
- paper
- 4 rulers
- transparent tape



Note: Not to scale



### Classifying Types of Rice

Rice grains are classified based on their ratio of length to width. This classification method provides scientists and farmers with a way to compare different types of rice. For example, rice grains that are very long compared to their width would have a high length to width ratio, more than 1:1. Other rice may be almost as long as it is wide. These types of rice would be classified as having a ratio lower than 1:1.

## Communicate Your Results

Meet with the class to discuss your results. Present the values your group found for the average length, average width, and length/width ratio. Compare your values with those of other groups in your class. Use the following questions to guide your discussion.

- Were there differences among the average lengths and widths for each type of rice over the different groups? If there were differences, what might be the causes?
- Were there differences among the length/width ratios for each type of rice over the different groups? If there were differences, what might be the causes?
- If needed, discuss the measurement procedures you used. As a class, decide on the most accurate values for the average length, average width, and length/width ratio of each type of rice.
- Now that you have the most accurate values from each sample of rice, are the differences among the different types of rice larger or about the same as the differences within one type of rice?

## What's the Point?

Rice grains have many traits. You can observe the traits of size and color, among others. When comparing rice grains from the same type of rice plant, the traits of the grains are very much the same. Length and width measurements do not vary much across rice grains of the same type. The differences across different types of rice are larger than the differences within one type of rice. Traits that can be observed and measured are used to classify different types of rice.



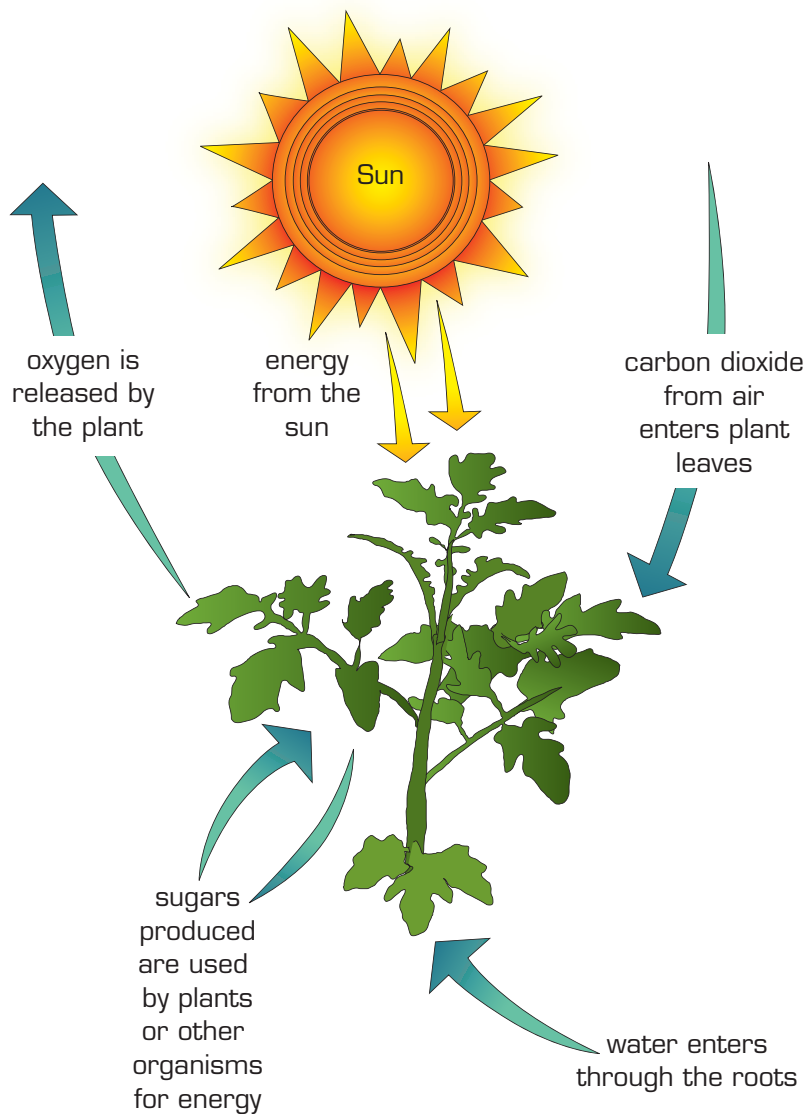
## 1.5 Read

# How Does Rice Provide Nutrition?

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

**carbohydrate:** a complex sugar. Carbohydrates provide energy when digested.

You know from your investigations in the last section that different varieties of rice grains have different traits. The size and color of the grain are two differences. Another trait that can vary is how nutritious the rice is. People eat rice because it can be very nutritious. It provides energy in the form of **starch**.



Starch is a type of complex sugar produced by plants. Complex sugars, are known as **carbohydrates**. When you eat carbohydrates, they provide energy for your body. Plants use energy from the Sun, along with 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 plant.

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 the animal's body can use as energy. Starch from grains is a very important source of nutrition for people all over the world. Rice provides humans with starch, minerals, vitamins, and some proteins. All of these compounds are essential for people. Because so many people in the world depend on rice for nutrition, rice is one of the most important grains among the cereals.

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 has the best possible nutritional value. If such a rice variety can be found, it will help to feed the world.

## Stop and Think

1. Why is rice a staple crop for millions of people?
2. Why might it be important to differentiate rice plants by the amount of starch they contain?
3. How is the starch found in rice grains produced?

## Update the *Project Board*

While working on this *Learning Set*, you have read about how rice is grown and who eats it. You have also identified several differences among different kinds of rice grains and measured some of the variations within types of rice grains and across types of rice grains. Add to the *What are we learning?* column of the *Project Board* what you have learned about similarities and differences across types of rice plants and what you have learned about rice and nutrition. Remember to add evidence to the *What is our evidence?* column for each entry to the *What are we learning?* column. Evidence can come from your reading or from your investigations.

## What's the Point?

Rice plants use energy from the Sun to produce sugars in a process called photosynthesis. Plants use some of the sugar they produce for growth and to support their life systems. The remaining sugars are stored as starch in the seeds and roots of the plants. When people eat rice, they digest the starch in the rice seeds, and it provides them with energy. Rice provides humans with starch, minerals, vitamins, and proteins. Rice grains contain different amounts of starch. The more starch in a grain, the greater its nutritional value. If scientists can find a rice variety that will grow in many different areas and that has high nutritional value, it will help to feed the world. Because so many people in the world depend on rice for nutrition, rice is one of the most important grains among the cereals.



**photosynthesis:** a process in which green plants use the energy from sunlight along with carbon dioxide and water to make their own food (sugar) and oxygen.

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





## Learning Set 1

# Back to the Big Challenge

*Make recommendations about developing a new rice plant that will produce more rice and more nutritious rice.*



**To:** All Collaborating Scientists

**From:** The Rice for a Better World Institute (RBWI)

**Subject:** Rice Traits

The Rice for a Better World Institute (RBWI) has received your information on how rice grains vary in size. We think you will need to know the traits of the different rice our researchers have developed. We have listed those traits in the chart below.

Rice variety	Trait
A	grows well in dry conditions
B	grows well even in flood conditions
C	has high starch content
D	has high fiber content
E	has high levels of vitamins and minerals
F	is resistant to pests
G	is resistant to disease

Rice variety	Trait
H	produces more rice grains per plant than other rice plants
I	requires less fertilizer per acre of rice than other rice plants

The goal of the RBWI and the collaborating scientists is to combine as many of these traits as possible in a new rice plant. As you go forward in your investigation, please keep this goal in mind. With your help, we may be able to produce a new rice plant with desirable traits.

## Conference

Using the information the *RBWI* scientists have just sent and what you now know about rice and the traits of rice plants, discuss the answers to the following questions with your group, and identify how each relates to the criteria and constraints of the challenge.

- What kind of traits do you think are most desirable for a new rice plant to have? How will this affect your recommendations?
- How will you make sure the traits of the new rice plant will meet the criteria?
- How will constraints you identified earlier affect your recommendations?
- What information from this *Learning Set* will you use to help you make your recommendations?
- What questions do you still have?
- Examine the rice traits in the letter from the *RBWI*. Identify why each might be important to growing more rice or rice that is more nutritious.



## Communicate

Share your group's answers to the questions with the class. As you listen to your classmates, make sure you understand the answers to these questions. If you do not understand something, or if they did not present something clearly enough, ask questions. Ask your questions and make your suggestions respectfully.

## Update Criteria and Constraints

Revisit the criteria and constraints for this challenge. Now that you know more about how rice plants are different from one another, you may have found that there is more to think about than you earlier imagined. You may now realize that the criteria and constraints are different from what you first expected. For example, you know that the amount of starch in a seed is important in developing a more nutritious rice. You read information from the *RBWI* and now know that developing rice plants resistant to pests and diseases is also important to think about. Using your new knowledge, update your list of criteria and constraints, making it more accurate. A more accurate list will help you better achieve the challenge.

## Update the *Project Board*

What you now know about different traits in rice plants has probably given you a better idea of what you need to do to address the challenge. Your new knowledge has allowed you to identify additional questions you need to answer. You might also have ideas about investigations you would like to conduct. You have updated the criteria and constraints for the challenge. Now add your new questions and ideas for investigations to the *Project Board*. Add your questions and ideas to the *What do we need to investigate?* column.

Put your recommendations about traits you think the rice plants should have in the last column of the *Project Board*. Feel free to add to the *What are we learning?* or *What is our evidence?* or *What do we think we know?* columns if you discover things that you did not put into those columns earlier. As the class *Project Board* is updated, remember to update your personal *Project Board*.