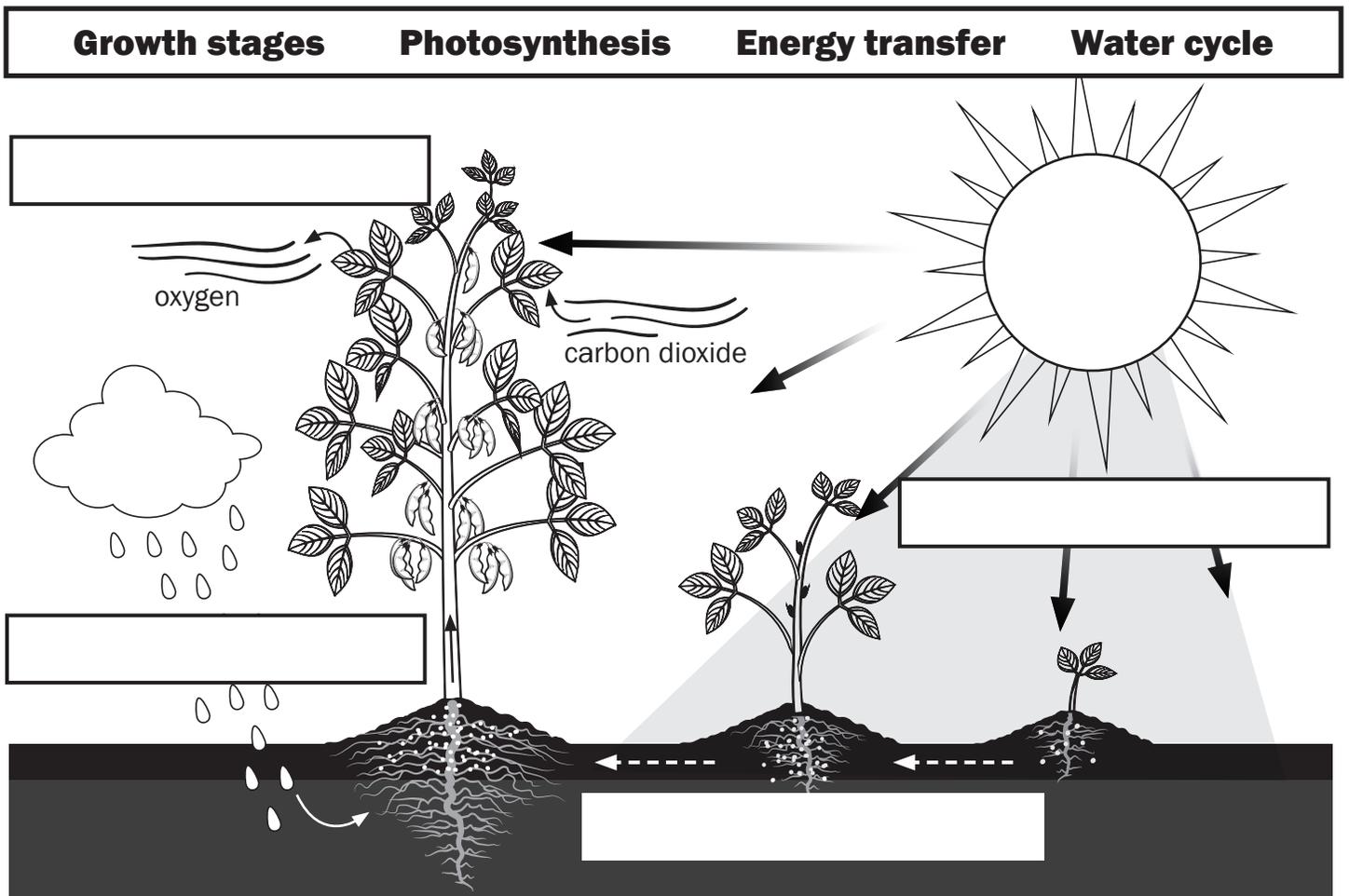


Name _____

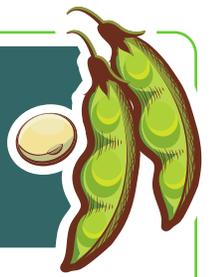
Let's see if you can remember some of the scientific processes happening in the soybean field. Use the word bank to fill in the blanks on the picture. When you're finished, Use the space below the picture to write a few sentences about what is happening in the field.





Science in the Soybean Field

Interactive 1: Teacher Notes



Introduction:

Welcome to a South Dakota soybean field! Review or briefly cover the topics below with the students to become familiar with some of the scientific processes happening in and around the soybean field. Use the continuing questions to guide discussion or reinforce the skills and concepts of this interactive as needed.

Topics:

- Plants are working all the time to make their own food in a process called **photosynthesis**. For a plant to do this, it needs three things – water, sunlight, and carbon dioxide. These things are readily available in most environments.
- The sun is a source of energy for these little soybean plants! Heat energy transfers to the plant, which in turn goes toward producing the plant product – the seed pod. The seeds can be used to produce more plants, or for human or livestock feed. Either way, the **energy transfer** continues!
- A critical part of growing soybeans includes the **water cycle**! Water is cycled through the earth and atmosphere through evaporation, condensation, and precipitation. These soybean plants have to have water for photosynthesis, remember?
- When a soybean seed is planted, it will start to absorb water from the soil and begins to grow. The seed will move through **growth stages**. All of this will happen in one growing season, or about four months!

Continuing Questions / Discussion:

- How does a plant make food, and what is the scientific name for this process?
 - How is this different from the way that humans get or make food?
- Energy can take multiple forms as it moves through the environment. How does heat energy from the sun convert to energy in a soybean plant?
- The water cycle is a critical part of the environment on Earth. List the parts of the cycle.
 - What happens when one (or more) parts of the water cycle are disrupted?

Standards:

- 5-LS2-1 Develop a model to describe the movement of matter and energy among producers, consumers, decomposers, and the environment.
- 4-PS3-2 Make observations to provide evidence for how energy can be transferred from place to place by sound, light, heat, and electric currents.
- 5-LS1-1 Support an argument that plants get the materials they need for growth chiefly from air and water.

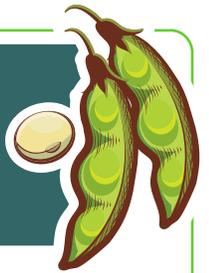
Additional Facts / Resources:

- PBS Learning Media: From Seed to Flower
 - <http://www.pbslearningmedia.org/resource/tdc02.sci.life.colt.plantsgrow/from-seed-to-flower/>



The Life of a Soybean

Interactive 2: Student Worksheet



Name _____

Every seed has a tiny, un-sprouted plant inside of them called an embryo. When the seed is exposed to water, the embryo quickly begins to grow, and will produce a sprout in a few days! When the sprout reaches sunlight, it will begin to photosynthesize, grow into a plant, and produce more seeds. This is the life cycle of a soybean plant!

On a soybean plant, the soybean itself is the seed. Each soybean has an embryo inside of it!

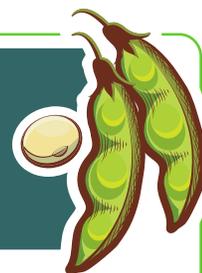
In the area below, draw a cross-section of a soybean seed. That's a fancy way of saying "draw what's on the inside!"

A large, empty rectangular box with a black border, intended for the student to draw a cross-section of a soybean seed.



The Life of a Soybean

Interactive 2: Teacher Notes



Introduction:

All plants have a way of reproducing, or making new plants. For the soybean, that process involves a seed — which is the actual soybean itself! All seeds have a very small un-sprouted plant living inside of them called an embryo. Use the continuing questions to guide discussion or reinforce the skills and concepts of this interactive as needed.

Topics:

- All plants have a way of reproducing, or making new plants. This is part of their unique life cycle.
- The soybean itself is the actual seed for the soybean plant. All seeds have a very small un-sprouted plant living inside of them called an embryo. This **embryo** can live on nutrients supplied from the seed for years.
- Once the seed is exposed to water, the embryo begins to grow inside the seed or **germinate**. Within a few days a sprout will reach sunlight, begin photosynthesis and eventually grow into a mature plant. The plant will produce seed pods that contain seeds, and the cycle starts all over again.

Continuing Questions / Discussion:

- How does a plant, specifically a soybean, continue to produce new plants?
- Discuss how humans can help and/or hurt the plant life cycle.
- What does a plant need to germinate? (Only needs water to germinate, needs sunlight to grow after that)
- Describe what an embryo is and how it contributes to the plant life cycle.

Standards:

- 3-LS1-1 Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.
- 4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

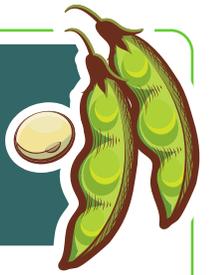
Additional Facts / Resources:

- YouTube video on plant germination
 - <https://youtu.be/MbORjG7ICQE>



Soybeans are Full of Energy

Interactive 3: Student Worksheet



Name _____

The world around us is full of energy, and soybeans are no different! Energy that is in a soybean can take two different energy paths shown below.

Sun → Plant → Seed → Plant

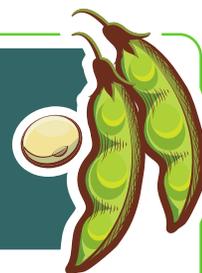
Sun → Plant → Seed → Food Source

Use the box below to write or illustrate in your own creative way **both** of these energy paths.



Soybeans are Full of Energy

Interactive 3: Teacher Notes



Introduction:

The world around us is full of energy, and soybeans are no different. The energy that resides in a soybean can be moved through two primary energy paths. Use the continuing questions to guide discussion or reinforce the skills and concepts of this interactive as needed.

Topics:

- Energy is constant in the environment, and can be transferred through different energy paths.
- Soybeans can transfer energy through two paths:
 - The sun transfers energy to a soybean plant, which produces soybeans (seeds). The energy in the seeds can be used to produce a new plant.
 - The sun transfers energy to a soybean plant, which produces soybeans (seeds). The seeds are taken off the plant, or harvested, and used for livestock or human consumption.
- The energy from the soybean seed, used for livestock or human consumption, continues the movement of energy through the environment.

Continuing Questions / Discussion:

- Other than human or livestock food, how else can the energy from soybeans be used? (Hint: think about fuel!)
- What can energy from the sun be used for inside the plant — besides producing a seed?
- Describe the movement of matter and energy, specific to the soybean life cycle.
- Think about two different states in the U.S. that are in different growing climates and have different weather, for example — South Dakota and Florida. Using the knowledge of energy transfer, compare and contrast soybean growth and development in these two states.
- Choose your favorite food. Think about the energy path that it took to get to your plate. Diagram the path.

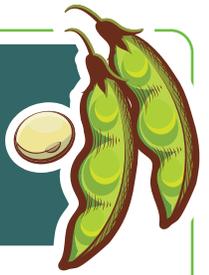
Standards:

- 5-LS2-1 Develop a model to describe the movement of matter and energy among producers, consumers, decomposers, and the environment.
- 4-PS3-2 Make observations to provide evidence for how energy can be transferred from place to place by sound, light, heat, and electric currents.
- 5-PS3-1 Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun.



The Life and Times of a Soybean

Interactive 4: Student Worksheet



Name _____

Many environmental factors can affect the growth of a plant. One is listed already. Add to the list below:

- **Weather** _____
- _____
- _____
- _____

Under normal conditions, a seed will grow through vegetative and reproductive stages in about 103 days, or just under four months. Use the space below to illustrate a soybean plant as it grows through its life cycle.

Vegetative Growth					
10 Days	15 Days	20 Days	25 days	33 Days	40 Days

Reproductive Growth			
43 Days	61 Days	76 Days	103 days



The Life and Times of a Soybean

Interactive 4: Teacher Notes



Introduction:

When a soybean seed is planted, it will start to absorb water from the soil and begin to grow. The seed will move through growth stages, and many external factors can influence this growth. The timeline from seed to mature soybean plant is about four months, which is one of the factors that makes soybeans an ideal agricultural food crop. Use the continuing questions to guide discussion or reinforce the skills and concepts of this interactive as needed.

Topics:

- Once planted, the soybean seed begins absorbing water and will germinate. The seed can get the material it needs to grow chiefly from air, water, and sunlight.
- Soybean plants go through a life cycle within a specific amount of days.
- Multiple environmental factors, such as weather, insects, temperature, and animals can interfere with the growth cycle.
- As the soybean plant grows, energy is transferred from the environment to the plant.

Continuing Questions / Discussion:

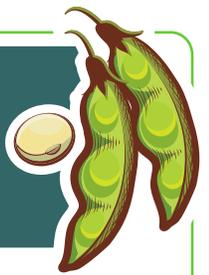
- Brainstorm ways that humans can help and/or hurt when attempting to control environmental factors that damage the growth cycle of plants.
- Why does the relatively short growth cycle of a soybean plant (approximately 4 months) make it an ideal agricultural food crop?
 - Research the growth cycle (or season) for other edible crops. How do they compare to soybeans?
 - How could you use this growth cycle knowledge to evaluate the efficiency of other agricultural crops?

Standards:

- 5-LS2-1 Develop a model to describe the movement of matter and energy among producers, consumers, decomposers, and the environment.
- 5-LS1-1 Support an argument that plants get the materials they need for growth chiefly from air and water.
- 3-LS3-2 Use evidence and reasoning to support the explanation that traits can be influenced by the environment.

Additional Facts / Resources:

- My American Farm: “That’s Life, Let’s Grow” interactive game
 - <http://www.myamericanfarm.org/classroom/games>



Name _____

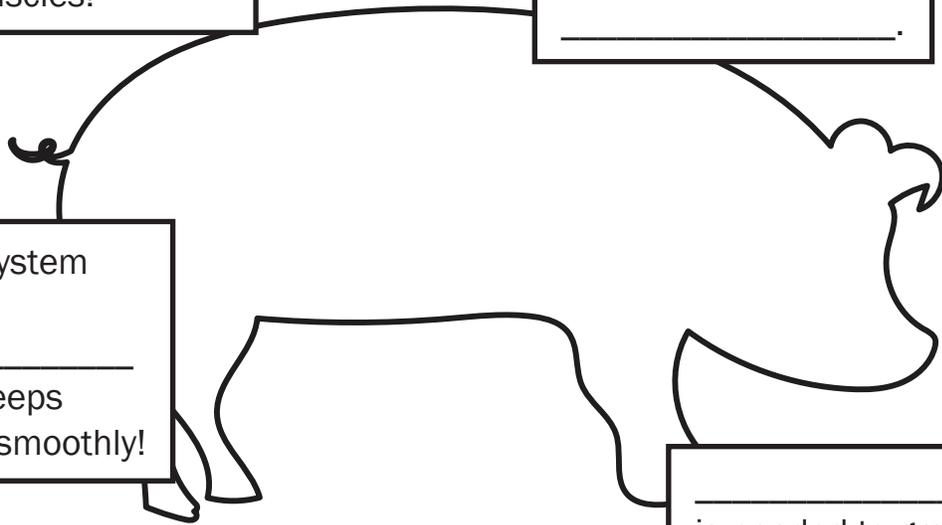
Soybeans are full of nutrients! Remember the energy cycle in Interactive 3? These nutrients can be used to feed a new soybean plant, humans, or livestock! Fill in the correct nutrient in the spaces by the picture. If you need help, use the tips at the bottom of the page.

Protein	Fiber	Calcium	Vitamin K
----------------	--------------	----------------	------------------

Soybeans are high in _____.
This nutrient helps build strong muscles!

I help the heart by keeping blood healthy! I am _____.

The digestive system wants to keep _____ in the diet! It keeps things running smoothly!



_____ is needed to grow strong bones and teeth.

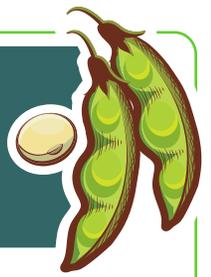
TIPS:

- Calcium helps to build strong bones and teeth.
- Protein is important to help build muscle.
- Fiber is necessary for digestive processes.
- Vitamin K helps keep blood healthy.



Soybean Nutrients

Interactive 5: Teacher Notes



Introduction:

Soybeans are full of nutrients! Livestock and humans both benefit from eating well-balanced meals, and soybeans can be a part of that diet. Soybeans contain many nutrients, including **protein**, **fiber**, **vitamin K**, and **calcium**. Use the continuing questions to guide discussion or reinforce the skills and concepts of this interactive as needed.

Topics:

- Soybeans contain vital nutrients needed by livestock and humans to live and grow. Soybeans contain the following nutrients:
 - Soybeans are high in protein. One serving of protein has almost three times as many grams of protein than a glass of milk. Protein is important to help build muscle.
 - Soybeans also provide a good source of fiber. Fiber helps the digestive system work smoothly.
 - Soybeans are full of vitamins and minerals, especially Vitamin K. Vitamin K helps to keep your blood healthy, which is important in making sure your heart is working properly.
 - Soybeans are also high in calcium. Calcium builds strong bones and teeth and is needed to grow and develop.

Continuing Questions / Discussion:

- Why is it important for both humans and livestock to eat a well-balanced diet with the proper nutrients?
 - What are some consequences of an improper diet?
- Describe how the energy transfer continues through the human body if you eat soybeans.

Standards:

Science Standard

- 5-LS2-1 Develop a model to describe the movement of matter and energy among producers, consumers, decomposers, and the environment.

Physical Education Standard

- S3.E6: Nutrition

Health Education

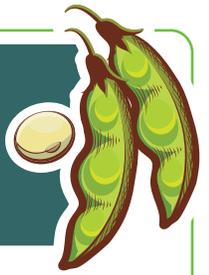
- Standard 5: Students will demonstrate the ability to use decision-making skills to enhance health.
- Standard 7: Students will demonstrate the ability to practice health-enhancing behaviors and avoid or reduce health risks.

Additional Facts / Resources:

- Soy Science Videos (specific to part 4: nutrition & cooking)
 - <http://intotheoutdoors.org/topics/soybean-science/#video>

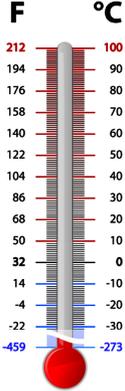
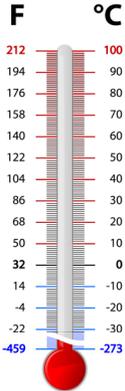
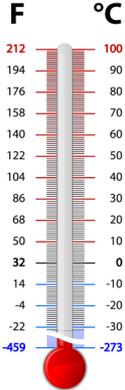
States of Water

Interactive 6: Student Worksheet



Name _____

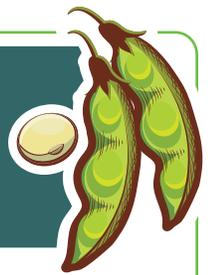
Water is what all living things have in common – we all need it to survive! Depending on the temperature, water takes different forms. Water can be a solid, liquid, or gas depending on the temperature. Use your knowledge to complete the pictures below.

Name of State	Draw a picture of water in this state	Illustrate what the water molecules are doing in this state?	What temperature or temperature range does this state occur?
Solid			
Liquid			
Gas			



States of Water

Interactive 6: Teacher Notes



Introduction:

Water is all around us, and is a necessary part of life. Every living thing needs water to survive. As the temperature changes, the molecules are arranged differently, resulting in the state changes between solid, liquid, and gas.

Topics:

- Every living thing needs water to survive.
- The state of water falling on a soybean field can affect growth! Liquid, or rain, is beneficial for soybeans. In its solid state, ice, water can be very detrimental to a crop.
- Water is found in nearly all aspects of our environment.

Continuing Questions / Discussion:

- Describe how water in its different states can be beneficial and detrimental to a crop of soybeans. Think about all of the stages!
- How do we see each state of water in our environment?
- Describe how the molecules changing shape affect the physical state of the water.
- How can we use different states of water? (Ex: liquid to water plants, steam to power engines, etc.)

Standard:

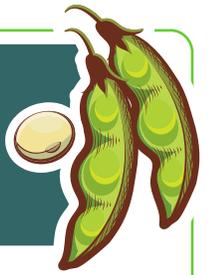
- 5-PS1-3 Make observations and measurements to identify materials based on their properties.

Additional Facts / Resources:

- Discovery Education, The Magic School Bus “How Water Changes”
 - <https://youtu.be/eHJuhEIG-9o>
- Science Kids: Changing State of Water Game
 - <http://www.sciencekids.co.nz/gamesactivities/statematerials.html>
- Peep & the Big Wide World “The Disappearing Drink”
 - <https://youtu.be/h30XjNlp6yY>

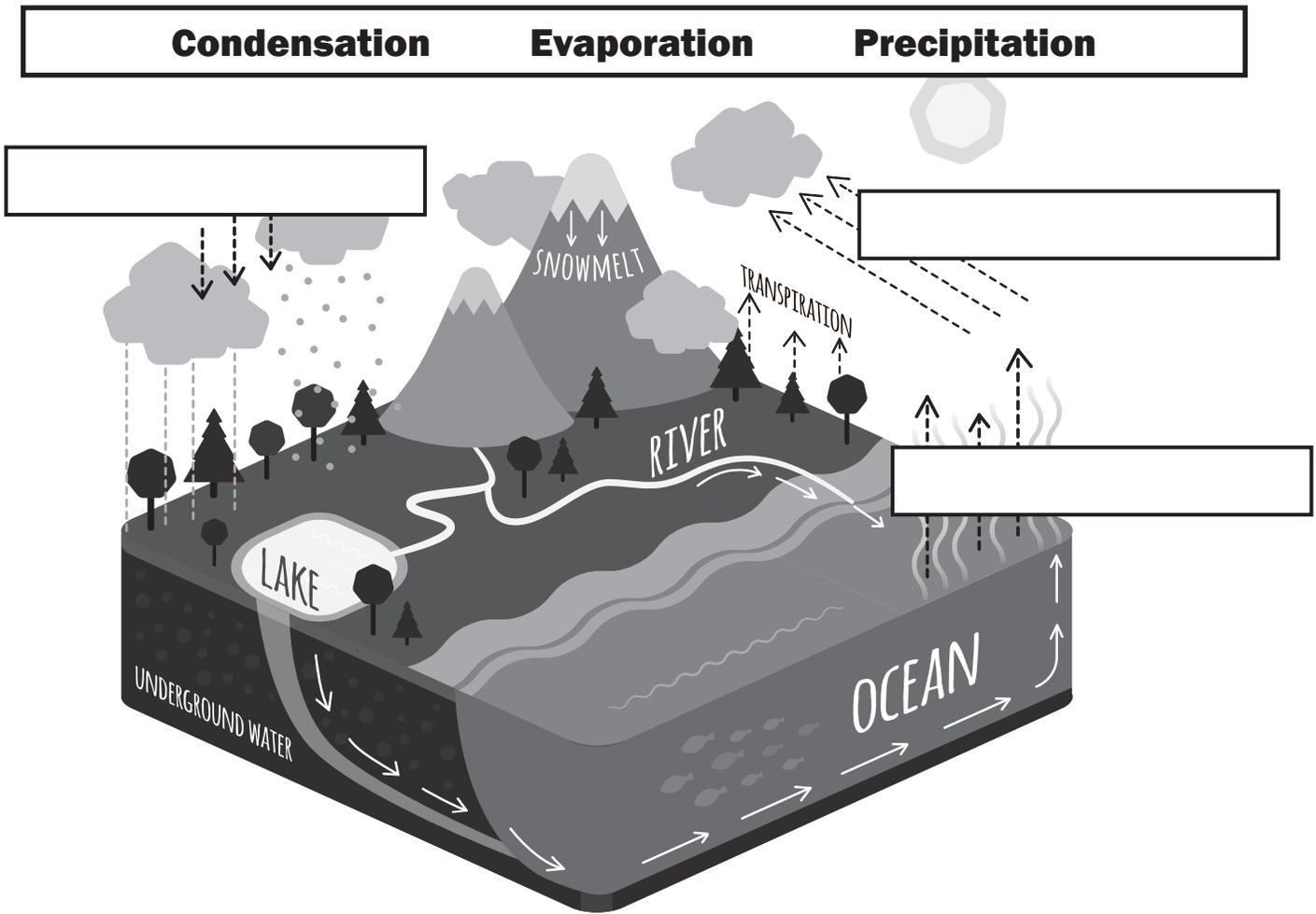
The Water Cycle

Interactive 7: Student Worksheet



Name _____

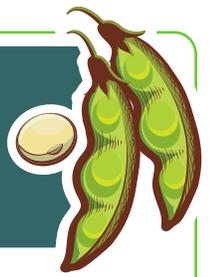
Let's see if you can remember some of the scientific processes involved with the water cycle. Use the word bank to fill in the blanks on the picture. When you're finished, use the space below the picture to write a few sentences about how water moves through the cycle. To really challenge yourself, write about the state changes within the water cycle too!





The Water Cycle

Interactive 7: Teacher Notes



Introduction:

Living things, especially plants, depend on the water cycle. Because water can change states from solid to liquid to gas, it can be found nearly anywhere in our environment. There are three processes that are part of the water cycle and they are condensation, evaporation and precipitation.

Topics:

- Every living thing needs water to survive.
- A critical part of growing soybeans includes the **water cycle!** Water is cycled through the earth and atmosphere through **evaporation, condensation, and precipitation.**
- Because water can change from solid to liquid to gas it can be found nearly everywhere in our environment.

Continuing Questions / Discussion:

- How can water that fell as snow be used later in the year by a soybean plant?
- How does temperature effect water as it changes from state to state?
- What processes are water molecules going through as they change state, specifically from solid to liquid or liquid to solid, and liquid to gas or gas to liquid.
- How could water that is stored in a plant end up in your body?

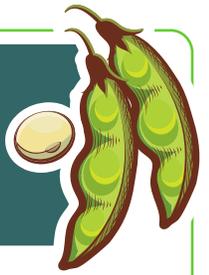
Standard:

Science Standard

- 5-LS2- 1 Develop a model to describe the movement of matter and energy among producers, consumers, decomposers, and the environment.

Additional Facts / Resources:

- PBS Learning Media: Water Cycle
 - <http://wimedialab.pbslearningmedia.org/resource/idptv11.sci.ess.watcyc.d4kwcy/water-cycle/>
- USGS: The Water Cycle for Schools
 - <http://water.usgs.gov/edu/watercycle-kids.html>



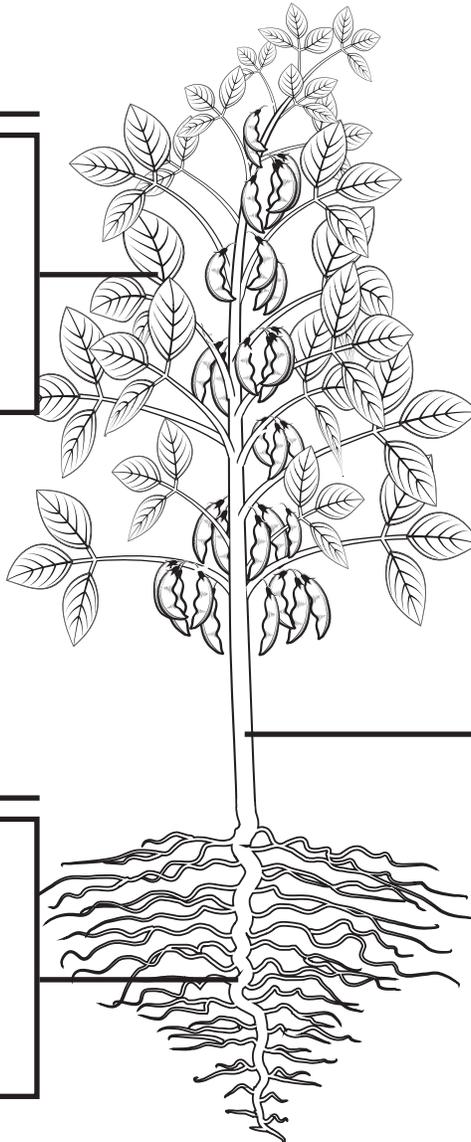
Name _____

Plants have different parts that are in charge of different tasks, just like humans. You wouldn't ask your knee to eat your lunch, would you? Each part has a job to do that is very specific. Use the words in the word bank to label the part of the soybean plant, and write one sentence about that part's job.

Roots Stem Leaves

Part Name:

Job: _____



Part Name:

Job: _____

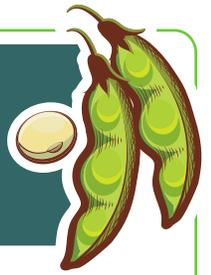
Part Name:

Job: _____



Soybean Parts in Action

Interactive 8: Teacher Notes



Introduction:

A soybean plant is like a lot of other plants, with basic parts like roots, a stem, and leaves. Many important processes take place in these parts of the plant. Use the continuing questions to guide discussion or reinforce the skills and concepts of this interactive as needed.

Topics:

- Parts of a plant work together to allow processes inside the plant to happen (roots/stem/leaves).
 - **Leaves** are important because they are where photosynthesis happens. As the leaves take in sunlight and carbon dioxide, they convert it to sugars – which help feed the plant.
 - The **stem** helps nutrients and water go either up (to the leaves), or down (to the roots). A strong stem also helps the leaves reach towards the sunlight.
 - The **roots** help the soybean plant in two ways: they absorb and carry water and nutrients from the soil, and they also help to support the plant so it can grow tall.

Continuing Questions / Discussion:

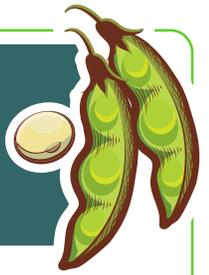
- Name a specific function of each part of the plant:
 - Roots
 - Stem
 - Leaves
- Describe how the roots, stem, and leaves can work together for the benefit of the plant.
- What could happen if one or more parts of the plant was not fully operational because of a genetic or environmental factor? Scientists are constantly looking for solutions to genetic and environmental factors that affect parts of the soybean plant. What excites you most about the possibilities within the scientific field in relation to soybeans?

Standard:

- 5-LS1-1 Support an argument that plants get the materials they need for growth chiefly from air and water.

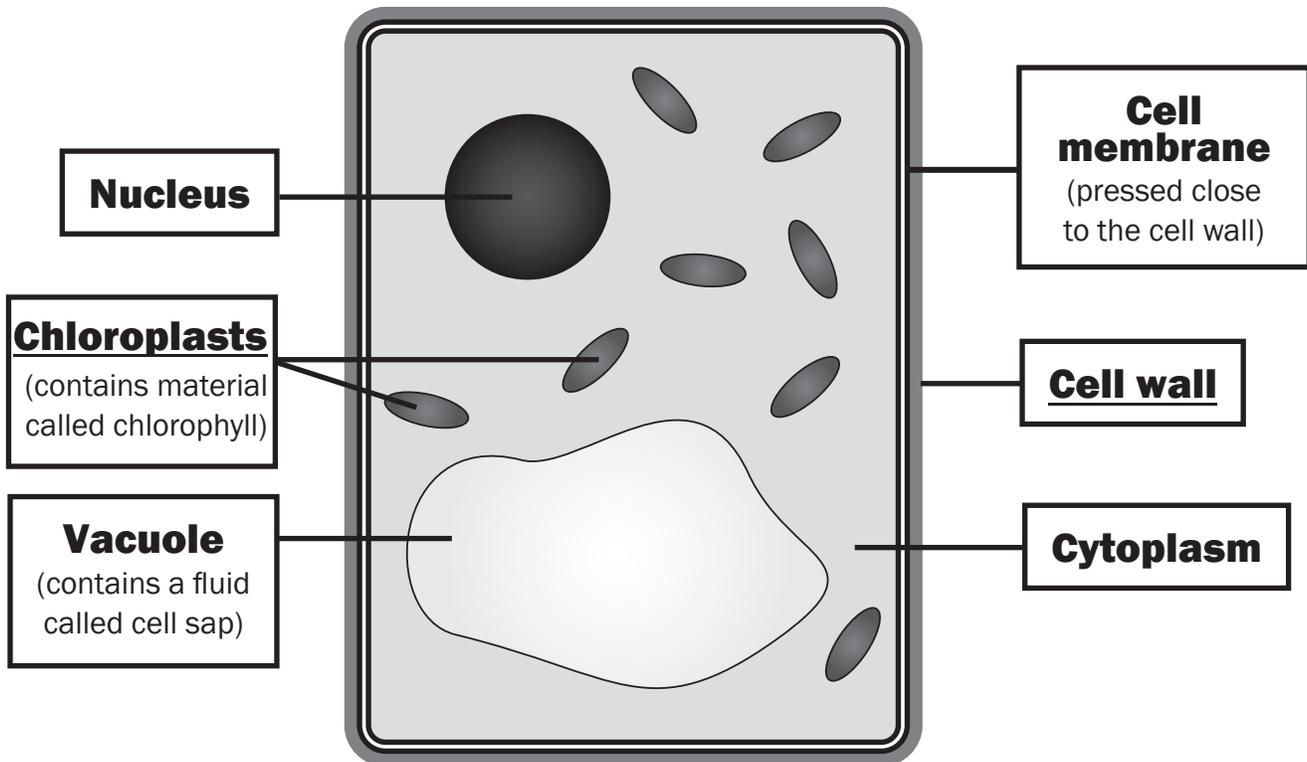
Additional Facts / Resources:

- Growing plants & plant parts lesson plan and activities
 - http://www.agclassroom.org/teacher/matrix/lessonplan.cfm?lpid=184&author_state=0&grade=0,3&search_term_lp=plant%20parts



Name _____

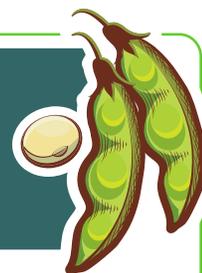
Plants are made up of cells, just like all living organisms. Plants have a few different items in their cells that make them unique. The two items underlined below are unique to plant cells. Use the space below the picture to write about why plants have or need these additional items in their cells.





A Look Inside: Soybeans Up Close

Interactive 9: Teacher Notes



Introduction:

Cells make up all living things, from plants to animals. Plant cells, unlike animal or human cells, are surrounded by a thick, rigid cell wall. This wall helps the plant create a structure that will not easily break or bend. They also have an enlarged vacuole that allows the cells to hold water. This is critical when water is limited or not available for a period of time in the environment. There are many parts of a plant cell, each with a specific job to do for the plant. Use the continuing questions to guide discussion or reinforce the skills and concepts of this interactive as needed.

Topics:

- Cells are the basis of all living things, and plants are made up of cells.
- Plant cells are made up of many parts, each with a specific job to do in order to make the plant viable.
- Plant cells are different than animal or human cells.

Continuing Questions / Discussion:

- Compare and contrast the microscopic views of the root, seed, and leaf. Create a diagram to demonstrate their similarities and differences.
- Discuss the parts of the plant cell and their function.
- Discuss why plant cells have rigid cell walls, in contrast to animal and human cells with flexible, or pliable walls.

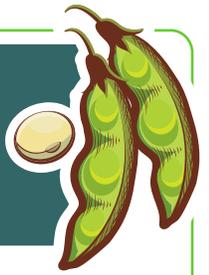
Standard:

- 5-LS1-1 Support an argument that plants get the materials they need for growth chiefly from air and water.



Plants Make Their Own Food

Interactive 10: Student Worksheet



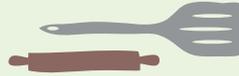
Name _____

Plants use the same recipe, day after day, to make the perfect food for them to grow and develop! Do you remember the three things that plants need to make food?

Use the recipe card below to write out how a plant makes its own food. Use the words in the word bank if you need a little help remembering the ingredients!

Sunlight Carbon Dioxide Water

Plant Food Recipe



Ingredients:

- _____
- **1:** _____
- _____
- **2:** _____
- _____
- **3:** _____
- _____
- _____

Directions:

- 1:** _____
- _____
- _____
- 2:** _____
- _____
- _____
- 3:** _____
- _____
- _____



From the kitchen of:

Plants Make Their Own Food

Interactive 10: Teacher Notes



Introduction:

Recipes are used like a blueprint to make a certain food. Plants use the same recipe, day after day, to make the perfect food them to grow and develop. For a plant to make food, it needs to take in three things: water, carbon dioxide, and sunlight. These three things interact in the chloroplast and create two new things – glucose (sugar), and oxygen. The oxygen is released into the atmosphere, and the glucose is used or stored for food for the plant. Use the continuing questions to guide discussion or reinforce the skills and concepts of this interactive as needed.

Topics:

- A plant makes its own food through the process of **photosynthesis**, which requires water, carbon dioxide, and sunlight.
- Inside the chloroplast, the process of photosynthesis creates two new products – glucose, and oxygen. Glucose is kept inside the plant for food. Oxygen is released into the atmosphere.

Continuing Questions / Discussion:

- Describe how a plant makes food, and how the food is used in the plant.
- Besides the basic “ingredients” for the plant food recipe – water, carbon dioxide, and sun – there are a few other things that a plant may need to thrive, such as soil and fertilizer. Discuss the need for these extra ingredients and how a plant may function with and/or without them.
- With the rise in popularity of alternative growing methods, such as hydroponics and aquaponics, plants are no longer confined to the soil. Discuss the opportunities and limitations of these alternative growing methods.

Standard:

- 5-LS1-1 Support an argument that plants get the materials they need for growth chiefly from air and water.

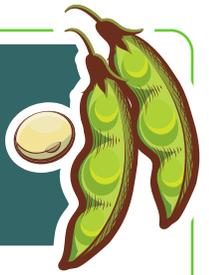
Additional Facts / Resources:

- Hydroponic gardening for kids: an activity and tutorial
 - <http://www.epicgardening.com/hydroponics-for-kids/>



Plants and Animals: We Need Each Other

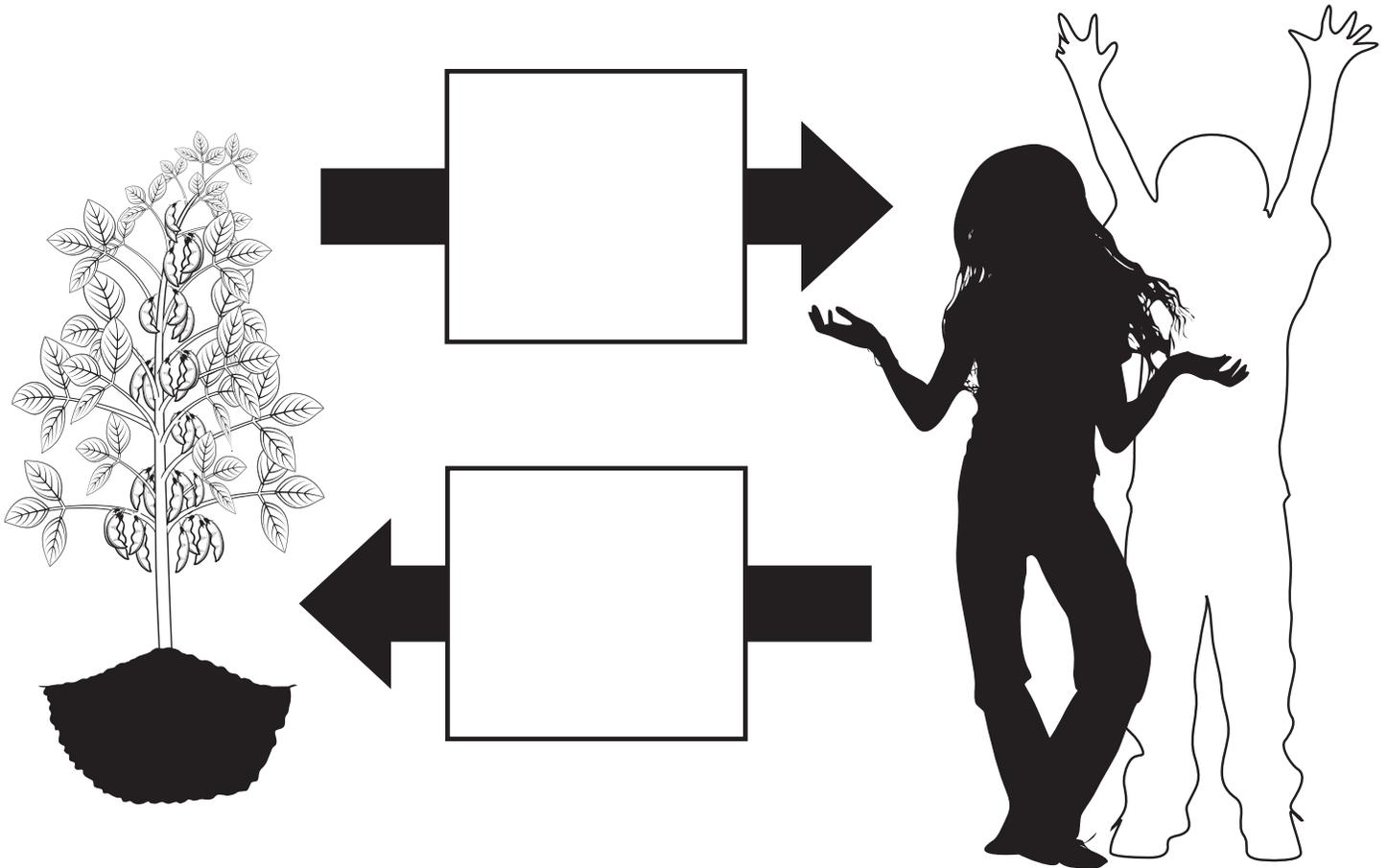
Interactive 11: Student Worksheet



Name _____

Without plants, the Earth's atmosphere would have too much carbon dioxide and not enough oxygen. For humans, that would be a major problem! Through photosynthesis, plants take in one gas and release another.

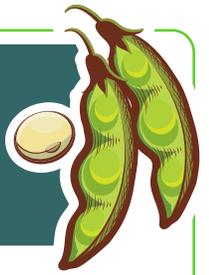
Complete the diagram below to show the exchange of gases between plants and humans. If you get stuck, remember what humans need to breathe in!





Plants and Animals: We Need Each Other

Interactive 11: Teacher Notes



Introduction:

Through the process of photosynthesis, plants take in carbon dioxide and return oxygen to the atmosphere for humans and animals to use during cellular respiration. This necessary environmental action makes plants absolutely critical for life on Earth. Use the continuing questions to guide discussion or reinforce the skills and concepts of this interactive as needed.

Topics:

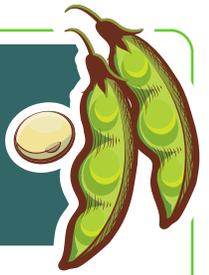
- Cellular respiration in plants provides a needed natural environmental resource to supply oxygen to the environment.
- Plant needs, and their available resources, combine to benefit the environment.

Continuing Questions / Discussion:

- How does the processes of photosynthesis benefit the environment?
 - How can we proactively work as individuals or in our community to increase the benefits?
- Aside from returning oxygen to the atmosphere, what other benefits do plants offer humans and the planet?
- Compare a city vs. a rural landscape. With your knowledge of photosynthesis, discuss the pros and cons of each setting.

Standards:

- 5-LS2-1 Develop a model to describe the movement of matter and energy among producers, consumers, decomposers, and the environment.
- 5-LS1-1 Support an argument that plants get the materials they need for growth chiefly from air and water.
- 5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.



Name _____

Plants store, or save, their own food for later. The glucose (sugar) that is saved will be used for specific jobs. The two different types of plants — annuals and perennials — are unlike each other based on their growing season and where they store glucose as food. Complete each sentence about the two types of plants.

Annual plants have a growing season that _____

Perennial plants have a growing season that _____

Now let's think about specific plants. Using the word bank below, fill in the sentences.

Perennial	Annual	Roots	Seeds
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The soybean plant is an _____ plant.
It stores glucose (food) in its _____.

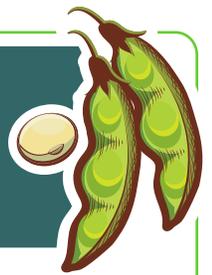


A tree is a _____ plant.
It stores glucose (food) in its _____.



The Plant Pantry

Interactive 12: Teacher Notes



Introduction:

Annual plants only have one growing season, and rely on humans to save their seeds so they can grow again the following year. In contrast, perennial plants continue to add to their growth every spring. The type of plant determines where the glucose, or plant energy, is stored. Annuals store their glucose in their seeds, while perennial plants keep it in their roots. Use the continuing questions to guide discussion or reinforce the skills and concepts of this interactive as needed.

Topics:

- Plants have inherent internal structures that function to support survival, growth, behavior, and reproduction.
- Annuals store glucose in seeds which will germinate and start a new plant the following year.
- Soybeans are an annual plant.
- Perennials (like trees) store glucose in roots, usually, to survive through the winter and use this food to grow back until the green leaves can start making food from sunlight again.

Continuing Questions / Discussion:

- Why would annual and perennial plants store their glucose in different places? Discuss the benefits of each type of plant and their storage system.
- Using a sampling of plants, classify them as annual or perennial.
- For an annual plant, like a soybean, discuss how humans can affect the growth process. Use the points below to spark conversation:
 - Saving seeds
 - Planting environment
 - Pests and controls

Standard:

- 4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

Additional Facts / Resources:

- Learn about soybean harvest — taking off the seed, where the soybean has stored energy!
 - http://www.myamericanfarm.org/videos/video_player.php?vurl=AH820_AR_Soybean_Harvest.mp4
- Math interactive game regarding harvest from My American Farm
 - <http://myamericanfarm.com/classroom/games>