Growth Requirements On Trial

The verdict is in...Soybeans are “guilty” of having certain requirements for growth and survival of the plants. But what happens when you “tamper” with one of those requirements? Now it is your turn to “weigh the evidence” on what those requirements are, and how they affect the plants. In the next seven “trials,” you will test the effects of changing light qualities, water and soil availability, and temperature. It is recommended to start several variations of this experiment at the same time for comparison purposes.
**Growth Requirements On Trial**

**Soil**

<table>
<thead>
<tr>
<th>Objective</th>
<th>NE Science Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observe how soil affects soybean growth</td>
<td>SC5.3.4a, SC8.3.4.a</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Time</th>
<th>You Will Need</th>
</tr>
</thead>
</table>
| 20 minutes | • plastic sandwich bag  
• plate/tray  
• soybeans  
• water  
• light source  
• observation sheet/journal |

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Case #1: Soil. Since planting seeds in soil is the most common method, this plant will serve as the control for all of the trials. The control is the part of the experiment that you compare back to with all of the other trials.
Activity Instructions

1. Fill the sandwich bag with soil. Poke 2-3 holes in the bottom for water drainage.
2. Plant the soybean seed about ½ inch deep, and add water until the soil is damp, yet not saturated. Place the bag on a plate or tray to catch the water drainage.
3. Place the sandwich bag and plate near a light source (lamp or window).
4. Add water to the soil as needed to keep it moist during the entire experiment.
5. Observe daily and record on the observation sheet. In your observations include the date, the length of roots and stem (preferably in centimeters), and any other qualities you observe such as color, wilting, etc.
6. If you are doing several variations of this experiment at the same time, you can compare your observations from plant to plant.

Check for Learning

1. Did the seed germinate (sprout) and continue to grow?
2. For the first few days, where is the new plant getting the energy and nutrients required to grow?
Growth Requirements On Trial

Water

Objective
Observe how water affects soybean growth

Time
20 minutes

You Will Need
- plastic sandwich bag
- soybeans
- paper towel
- water
- light source
- observation sheet/journal

NE Science Standards
SC5.3.4a, SC8.3.4.a

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Case #2: Water. It is a fact that all living things need water to thrive, but can they survive on water alone? This trial will put that question to the test.
Growth Requirements On Trial

Water

Activity Instructions

1. Thoroughly wet a paper towel.
2. Wrap the dripping paper towel around one soybean.
3. Place the paper towel containing the soybean in the plastic sandwich bag and close it.
4. Place the sandwich bag near a light source (lamp or window).
5. Add water to the paper towel as needed to keep it moist during the entire experiment.
6. Observe daily and record on the observation sheet. In your observations include the date, the length of roots and stem (preferably in centimeters), and any other qualities you observe such as color, wilting, etc.
7. If you are doing several variations of this experiment at the same time, you can compare your observations from plant to plant.

Check for Learning

1. Did the seed germinate (sprout) and continue to grow if only water is present?

2. Where does the plant get the energy and nutrients required to grow?

3. How can farmers apply this information to growing their crops?
## Growth Requirements On Trial

### Light

#### Objective
Observe how the presence of light affects soybean growth.

#### NE Science Standards
SC5.3.4a, SC8.3.4.a

#### Time
20 minutes

#### You Will Need
- plastic sandwich bag
- plate/tray
- soybeans
- water
- dark space
- observation sheet/journal

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Case #3: Light. We know there is energy in the light from the sun, but is it absolutely necessary for germination (sprouting) and continued growth? You be the judge!
Activity Instructions

1. Fill the sandwich bag with soil. Poke 2-3 holes in the bottom for water drainage.
2. Plant the soybean seed about ½ inch deep, and add water until the soil is damp, yet not saturated. Place the bag on a plate or tray to catch the water drainage.
3. Place the sandwich bag and plate in a dark space (closet, cupboard).
4. Add water to the soil as needed to keep it moist during the entire experiment.
5. Observe daily, and record on the observation sheet. In your observations include the date, the length of roots and stem (preferably in centimeters), and any other qualities you observe such as color, wilting, etc.
6. If you are doing several variations of this experiment at the same time, you can compare your observations from plant to plant.

Check for Learning

1. Did the seed germinate (sprout) and continue to grow?
2. Where did the plant get the energy and nutrients required to grow?
3. What does this mean for farmers?
Growth Requirements On Trial
Light Color

Objective
Observe how different colors of light affects soybean growth

Time
20 minutes

You Will Need
• 2 plastic sandwich bags
• plate/tray
• 3 soybeans
• water
• 1 large glass beaker, wrapped in red cellophane
• 1 large, glass beaker, wrapped in green cellophane
• 1 large, glass beaker, wrapped in blue cellophane
• observation sheet/journal

NE Science Standards
SC5.3.4a, SC8.3.4.a

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Case #4: Light Color. Different colors have different wavelengths of light. The shorter the wavelength, the more energy is present. Also, the color that we see is the wavelength that bounced off of the object instead of getting absorbed. We know there is energy in the light from the sun, but does the color matter?
Growth Requirements On Trial

Light Color

Activity Instructions

1. Fill the sandwich bag with soil. Poke 2-3 holes in the bottom for water drainage.
2. Plant the soybean seed about ½ inch deep, and add water until all the soil is damp, yet not saturated. Place the bag on a plate or tray to catch the water drainage.
3. Place the sandwich bag and plate under the large, glass beaker wrapped in red cellophane.
4. Repeat steps 1-3 using the beakers wrapped with green and blue cellophane.
5. Place all plants near the light source.
6. Add water to the soil as needed to keep it moist during the entire experiment.
7. Observe daily, and record on the observation sheet. In your observations include the date, the length of roots and stem (preferably in centimeters), and any other qualities you observe such as color, wilting, etc.
8. If you are doing several variations of this experiment at the same time, you can compare your observations from plant to plant.

Check for Learning

1. Using the picture on the other side of the card, determine which color of cellophane was blocking the longest wavelength. Which color of cellophane was blocking the shortest wavelength?

2. Did the color and wavelength of light blocked seem to have an effect on any of the seedlings? Why do you think this happened?
Growth Requirements On Trial

Light Angle

Objective
Observe how the angle of light affects soybean growth

Time
20 minutes

You Will Need
- 2 plastic sandwich bags
- 2 plate/tray
- 2 soybeans
- water
- 2 lamps
- 2 dark spaces
- observation sheet/journal

NE Science Standards
SC5.3.4a, SC8.3.4.a

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Case #5: Light Angle. In nature, plants receive the sun’s light from different angles as our planet rotates, and the angle affects the light intensity (the amount of light). The quantity of light decreases with distance and angle from the source. Plants receive maximum quantity of sunlight in summer because the angle that the light hits the surface of the planet is closer to 90 degrees. Will light angle affect plant growth?
Activity Instructions

1. Fill the sandwich bag with soil. Poke 2-3 holes in the bottom for water drainage.
2. Plant the soybean seed about ½ inch deep, and add water until all the soil is damp, yet not saturated. Place the bag on a plate or tray to catch the water drainage.
3. Place the sandwich bag and plate in a dark space with lamp shining directly above (within 2-6 inches).
4. Repeat steps 1-3, but arrange for the light to shine from the side of the plant instead of directly above (within 2-6 inches).
5. Add water to the soil as needed to keep it moist during the entire experiment.
6. Observe daily, and record on the observation sheet. In your observations include the date, the length of roots and stem (preferably in centimeters), and any other qualities you observe such as color, wilting, etc.
7. If you are doing several variations of this experiment at the same time, you can compare your observations from plant to plant.

Check for Learning

1. What observations did you make in regards to the growth or appearance of the plant based on the location/angle of the light?
2. How does this information relate to farming practices for growing soybeans?
Growth Requirements On Trial
Leaves

Objective
Observe the role that leaves play in soybean growth

NE Science Standards
SC5.3.4a, SC8.3.4.a

Time
20 minutes

You Will Need
• plastic sandwich bag
• plate/tray
• soybeans
• water
• light source
• black construction paper
• scissors
• tape
• observation sheet/journal

The verdict is in…Soybeans are “guilty” of having certain requirements for growth and survival of the plants. But what happens when you “tamper” with one of those requirements? Now it is your turn to “weigh the evidence” on what those requirements are, and how they affect the plants.

Case #6: Leaves. Plants use photosynthesis to create food from sunlight and carbon dioxide. This reaction occurs because of the green chlorophyll within plants that absorbs the light energy. What structures in the plant catches the most light? What happens if the light is blocked?
Growth Requirements On Trial
Leaves

Activity Instructions

Activity Instructions:
1. Fill the sandwich bag with soil. Poke 2-3 holes in the bottom for water drainage.
2. Plant the soybean seed about ½ inch deep, and add water until all of the soil is wet. Place the bag on a plate or tray to catch the water drainage.
3. Place the sandwich bag and plate near a light source (lamp or window).
4. Add water to the soil as needed to keep it moist during the entire experiment.
5. Once the plant has grown and produced a few leaves cover one of them by wrapping and taping the black construction paper around it. Use scissors to cut the paper to the appropriate size.
6. Observe daily (after adding the construction paper), and record on the observation sheet. In your observations include the date, the length of roots and stem (preferably in centimeters), and any other qualities you observe such as color, wilting, etc.
7. If you are doing several variations of this experiment at the same time, you can compare your observations from plant to plant.

Check for Learning

1. What happened to the leaf under the paper?

2. What would happen to the plant if all of the leaves were covered?
Objective
Observe how temperature affects soybean growth

Time
20 minutes

You Will Need
• plastic sandwich bag
• plate/tray
• soybeans
• water
• light source
• observation sheet/journal

NE Science Standards
SC5.3.4a, SC8.3.4.a

The verdict is in…Soybeans are “guilty” of having certain requirements for growth and survival of the plants. But what happens when you” tamper” with one of those requirements? Now it is your turn to “weigh the evidence” on what those requirements are, and how they affect the plants.

Case #7: Temperature. Temperatures play a large role in determining when farmers plant, water, and harvest. Should soybean farmers hope for cool, warm or hot temperatures to get the highest yields possible?
Activity Instructions

1. Fill the two sandwich bags with soil. Poke 2-3 holes in the bottom of each for water drainage.
2. Plant the soybean seed about ½ inch deep in each bag, and add water until the soil is damp, yet not saturated. Place the bags on plates or trays to catch the water drainage.
3. Place the plants in similar places with different temperatures (Ex: basement window vs. upstairs window, highly air-conditioned room vs. non air-conditioned). Keep thermometers in both places to record temperatures.
4. Add water to the soil as needed to keep it moist during the entire experiment.
5. Observe daily, and record on the observation sheet. In your observations include the date, temperature, the length of roots and stem (preferably in centimeters), and any other qualities you observe such as color, wilting, etc.
6. At the end of the experiment, determine an average temperature for both plants (Add up all of the temperatures recorded for that plant, then divide by the number of temperatures you recorded for that plant).
7. If you are doing several variations of this experiment at the same time, you can compare your observations from plant to plant.

Check for Learning

1. Which plant appeared to germinate and grow the best?
2. What would you consider ideal growing temperatures for soybeans?
Soybean Activities
Perfect Pollination

Objectives

• Learn about the flower parts necessary for pollination
• Discover different methods of pollination

Time

20 minutes

You Will Need

• cheetos
• brown paper bag, cut to ½ its size
• scissors
• “perfect” flower paper cutout
• glue stick

NE Science Standards

SC5.3.2.b, C8.3.2.b

Pollination is the transfer of pollen from the male parts of a flower, called the stamen, to the female parts of a flower, called the pistil. Pollination helps the plant form a seed, which can then make another plant! Soybeans are special because they don’t have to rely on other plants for pollination. How is this possible?

A “perfect flower” is one that contains both the male and female parts. A perfect flower can actually pollinate itself, but can also be pollinated by other flowers. Soybeans have perfect flowers! Try this activity to see how flower parts play a role in creating more soybean plants!
Activity Instructions

1. Cut out the “Perfect” Pollination Flower image on the next page.
2. Empty cheetos into your brown paper bag.
3. Begin eating your cheetos, but DO NOT LICK YOUR FINGERS!!!
4. Use the flower diagram on the other side of the card to label the stamen, pistil, flowers and sepals on your blank flower cutout.
5. Continue eating your cheetos, but DO NOT LICK YOUR FINGERS!!!
6. Use the glue stick to attach the flower to one side of the bag.
7. Continue eating your cheetos, but DO NOT LICK YOUR FINGERS!!!
8. Look at your dirty fingers, then at your flower on your bag. Notice anything?

Check for Learning

Most likely, there is cheeto dust smeared on your flower picture, and you have just modeled pollination! Check your understanding by answering below:

1. The ____________ represented the pollen.
2. The ____________ represented the insect or wind that does the work of pollination.
3. Why is pollination important for soybeans?
Print and cut loosely around the edges of this flower to prepare for the “‘Perfect’ Pollination” activity.
**Objective**

Measure the amount of energy in a soybean

**Time**

45 minutes

**You Will Need**

- 1 nut (Pecan, Cashew or Almond)
- 1-2 soybeans
- 1 Peanut
- 2 large paperclips
- stopwatch
- empty aluminum can
- water
- graduated cylinder
- small glass dish
- masking tape
- thermometer
- ringstand
- food or balance scale
- safety glasses
- grill lighter
- glass burner
- “Observation Log” & questions

**NE Science Standards**

SC5.4.2c, SC8.4.2.h

*Where do we get energy? The same energy that you get from food can be used for fuel. What is a biofuel? Biofuels are made from renewable resources like soybeans rather than non-renewable sources like crude oil and coal. How much energy can you get from a plant—a nut? a soybean? a peanut? Try this experiment to measure the energy.*
**Activity Instructions**

1. *Always wear safety glasses and use proper practices for dealing with an open flame. This activity should be carried out under the supervision of an adult.*
2. Construct the apparatus that you see on the other side of this card.
3. Fill the aluminum can with 50 mL of water, and place thermometer in can to record the temperature.
4. Arrange nut on the unfolded paperclip, which is taped to the glass dish. Measure the mass of these items together and record.
5. Place the nut and holder under the aluminum can (see figure 1).
6. Use the grill lighter to ignite the nut and start the stopwatch. The flame should reach the bottom of the can.
7. Monitor the temperature of the water, but do not allow thermometer to touch bottom of the can.
8. After the nut is completely consumed, record the temperature of the water and the burn time of the nut.
9. When can is cool to the touch (or using hot pads), discard water.
10. Repeat steps 3-9 with the soybean and peanut in the glass burner (extinguish at the longest nut/soybean time). For accurate results, be sure to remain the same distance away from the bottom of the can with your thermometer when taking the temperature.
11. Calculate which fuel (nut, soybean, peanut) produced the most energy by taking the change in temperature divided by the change in mass.

*This is an adapted activity from a 4H Agriscience Biotechnology Series. For more information and a more extensive activity see [http://ideabin.org/wp-content/uploads/2013/10/4HBiomassToBiofuel.pdf](http://ideabin.org/wp-content/uploads/2013/10/4HBiomassToBiofuel.pdf)*
**Observation Log**

<table>
<thead>
<tr>
<th>Fuel: Nut (Pecan, Cashew or Almond)</th>
<th>Initial</th>
<th>Final</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°C) of water in can</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combined mass of fuel (g) holder, glass dish</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time (min.)</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fuel: Soybean</th>
<th>Initial</th>
<th>Final</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°C) of water in can</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combined mass of fuel (g) holder, glass dish</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time (min.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fuel: Peanut</th>
<th>Initial</th>
<th>Final</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°C) of water in can</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combined mass of fuel (g) holder, glass dish</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time (min.)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Compare change in mass to change in temperature.**

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Change in Temperature °C</th>
<th>Change in Mass</th>
<th>Temperature °C Change in Mass (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nut</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soybean</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peanut</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Look at the data.

Per gram of fuel, which was most effective at heating water?

Which fuel was most efficient (burned the greatest percentage of its own mass)?
Objective

- Compare/contrast oil and water
- Observe changes in matter
- Understand that plant oils have different fatty acids

Time

30 minutes

You Will Need

- safety glasses
- glass measuring cup
- plastic wrap
- microwave
- stir stick
- a mold (special soap molds, wooden box, pvc pipe, etc.)
- 1-5 lbs glycerin* soap base (sold at craft stores; in bars, shredded or flakes)
- Optional: fragrance oils, food coloring
- 1 soybean seed
- spoon
- dark colored napkin or paper towel
- Soybean Utilization Poster (http://www.ccur.iastate.edu/education/soyposter.pdf)

Soap made from soybeans? Plant oils have important “fatty acids” that determine the characteristics of your soap -- is it creamy, bubbly, hard or soft? Originally, soap was made only from animal oils until the conditioning and moisturizing properties of plant oils were discovered. Try this easy, melt-and-pour recipe to put soybean chemistry to work, and create your own soap.

*This is an adapted activity from a 4H Agriscience Biotechnology Series. For more information and a more extensive activity see http://ideabin.org/wp-content/uploads/2013/10/4HSoysoap.pdf
**Activity Instructions**

1. Always wear safety glasses and use proper practices for dealing with hot liquids.
2. Put enough soap base into the measuring cup to fill your mold when melted.
3. Microwave the soap base for one minute, or until you can use the stir stick to stir it into a liquid.
4. Optional: Add 1-2 drops of fragrance oil and/or food coloring. Stir.
5. Pour the mixture into the mold(s), and set the molds in the refrigerator or somewhere they won’t be disturbed for approximately 3 hours.
6. Once the mixture hardens, remove the bar(s) of soap from the mold(s). If difficult to remove, put the mold in the freezer for 30 minutes, and try again.
7. Test your soap!
8. Take a soybean and on a dark colored napkin or paper towel, use the back of a spoon to lightly crush the bean.
9. Look for and touch the crushed seed to detect the presence of the oil contained in the soybean.
10. Review the Soybean Utilization Poster and find all the ways that soybean oil is used.

**Check for Learning**

1. How did heat affect the state of the soap base?

2. Some oils – like those in glycerin made from soybeans - have properties that attract particles but repel water. Why is that useful in soap?

3. What other products are made with refined soybean oil?
Surrounded by Soy

Objective
Understand how by-products of soybeans are used in products we interact with every day

Time
20 minutes

You Will Need
• 2 Tbsp cornstarch
• 2 Tbsp water
• 4-5 drops of soybean oil (vegetable oil)
• 3-4 drops of food coloring
• 1 re-sealable plastic bag
• microwave

NE Science Standards
SC5.2.1d, SC8.2.1.c, SC12.2.1.c

Look around you! Chances are that there are several things nearby that may not look like a soybean, but just might be made from soybean by-products. A by-product is a secondary use for a product. Although they aren’t the original use, by-products can be very valuable. Did you know that soy is used to make soaps, cleaners, food, inks, candy, putty, fuel, paint and even plastic? In this activity, a little soy will go a long way in helping you make your own plastic!
Activity Instructions

1. Place 2 tablespoons of cornstarch in the bag
2. Add 2 tablespoons of water, 4-5 drops of soybean oil, and 3-4 drops of your favorite food coloring.
3. Seal the bag completely, and knead the mixture for 3 minutes.
4. Unzip a small opening for a vent. Place the mixture in the microwave for 30-40 seconds. Use caution when removing hot bag from microwave!
5. Once cool, take the bag out of the microwave and check out your very own homemade plastic!

Check for Learning

1. What is a by-product?

2. Name three by-products made from soybeans.
Objective

- Observe the life cycle of a soybean plant
- Depict stages of the life cycle by drawing

Time

10 minutes each day

You Will Need

- “Life Cycle” handout
- 1-2 soybean seeds
- small pot/container w/ soil
- light source (lamp or sun)
- water for plant
- roll of paper
- crayons/colored pencils/markers
- magnifying glasses
- tape (optional)

NE Science Standards

All living things go through different stages of development in their life span. A new life cycle begins when all of the stages are completed, and the stages start to repeat.

The soybean cycle begins when the seed germinates (sprouts), and is followed by vegetation (plant growth), reproduction (flowering, pollination, fertilization), and Bean Pod (seed forms and matures) stages. From here the dormant seeds in the pods can be harvested and used for feed and other soy by-products or can be replanted to begin the cycle again!
Activity Instructions

1. On the left edge of the paper, draw a picture of what the seed(s) look like.
2. Plant the soybean seeds 2 inches apart and ½ inch deep in the soil. Wet the soil as needed when it begins to dry out.
3. After about 3 days, observe the seed (even if you have to gently dig it up, then bury it back under the soil). Draw what you see on the roll of paper, and label it with a date. Did germination occur?
4. After germination, observe, date and draw the plant on a weekly basis. Use the information on this card and the “Life Cycle” handout to label the stages on the timeline.
5. Once the plant flowers and pods are filled, stop watering when the leaves turn yellow and/or drop.
6. When the plant dries out, harvest the pods, and take out the seeds. One cycle is complete! Optional: Using tape, attach one side of the time line to the other in order to represent the cyclic nature of these processes.
7. For Best Results: Start your seed in pots and move outside in full sun, but bring inside anytime the air temperature is expected to be 40 degrees F or lower. A
8. Back Up Plan: If you experience trouble growing your plant, use one of these YouTube® videos: https://youtu.be/reuggGLBmWo, http://prairiecalifornian.com/soybean-growth-stages/, or other available resources to complete the activity.

Check for Learning

1. Name and describe the stages of development in the soybean life cycle.
2. Compare these stages to the stages of development of humans.
Hoop it Up for Predicting Soybean Yields

Objective
Predict potential yields of an acre of soybeans

NE Science Standards
5.1.2.b, SC8.1.2.b, SC12.1.2.b

Time
20 minutes

You Will Need
• 1 hula hoop
• 1 meter stick

Yield refers to the amount of soybeans harvested in one acre of land. The more soybeans harvested, the higher the yield! Soybean yields have increased by a lot over the last 100 years thanks to better farming practices, equipment, and other new technologies. In 1924 U.S. soybeans yielded 11 bushels per acre, and sold for $2.50. In 2013 soybeans yielded 43 bushels per acre and sold for $12.70.

Soybean producers have a lot of tough decisions to make! For example, if crops are damaged early in the growth stages, farmers must decide if they should replant the field. They must consider how much it will cost for seed, fuel, fertilizer, pesticides, and other inputs for the second time. Will the financial gain outweigh the cost? A yield prediction can help!
Hoop it Up for Predicting Soybean Yields

Activity Instructions

1. Measure the diameter of the hula-hoop.
2. Toss the hula-hoop like a Frisbee into the soybean field, and watch carefully to see where it lands.
3. Count the number of plants within the hula-hoop, and complete the following calculations to predict the soybean yield for that acre.
4. Assume that approximately 6,500 hula-hoops would fit in one acre. 
   _________ (# of plants in hoop) X 6,500 = _______________ plants per acre
5. If each plant produces about 50 beans, how many will this acre produce? 
   ______________(# of plants per acre) X 50 beans = _______________ soybeans per acre.
6. About 1500 soybeans weigh one pound (lb). How many pounds of soybeans will this field produce? 
   ___________ (# of soybeans) divided by 1500 = _________ lbs of soybeans.
7. If one bushel of soybeans weighs 60 pounds, how many bushels (bu.) will this field produce? 
   ____________ (lbs. of beans) divided by 60 = ____________ bu. of soybeans.

Check for Learning

1. What factors might impact the yield of this field?
2. How would the price that beans sell for impact a decision to replant?
Comparing Cousins

Objective

Compare and contrast metric measurements of soybeans between Argentina and US

Time

30 minutes

You Will Need

• approximately 150 soybeans (or other easily counted pieces)
• 2 large cups (representing grain trailers pulled by a semi truck)
• calculator (optional)

NE Science Standards

SC5.2.1c, SC8.1.2.c, SC12.1.2.a

Your cousin from Argentina is visiting, and while she is talking about soybeans in her country, you notice she keeps using words you don’t understand. Hectare? Kilograms? It turns out that many other countries use a different system of measurement called the Metric System. So instead of “pounds”, she says “kilograms”, and instead of “acres”, she says “hectares”. This activity will give you (and your cousin) practice converting from our customary system to the metric system, and back again!

1 pound (lb) = .45 kilograms (kg)
1 acre (ac) = .4 hectares (ha)

You could also say...

2.2 pounds (lbs) = 1 kilogram (kg)
2.5 acres (ac) = 1 hectare (ha)
Activity Instructions

1. Using your soybeans or other countable pieces, construct a rectangular field that is 1 hectare. A hectare is 10 meters long by 10 meters wide. **1 soybean represents one square meter.**
2. Using the field that you just constructed, and the information on the other side of this card, construct another rectangular field that is the equivalent of 1 acre. Again, **1 soybean represents 1 square meter.**
3. Now assume you harvested your soybeans and are loading them into a grain trailer pulled by a semi truck (represented by 1 large cup) that can hold about 80,000 pounds. **Fill one cup with 80 soybeans showing that 1 soybean represents 1,000 pounds.**
4. Using the information in Step 3, and the information on the other side of this card. Fill your second cup with the correct number of soybeans if **1 soybean equals 1,000 kilograms.**

Check for Learning

1. Circle which measurement label has more mass? 1 kg or 1 lb
2. Circle which has a larger area? 1 ha or 1 ac
3. If your field averages 40 bushels per acre, how many bushels would you get in one hectare?
Discovering DNA

Objective
Model DNA extraction similar to that used in soybean technology

Time
40 minutes

You Will Need
- 10 mL graduated cylinder
- 29 mL or larger graduated cylinder
- distilled water
- 10 g (2 teaspoons) table salt
- 10 mL drinking water
- 2 - 250 mL beakers or glass
- liquid dish soap (Ivory, Dawn, etc.)
- paper cups
- 1 large (50 ml) test tube w/ cap
- 1 small (1.5 ml) test tube w/ cap
- rubbing alcohol (90%)
- wood stick or wire w/ hook

DNA is found in every cell of every living thing, and it gives the instructions on how the organism should be built. Since soybeans are living organisms, they have DNA, too! Since DNA was discovered in the 1950s, scientists have come up with many new technologies that have improved farming practices!

Did you know that “Roundup Ready Soybeans” are a type of bean in which scientists have added DNA from a bacterium to the DNA of the plant? Why would they do this? While Roundup® herbicide will stop the growth of many plants, it has no negative impact on this bacteria. Roundup® would typically harm soybeans, but by putting the bacterium’s DNA into the soybean DNA, farmers can spray Roundup® on their fields to kill the weeds, but not the soybeans. Fewer weeds mean healthier soybeans, and more of them, too!

In this activity, you will “extract” or remove some of your own DNA, just like scientists do so that they can work with it, and learn more about it!

This activity was adapted from http://www.monsanto.com/whoweare/pages/dna-extraction.aspx

NE Science Standards
SC5.3.4a, SC8.3.4.a, SC12.3.4.a
Activity Instructions

1. Make the “Extraction Fluid A” by combining 90 mL of distilled water and 10 g (2 tsp) of salt in one of the beakers. Set aside.
2. Make “Extraction Fluid B” by combining 75 mL of distilled water and 25 mL of liquid dish soap. Set aside.
3. Make “Extraction Fluid C” by pouring 2-3 mL of rubbing alcohol into the small test tube. Set aside.
4. Measure 10 mL of drinking water into a paper cup. Put the water in your mouth and swish it around forcefully for about 45 seconds to release cells from the inside of your cheek. Spit the water into the large test tube.
5. Add 1 mL of the “Extraction Fluid A” to the large test tube. Cap the tube and gently mix for 10 seconds.
6. Add 1 mL of “Extraction Fluid B” to the large test tube. Recap the tube and gently mix for 10 seconds.
7. Let the mixture in the large test tube sit for 1-2 minutes.
8. Add 2-3 mL of the “Extraction Fluid C” to the large test tube by tilting the tube and allowing the fluid to run down the side. DO NOT MIX!
9. Observe for 30-60 seconds. The mixture should separate into a watery layer on the bottom, an alcohol layer on the top, and a cloudy, stringy mixture in the middle—This is the DNA!
10. Use the wooden stick or wire to carefully draw the stringy DNA out of the test tube and observe. This is actually millions of DNA fragments clumped together!

Activity Bonus:
If you would like to preserve your own DNA sample, place the string DNA in a tiny test tube or container that is filled with rubbing alcohol, and cap it. You can even attach a string to make your own DNA necklace or bracelet!
What’s in a Soybean

**Objective**
Determine the presence of lipids, proteins, and carbohydrates in a soy product.

**Time**
30 minutes

**You Will Need**
- 8 test tubes
- Test tube rack
- 10 mL graduated cylinder
- Soybean oil
- Biuret solution for protein test
- Benedict solution for sugar test
- Sudan red solution for lipid test
- Water
- Beaker/glass
- Hot plate/stovetop

**NE Science Standards**
SC5.1.a,c,d,e; SC8.1.b,d; SC12.1.b

Humans, as well as all other living things, are made up of structures called proteins, carbohydrates (sugars and starches), and lipids (fats). As we go about our daily activities, our bodies are constantly building more of these structures. How do you think we do that? We eat! Different foods have different combinations of these structures, and after digestion, our bodies can use them. **Proteins** make up muscles, hair, enzymes and more. **Carbohydrates** give your body energy. **Lipids** also give the body energy, hold cells together, and help the nervous system.

Soybeans are used in many food products, too! In this lab, we will be testing soy food products for the presence of proteins, sugars, starches, and lipids.
Activity Instructions

1. Always wear safety glasses and use proper practices for dealing with hot liquids. Some solutions may stain clothing or skin.

2. Put 2-3 mL of soybean oil in 4 of the test tubes, and put 2-3 mL of water in the other 4 test tubes. The water is called the “control” and is compared to the changes in the soybean oil. In all cases, the water should not turn color.

3. **Protein Test.** Add 2-3 mL of Biuret solution to 1 soybean oil tube and 1 water tube. If protein is present, the combined solution will turn purple or pink. Compare the soybean test tube to the control (water only).

4. **Lipid Test.** Add 2 more mL of water to 1 new soybean oil and 1 new water test tube. Then add 2-5 drops of Sudan red solution to both tubes. If lipids are present, the solution will turn red. Compare the soybean test tube to the control.

5. **Sugar Test.** Bring water in a glass beaker to a boil. Add 1 mL of Benedicts solution to 1 new soybean and 1 water test tube. The solution will look blue. Place the test tubes inside the beaker with water for about 3 minutes. If simple sugars are present the solution will turn brick red. Compare the soybean test tube to the control.

Check for Learning

1. Which important structures listed earlier can be found in soybean oil?

2. How can these structures be used in your body?
Objective
Understand how soy plays an important role in the food chain

Time
20 minutes

You Will Need
- 2 teams in which students represent:
  - 1 human
  - 2-3 pigs
  - 3-6 soybean plants
- 1 large bucket w/ water
- small cups (1 for each soybean plant)
- medium cups (1 for each pig)
- large cups (1 for each human)
- permanent markers for labeling
- Optional: cooked bacon (or other snack)

NE Science Standards
5.3.3a, SC8.3.3.a

Although we eat many soy products ourselves, one of the main uses for soybeans is in animal feed. At first glance, you might think that what animals eat doesn’t have anything to do with you until you take a closer look at how matter and energy flow from one organism to the next in a food chain. Nutrient-rich plants are eaten by animals, animals convert those plants into energy to grow, and then we eat them. At each step of the food chain, some of the nutrients and energy are passed into the organism that is consuming (eating) the other. Speaking of energy, this activity will definitely get you going as you learn more about a simple food chain involving soy!
Activity Instructions

1. Consider doing this activity outdoors or where it is safe to spill water.
2. Divide into two teams according to the breakdown in the “you will need” section. Give all participants the correct size of cup according to their roles. Use permanent markers to label the soybean cups as “feed,” and the pig cups as “bacon.” Label the human cups as “breakfast.”
3. The bucket filled with water represents the sun and the energy it gives to the soybean plants. It should be placed on one end of the activity space. Label it “Energy.”
4. Place the people representing the soybean plants near the bucket.
5. Place the people representing the pigs in a horizontal line, 15-20 feet from the bucket.
6. Place the two humans 30-40 feet from the bucket (15-20 feet behind the pigs).
7. On “go,” the soybeans fill their cups with energy/water, run over to one of the pigs on the same team, and dump the water into the pig’s cup. Repeat this process, but don’t go to the same pig twice in a row.
8. When a pig’s cup is full, the pig runs to the human on the same team to dump the cup. Repeat this process until the human’s cup is full to the brim, and yells, “I am full!”
9. The team with the first human to yell, “bacon,” gets to eat real bacon (or some other snack) first!

Check for Learning

1. How are the majority of soybeans used?
2. Explain how soybeans are related to bacon. What is this relationship called?
Harvesting Headaches?
Not Anymore!

Objective
Identify parts of the combine responsible for solving problems within soybean harvest

Time
15 minutes

You Will Need
• Combine handout

NE Science Standards
SC5.1.3.a, SC8.1.3.a

Problem: There are several steps that must be taken in order to prepare soybeans to be utilized in animal feed, biodiesel, tofu, infant milk or any other useful product. Each step presents another problem to address with another solution. In ancient times, many of these steps were done by people, but it was extremely time consuming! Today, it would be not be possible to harvest so many acres by hand, nor could a farmer be able to afford to have it done! Take a look at these early methods for harvesting and preparing crops. Can you draw a line from each problem to the correct solution?

1. Gather and cut the crop from the stem.
2. Remove from field to preparation site.
3. Break the bean pod open.
4. Separate the soybean seed from pods and stems.
5. Catch the seed.
Activity Instructions

Solution: Can you think of a single, modern piece of equipment that addresses all five steps on the other side of this card? If you said combine, you’re right! Technologies such as the combine have drastically decreased the time and money that must be spent to harvest crops! New technologies are being developed all the time that help farmers measure yields on the go, make maps, and much, much more!

See if you can match the same five “problems” from before to their “solutions” within the combine picture by drawing a line.

1. Gather and cut the crop from the stem.
2. Remove from field to preparation site.
3. Break the bean pod open.
4. Separate soybean seed from pods and stems.
5. Catch the seed.

For extra help go to http://www.explainthatstuff.com/howcombineharvesterswork.html
Harvesting Headaches? Not Anymore!
An agronomist is someone who works with plants to produce food, fiber (cloth, paper, rope, etc), fuels or any other by-product. Agronomists are often hired by companies or farmers to advise on the best practices to use in order to accomplish their goals. For most farmers, high yields (more of the crop) are important in making a profit. Yield, however, is not the only trait that must be considered. Stress tolerance (lack of water, hot/cold temperatures, insects, etc), disease tolerance, days until mature, and how likely the seed is to germinate and emerge above the soil are all important factors to weigh when choosing which variety of seed to buy, and which practices to use. In this activity you will have the opportunity to be the agronomist and recommend different varieties to different customers based on their needs!
Activity Instructions

1. Read the traits for three different varieties of soybeans below. E=Excellent, G=Good, F=Fair, P=Poor
2. In the “Check for Learning” section on this card, rank the three soybean varieties for each situation. 1=First Choice, 2=2nd Choice, 3=Third Choice
3.

<table>
<thead>
<tr>
<th>Variety A</th>
<th>Variety B</th>
<th>Variety C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield: E</td>
<td>Yield: E</td>
<td>Yield: G</td>
</tr>
<tr>
<td>Stress Resistance: E</td>
<td>Stress Resistance: F</td>
<td>Stress Resistance: G</td>
</tr>
<tr>
<td>Disease Resistance: F</td>
<td>Disease Resistance: F</td>
<td>Disease Resistance: F</td>
</tr>
<tr>
<td>Emergence: G</td>
<td>Emergence Score: E</td>
<td>Emergence: G</td>
</tr>
<tr>
<td>Days to Maturity: 100</td>
<td>Days to Maturity: 100</td>
<td>Days to Maturity: 85</td>
</tr>
</tbody>
</table>

Check for Learning

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Variety (A,B,C)Rankings</th>
</tr>
</thead>
</table>
| **Farmer Brown** wants to plant 320 acres of soybeans. The field is irrigated (uses a pivot to water the crops)** | 1st Choice: Variety ________  
2nd Choice: Variety ________  
3rd Choice: Variety ________ |
| **Farmer Green** wants to replant 80 acres of irrigated soybeans after a hail storm destroyed the crop.** | 1st Choice: Variety ________  
2nd Choice: Variety ________  
3rd Choice: Variety ________ |
| **Farmer Grey** wants to plant 640 acres of dryland (non-irrigated) soybeans.** | 1st Choice: Variety ________  
2nd Choice: Variety ________  
3rd Choice: Variety ________ |

What characteristics did you look at to determine your choices?
Fact or Myth

Objective
Determine the difference between myths and facts when it comes to discussions surrounding biotechnology.

Time
30 minutes

You Will Need
- computer with internet to access https://youtu.be/L9tlirsBNg4
- “Fact or Myth” worksheet

NE Science Standards
SC5.1.2 a,b; SC8.1.2 a, b; SC12.1.2 a, b, c

Biotechnology is the application of living organisms to develop new products or improve existing ones. Current biotechnology methods, which allow the transfer of a gene from one organism to another, involve the same basic scientific processes — crossbreeding and fermentation — that people have used for centuries to increase crop productivity, improve the food supply and produce better foods. Genetically modified organisms (GMOs) is a commonly referred to term when discussing biotechnology. GMO means that a change has been made to the DNA of an organism. There is a lot of information available on biotechnology, but not all of is reliable. The purpose of this activity is to help you separate FACT from MYTH, so that you can make an INFORMED decision for yourself!
1. Merriam-Webster Dictionary for Kids defines fact as “some thing that has truly happened or exists,” or “a true statement.” It also defines myth as “a popular belief that is false or unsupported.”


3. Fill out the “Fact or Myth” worksheet as you watch the video.
**Fact or Myth**

Copy down information from the video under the correct heading.

<table>
<thead>
<tr>
<th>FACT</th>
<th>MYTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Some thing that has truly happened or exists; a true statement.”</td>
<td>“A popular belief that is false or unsupported.”</td>
</tr>
</tbody>
</table>