A Priceless Collection

Grades 6-8

English Language Arts, Science

Objectives

Students will read a dramatic story about the Russian plant breeder, Nikolai I. Vavilov, who faced starvation during World War II to protect a valuable collection of seed potatoes and other seed crops. Students will learn about present-day seed banks and their importance in maintaining and improving crops. Students will experiment with seed germination and record their observations.

Vocabulary

breeder—someone who develops new or improved strains in plants, chiefly through controlled mating and selection of offspring for desirable traits
gene—a part of a cell that controls or influences the appearance, growth, etc., of a living thing
gene bank—a place where seeds are preserved under dry, cool conditions and where other plant materials are kept in test tubes or in field collections
gene pool—all of the genes in a particular group of people or animals
genetic erosion—the loss of genes from a gene pool due to the elimination of populations
genotype—the distinct and unique combination of genes in an organism
hybrid—an animal or plant that is produced from two animals or plants of different kinds

Background

There are tens of thousands of edible plant species in the world, but only about 150 species have been cultivated. The world depends on only about 30 crop species for 95 percent of its food. Three crops—wheat, rice and maize (corn)—account for over 75 percent of our cereal consumption.

The diets of prehistoric peoples were much more varied than our own. Prehistoric peoples found food in over 1,500 species of plants and cultivated at least 500 vegetables. Medieval Europeans grew carrots in a rainbow of colors—purple, yellow, white, and orange. Well before the 20th Century, all but the orange ones had disappeared, although carrots in some other colors have now begun to appear on some grocery shelves. Early American farmers planted many more varieties of vegetables than their modern counterparts. Thomas Jefferson grew 250 varieties.

Early farmers had to plant a dozen or more varieties of each crop with the hope that something would make it to harvest through drought, flood, disease, or anything else that happened during the growing season. The development of pesticides, chemical fertilizers and farm machinery in the 1920s gave farmers more control over growing conditions and allowed them to grow more food on less land.

Farmers found they could make more money through monoculture—planting only one crop. This practice allowed farmers to feed more people on less land, but it also contributed to **genetic erosion**—the loss of **genes** from a **gene pool** due to the elimination of populations. A plant's genes are responsible for all the many things about it that make it different from other plants. Some plants are taller than others; some hold onto their seeds longer; some can withstand hotter weather; some produce fruit faster than others.

A **genotype** is the distinct and unique combination of genes in an organism. Plant **breeders** worry about genetic erosion because they use the genetic material found in plants to improve the crops that provide us with the food we eat. Some improved crop varieties produce more food on less land. This is a very important improvement in today's world, with the human population growing larger and the amount of land available for growing food growing smaller. Other improved varieties are more resistant to insects and diseases. Some are improved to provide more of the nutrients we need to stay healthy.

In 1970, an outbreak of southern corn leaf blight destroyed a large portion of the American corn crop. By the following year, American farmers were able to buy varieties that were resistant to this disease. Using genetic materials from **gene banks** in the US, Argentina, Hungary, and Yugoslavia, plant breeders were able to develop blight-resistant **hybrids** before spring planting in 1971. A gene bank is a place where seeds are preserved under dry, cool conditions and where other plant materials are kept in test tubes or in field collections. Gene banks store samples of primitive or traditional plant varieties, more recent varieties that are no longer in use and related wild species. Field gene banks are natural preserves where plants, including their wild relatives, are maintained in their natural habitats.

The Russian geneticist and plant explorer Nikolai I. Vavilov was a pioneer in the establishment of gene banks. Vavilov was interested in the potential of wild relatives of crop species for improving agriculture. He conducted expeditions in the former USSR (now Russia) and in over 50 countries in Asia, the Americas, Northern Africa, Europe and the Mediterranean during the 1920s and '30s. He collected over 50,000 seed samples of wheat, rye, oats, peas, lentils, beans, chickpeas, and maize. This large collection of plants and close relatives from afar provided the foundation for the establishment of modern gene banks in the Soviet Union.

Vavilov helped form a network of 400 research laboratories, employing 20,000 employees. These laboratories did extensive research with precious seed collections. Other countries followed suit by establishing their own seed banks. During the 1930s seed banks were set up in the United States, England, Germany and Sweden. In the US today, the Plant Genetics and Germplasm Institute of the Agricultural Research Service (US Department of Agriculture) maintains seed banks for many crops.

Almost all the domesticated plants used today for food and agriculture were domesticated in what are called centers of origin. In these centers there is still a great diversity of closely related wild plants, so-called crop wild relatives, which can also be used for improving modern cultivars by plant breeding.

On a smaller scale, individuals around the world have created their own heirloom seed repositories. While some plant nurseries market heirloom seeds, serious gardeners will tell you the best source for plants adapted to your area are the local "seed savers". These gardeners have saved seed from the strongest open-pollinated plants in the garden or flower bed to create their own well adapted varieties.

While there is no universally accepted definition of heirloom seeds and plants, key components usually include seeds that have been in use for at least three generations, some use 1950 as a starting point. Some seeds have genuine family history, like The Bidwell Casaba melon is named for Civil War general and U.S. Senator John Bidwell, who got the seeds from the USDA in 1869. Seeds from the Cream of Saskatchewan watermelon were brought to their namesake Canadian province by Russian immigrants because this variety does well in cool, northern climates. The Dester tomato seeds can be traced to a Missouri farmer, who received them from an Amish woman, who received them from a doctor, whose family brought them from Germany.

If you think about packing up your entire life and moving to a new country, what would you take? Important papers, clothes, medicine, and photos, but seeds?! When gardeners of the past took their seeds across borders, they risked breaking the law. To hide the seeds from officials, they were sewn into the hems or hidden behind the lining of a suitcase. Think about that. Seeds were that precious. Farmers and gardeners held onto their heritage through those seeds. Even though the view from their kitchen window was different, the plants in their gardens and the food on their table gave them a sense of home.

As heirlooms have been handed down from generation to generation they've become adapted to specific places and climates. They've evolved natural defenses to certain diseases, pests, and weather patterns. They can also continue to adapt to different localities.Each heirloom variety is a piece of living history. They tell the story of the people who grew them and the places they farmed. Keeping these varieties alive maintains a connection to cultural roots, ancestral ways, and the earth.

Additional Reading

Bramwell, Martyn, *Food Watch: Protecting Our Planet*, DK Children, 2001.
Foust Prater, Lisa, *Heirloom Seeds Have Rich History*, Successful Farming, 1/30/2020.
Gallo, Maria and Dohle, Sarah, Delaware Valley University, *Why is it important to have seed banks and seed access?*, Sustainable, Secure Food Blog, August 7, 2018.
Hawkes, Nigel, *Genetically Modified Food*, Copper Beech, 2000.
Hesser, Leon, *The Man Who Fed the World: Nobel Prize Laureate Norman Borlaug and His Battle to End World Hunger*, Durban House, 2006.
Juettner, Bonnie, *The Seed Vault (Great Idea)*, Norwood House, 2009.
Peres, Sara, *Saving the gene pool for the future: Seed banks as archives*, Studies in History and Philosophy of Biological and Biomedical Sciences, Volume 55, February 2016, Pages 96-104
Reich, Lee, *With Heirloom Seeds, You're Planting History in Your Garden*, Denver Post, 4/28/2017
Simpson, Kathleen, *Genetics: From DNA to Designer Dogs*, National Geographic, 2008.

Websites

www.seedsavers.org
https://www.monticello.org/site/house-and-gardens/thomas-jefferson-center-historic-plants
https://www.cbsnews.com/news/doomsday-vault-cherokee-nation-first-u-s-tribe-preserve-seeds-arctic-svalbard-norway/

Activity 1: Importance of Gene Banks, (ELA) 1 50 minute class period

Students will gain vocabulary and research skills while learning about the role of seed/gene banks in preserving the food supply as well as culture.

Oklahoma Academic Standards

Activity 1: Importance of Gene Banks (ELA)

6.4.R.1 7.4.R.1 8.4.R.1	Students will increase knowledge of academic, domain-appropriate, grade-level vocabulary to infer meaning of grade-level text.
6.4.R.5 7.4.R.5 8.4.R.5	Students will use a dictionary, glossary, or a thesaurus (print and/or electronic) to determine or clarify the meanings, syllabication, pronunciation, synonyms, and parts of speech of words.
6.6.R.2 7.6.R.2 8.6.R.2	Students will record and organize information from various print and/or digital sources.
6.6.R.3 7.6.R.3 8.6.R.3	Students will determine the relevance and reliability of the information gathered.

Materials:

- Activity 1 Reading Page 1 "**Importance of Gene Banks"**
- Activity 1 Worksheet 1 "**Vocabulary"**
- Activity 1 Worksheet 2 **"Seed Bank Locations"**

Procedures

1. Read and discuss background and vocabulary.
2. Write the following terms on the chalkboard: "gene;" "gene pool;" "genotype;" "genetic erosion;" "gene bank;" "hybrid;" "plant breeder." Discuss their meanings.
3. Students will read the information on Activity 1 Reading Page 1 "**Importance of Gene Banks"** and then answer the questions Activity 1 Worksheet 1 "**Vocabulary,"** and Activity 1 Worksheet 2 **Seed Bank Locations."**
4. When students have completed the worksheet, use the questions to lead a classroom discussion on the importance of gene banks.
5. Students will conduct online research or library references to find information about the seed banks listed on Worksheet 2 **"Seed Bank Locations."**

Extinction of a plant or animal, due to natural or man-made factors is a serious concern. Once a plant or animal is gone, we have lost them forever. Seed banks are used to help prevent losing plants to extinction. Seed banks also allow for faster recovery from a natural disaster. It seems as if almost every day we hear about oil spills, wildfires, hurricanes, earthquakes and flooding. These events can lead to huge losses of plant life in the blink of an eye.

A seed bank is a type of **gene bank.** A gene bank is a place where seeds are kept safe under dry, cool conditions. Plant materials are also kept in test tubes or in field collections at gene banks. Gene banks store samples of traditional plant varieties, more recent varieties that are no longer in use, and related wild species. Field gene banks grow plants, including their wild relatives, in their natural habitats. These gene banks provide plant **breeders** with the samples they need to improve food crops so we will continue to have plenty to eat. There are seeds and plants kept in gene banks all over the world.

A **genotype** is the unique combination of genes in an organism. Plant breeders worry about **genetic erosion** because they use the genetic material found in plants to improve the crops that provide us with the food we eat. Some improved crops produce more food on less land. Genetic erosion is the loss of **genes** from a **gene pool** due to the elimination of plants. A gene pool includes all of the genes in a group of people or animals. Improved varieties, including **hybrids**, can be more resistant to insects and diseases. Some are improved to provide more of the nutrients we need to stay healthy. Hybrid plants are made from two plants of different kinds. Genes are a part of a cell that control the plants appearance, growth, etc. Genes make one plant different from another plant. Some plants are taller than others. Some plants hold onto their seeds longer. Some plants can tolerate hotter weather. Some plants produce fruit faster than others.

In 2017, Hurricane Maria caused severe crop loss in Puerto Rico. The loss of crops from hurricanes is a problem for food and economic security in any location. But on an island, where soil and weather create very unique and specific growing conditions, the situation is even more serious. Replacing crops quickly is an important goal in island recovery. Having access to usable seeds that are able to grow in a climate quickly is part of this recovery. There was a clear need for seeds for Puerto Rican growers following Hurricane Maria. The University of Puerto Rico Extension Service responded by quickly distributing an estimated 8,000 pounds of donated seed. The seeds went to small-scale farms, community gardens, and individuals across the island. Within weeks of getting the seeds, growers were selling seedlings and microgreens. Home gardeners, retirees, career growers, and school children all received donated seeds to jump start their produce production on the island. Without seed banks from a similar climate to draw from, Puerto Rico would have started over with seeds that were not well adapted to their growing conditions. Then their path to recovery would have been more difficult.

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Activity 1 Worksheet 1: Vocabulary

Name: _____ Date: _____

Match the word on the left with the definition on the right.

A. breeder

B. gene

C. gene bank

D. gene pool

E. genetic erosion

F. genotype

G. hybrid

___ a place where seeds are preserved under dry, cool conditions and where other plant materials are kept in test tubes or in field collections

___ the loss of genes from a gene pool due to the elimination of populations

___ the distinct and unique combination of genes in an organism

___ an animal or plant that is produced from two animals or plants of different kinds

___ someone who develops new or improved strains in plants, chiefly through controlled mating and selection of offspring for desirable traits

___ all of the genes in a particular group of people or animals

___ a part of a cell that controls or influences the appearance, growth, etc., of a living thing

A Priceless Collection

Activity 1 Worksheet 1: Vocabulary

ANSWER KEY

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Match the word on the left with the definition on the right.

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C a place where seeds are preserved under dry, cool conditions and where other plant materials are kept in test tubes or in field collections

E the loss of genes from a gene pool due to the elimination of populations

F the distinct and unique combination of genes in an organism

G an animal or plant that is produced from two animals or plants of different kinds

A someone who develops new or improved strains in plants, chiefly through controlled mating and selection of offspring for desirable traits

D all of the genes in a particular group of people or animals

B a part of a cell that controls or influences the appearance, growth, etc., of a living thing

A Priceless Collection

Activity 1 Worksheet 2: Seed Bank Locations

Name: _____ Date: _____

There are more than 1,000 seed banks throughout the world. Using a larger world map, locate the seed banks listed below. Mark the spot on the map below and then draw a line to the institute name.

- National Seed Storage Laboratory (NSSL),
  Colorado State University
  Ft. Collins, CO, USA
- Camino Verde
  Concord, MA, USA and
  Puerto Maldonado, Peru
- Ethiopia Seed Bank,
  Addis Ababa, Ethiopia
- Native Seed/SEARCH
  Tucson AZ, USA
- Millennium Seed Bank Partnership
  Wakehurst, England
- Svalbard Global Seed Vault,
  Spitsenbergen, Norway
- N.I. Vavilov Research Institute of Plant Industry
  St. Petersburg, Russia
- International Center for the Improvement of
  Maize and Wheat
  Mexico City, Mexico

A Priceless Collection

Activity 1 Worksheet 2: Seed Bank Locations

ANSWER KEY

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- International Center for the Improvement of
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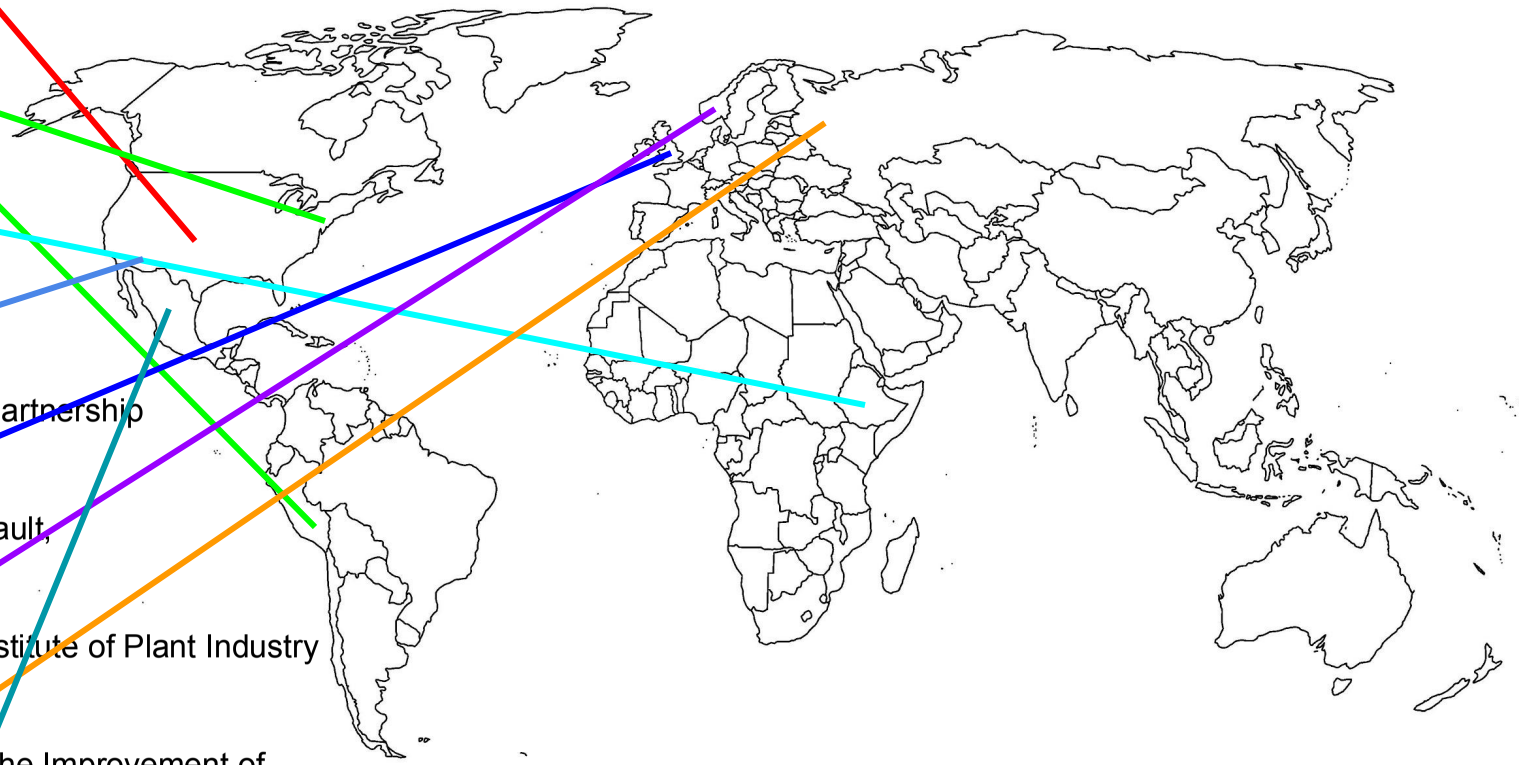


Activity 2: Heroic Seed Savers, (ELA) 1 50 minute class period

Students will gain vocabulary and research skills while learning about the role of seed/gene banks in preserving the food supply as well as culture.

Oklahoma Academic Standards

Activity 2: Heroic Seed Savers (ELA)

6.4.R.1 7.4.R.1 8.4.R.1	Students will increase knowledge of academic, domain-appropriate, grade-level vocabulary to infer meaning of grade-level text.
6.4.R.5 7.4.R.5 8.4.R.5	Students will use a dictionary, glossary, or a thesaurus (print and/or electronic) to determine or clarify the meanings, syllabication, pronunciation, synonyms, and parts of speech of words.
6.6.R.2 7.6.R.2 8.6.R.2	Students will record and organize information from various print and/or digital sources.
6.6.R.3 7.6.R.3 8.6.R.3	Students will determine the relevance and reliability of the information gathered.

Materials:

- Activity 2 Reading Page 1 "**Heroic Seed Savers"**
- Activity 2 Worksheet 1 "**Seed Banks"**

Procedures

1. Read and discuss background and vocabulary.
   —Write the name of the Russian geneticist Nikolai (nick oh lye) Vavilov (vah vee loff) on the board and pronounce it for students to hear.
2. Students will read the information on Activity 2 Reading Page 1 "**Heroic Seed Savers"** and then answer the questions on Activity 2 Worksheet 1 "**Seed Banks.**"
3. When students have completed the worksheet, use the questions to lead a classroom discussion on the importance of gene banks.
4. Students will research the Irish Potato Famine of the late 1840s.
   —What was the cause?
   —How might this tragedy have been prevented?

Read the following true story. Use the information to complete the student worksheet.

Nikolai Vavilov examining wheat herbarium specimen in 1930

A gene bank is a place where seeds and plants are preserved. There are collections of seeds and plant material kept in gene banks all over the world. These banks provide plant breeders with the samples they need to improve food crop varieties so we will continue to have plenty to eat.

One of the first gene banks was founded by the Russian scientist, Nikolai I. Vavilov. Vavilov was the first director of the Institute of Applied Botany and New Crops in Leningrad. During the 1920s and 30s, he conducted plant-hunting trips in the former Soviet Union and in more than 50 countries in Asia, the Americas, northern Africa, Europe, and the Mediterranean. He collected over 50,000 seed samples of wheat, rye, oats, peas, lentils, beans, chickpeas, and maize. By 1941 he had collected more than 187,000 specimens. He helped form a network of 400 research laboratories. Today this collection includes over 380,000 seed samples from more than 180 locations around the globe.

This important collection nearly ended during the World War II Siege of Leningrad. For 880 days Hitler's forces shelled the city. When shelling began, workers duplicated the most important specimens. This way they would not be destroyed. They knew that food would be in short supply after the war. They harvested potatoes to save as seed. Each eye on a potato can grow a new plant, so one potato can grow many new plants. With the help of the Russian army, they moved them to the basement to protect them from not only the shelling, but to provide a more stable temperature so the potatoes would not freeze. When winter arrived, there was little food and nothing left to heat the buildings which were still standing at the institute. To heat the basement where the potatoes were stored, workers burned boxes, paper, cardboard, and debris from the other buildings. Though half-frozen and starved, they continued to guard the precious potatoes.

Soon rumors spread through the bombed-out city that there were potatoes, rice, and other edible seeds stored at the institute. Security was tightened. An emergency plan was developed for removing the seed collection from the building. The collection was divided among 16 separate rooms.

No one was allowed to be alone inside any of the rooms. At least nine scientists and workers died from starvation rather than nibble away at precious seeds. Peanut specialist Alexander Stchukin died at his writing table. Dmitri Ivanov, the institute's leading expert on rice, died while keeping watch over several thousand packets of rice.

Vavilov was not present to watch these acts of heroism. He was in prison due to false claims by a rival scientist who wanted to be the director of the institute Vavilov had founded. On August 6, 1940, Vavilov was arrested while collecting specimens in Ukraine. He was questioned, charged with high treason and espionage, and sentenced to death. On January 26, 1943, he died of malnutrition in prison. After his death, the Soviet government honored him by renaming the gene bank the N. I. Vavilov All-Union Institute of Plant Industry. Known worldwide by the abbreviation VIR, the institute is still one of the most important of all the gene banks in the world.

A Priceless Collection

Activity 2 Worksheet 1: Seed Banks

Name: _____ Date: _____

Answer the questions below after you have read the information on the "Heroic Seed Savers" Reading Page.

1. Why are gene banks important?

2. Why did gene bank workers move potatoes to the basement of the Institute of Applied Botany and New Crops during the Siege of Leningrad?

3. Why was no one allowed to be alone in a room where the seeds were stored during the siege?

4. Explain why workers starved rather than eat the rice and potatoes stored at the institute.

A Priceless Collection

Activity 2 Worksheet 1: Seed Banks

ANSWER KEY

Name: _____ Date: _____

Answer the questions below after you have read the information on the "Heroic Seed Savers" Reading Page.

1. Why are gene banks important?

They protect and preserve plant varieties to prevent extinction and to serve as a source for replenishing seeds and plants after a natural disaster or disease wipes out a crop.

2. Why did gene bank workers move potatoes to the basement of the Institute of Applied Botany and New Crops during the Siege of Leningrad?

They knew that food would be in short supply after the war, so they harvested the potatoes to serve as "seed" potatoes for a new crop. Each eye on a potato represents a potential new plant. They moved them to the basement to protect them from not only the shelling, but to provide a more stable temperature so the potatoes would not freeze.

3. Why was no one allowed to be alone in a room where the seeds were stored during the siege?

Preserving the seeds for life after the war was so important and their hunger was so great that they didn't want anyone to be tempted to eat the seed or plants.

4. Explain why workers starved rather than eat the rice and potatoes stored at the institute.

Their commitment as scientists was greater than their personal desire to survive. They understood that their sacrifice would allow later generations to eat and survive.

Activity 3: A Priceless Collection, (Science) 1-7 50 minute class periods

Students will expose seeds to very cold temperatures by putting them in the freezer and compare them with a control group of seed kept at room temperature by planting seeds and observing sprout times, plant vigor and growth.

Oklahoma Academic Standards

Activity 3: A Priceless Collection (Science)

6.LS1.3	Use an argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.
7.LS2.1	Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
8.LS4.4	Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.

Materials:

- Pea, bean, squash seeds (at least 4 seeds per student)
  (Do a germination test a couple of weeks ahead of activity to ensure seeds are viable)
- Zip-top sandwich or snack size bags (2 per student)
- Peat pellets (2 per student) (or small peat pots and potting soil)
- Shallow tray to contain seeds
- Activity 3 Worksheet 1 "**Frozen Seed"**
- Activity 3 Worksheet 2 "**Seed Germination"**
- Activity 3 Reading Page 1 "**Preserving Cherokee Seeds"**

Procedures

1. Students will conduct the following experiment with seeds.
   —Put seeds into two bags. Label the bags "frozen" and "room temperature"
   —Place one bag in a freezer and the other in a room where it will not be disturbed.
   —Leave the bags in place for one week.
2. After a week, plant the seeds in peat pellets or small pots and water enough for soil to stay slightly moist throughout the sprouting period (about a week). Label the ones stored in the freezer "frozen" and the other ones "room temperature."

Continued procedures:

3. If the classroom is cold, you may need a heating pad to warm the soil. If there is a refrigerator in the room, pots can be put in a tray on top of the appliance to warm the soil as well.
4. Observe and record the sprouting results on Activity 3 Worksheet 1 "**Frozen Seed"**
5. After the seeds have been planted for a week, students will communicate their observations.
    - Which seeds broke the soil first?
    - Did the frozen seeds suffer any visible effects when a plant emerged? (Most dry seeds are not damaged by freezing, even after long periods of time.)
    - Discuss variables.
6. Use Activity 3 Worksheet 2 "**Seed Germination**," to list plant structures as the seed germinates and begins to grow.
7. Have students brainstorm to develop a list of growing conditions in your area that would affect plant growth (hot summers, high winds, rocky, sandy or clay soil, insect pests, plant diseases, wide temperature fluctuations, etc.).
8. Students will use online resources, library references or interviews with experts, and find out what varieties of common vegetables grow best under the conditions listed. The OSU Extension Fact Sheets database can be searched at https://extension.okstate.edu/fact-sheets/
9. Invite a local gardener or farmer to speak to the class about how they decide what varieties of seed to plant.
10. Invite a County Educator from the OSU Extension Office to speak to the class about variety trials and test plots in the county and state and how those are used to determine the best varieties of trees, vegetables and fruits to plant in Oklahoma.
11. For an Oklahoma Native American connection, have students read the Activity 3 Reading Page 1 "**Preserving Cherokee Seeds**." Discuss why preserving these heirloom seeds helps preserve the tribal culture. If you are located within the Cherokee Nation, invite a tribal representative to speak to the class about the Cherokee Seed Bank.

If this lesson is started after spring break (mid-March) seedlings will be ready to transplant into home or school gardens by mid- to late April.

A Priceless Collection

Activity 3 Worksheet 1: Frozen Seed

Name: _____ Date: _____

Observe the seeds you planted to see if there is any difference in performance of frozen seed vs seed stored at room temperature.

	Room Temperature	Frozen
# of days to sprout		
# days to first true leaves		
# of leaves at 1 week		
# of leaves at 2 weeks		
# of leaves at 3 weeks		

Seed for this year's garden was harvested last year. Based on the reading pages and the results of your experiment, how do you think the seed is stored until it is time to package seeds for home and garden stores and mail order distributors?

Seeds in the seed banks can be stored for many years at very cold temperatures. What might be the difference between a seed bank's cold storage and your freezer at home?

Seeds from many trees, wildflowers and perennial plants (plants that come back each year) must freeze, or at least experience some sustained cold before they will germinate. Why would these seeds require different treatment than plants (like beans, corn, and tomatoes) that must be replanted each year?

A Priceless Collection

Activity 3 Worksheet 1: Frozen Seed

ANSWER KEY

Name: _____ Date: _____

Observe the seeds you planted to see if there is any difference in performance of frozen seed vs seed stored at room temperature

	Room Temperature	Frozen
# of days to sprout		
# days to first true leaves		
# of leaves at 1 week		
# of leaves at 2 weeks		
# of leaves at 3 weeks		

Seed for this year's garden was harvested last year. Based on the reading pages and the results of your experiment, how do you think the seed is stored until it is time to package seeds for home and garden stores and mail order distributors?

Seeds for the following year are stored in cool (sometimes cold) dry conditions where seeds are protected from insects and moisture.

Seeds in the seed banks can be stored for many years at very cold temperatures. What might be the difference between a seed bank's cold storage and your freezer at home?

The seeds stored in seed or gene banks are stored at a controlled temperature and humidity, specific to the particular seed. Your home freezer is likely to be "frost free" or self-defrosting. This means that freezer gets slightly warmer to melt any frost or ice that may have formed. That means that everything in the freezer thaws a little and refreezes during this cycle.

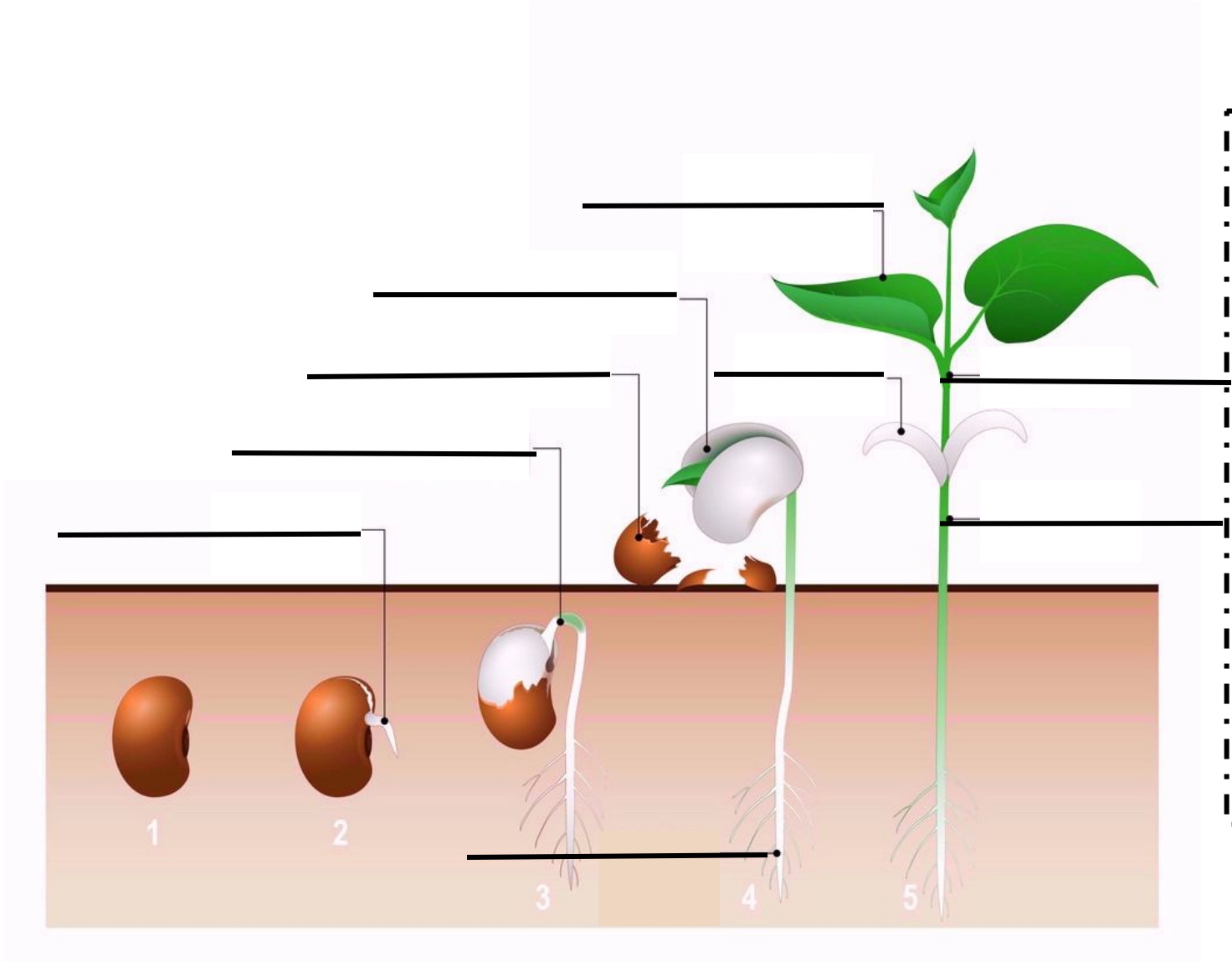
Seeds from many trees, wildflowers and perennial plants (plants that come back each year) must freeze, or at least experience some sustained cold before they will germinate. Why would these seeds require different treatment than seeds from plants (like beans, corn, and tomatoes) that must be replanted each year?

Seeds from perennial plants require a certain period of cold treatment before they will germinate to prevent sprouting before the plant could survive. For example, if a plant sheds seeds during the summer and fall, the need for a freeze ensures survival of the plant's genetic line. If it were immediately able to sprout, and germinated in the fall, it could be too delicate to survive the first freeze. When the seed germinates in the spring, it has the summer and fall to develop roots and stems that can withstand cold weather.

A Priceless Collection

Activity 3 Worksheet 2: Seed Germination

Name: _____ Date: _____



Use the words below to fill in the blanks on the diagram. Some plant parts are shown at more than one stage of germination, and those words will be used more than once.

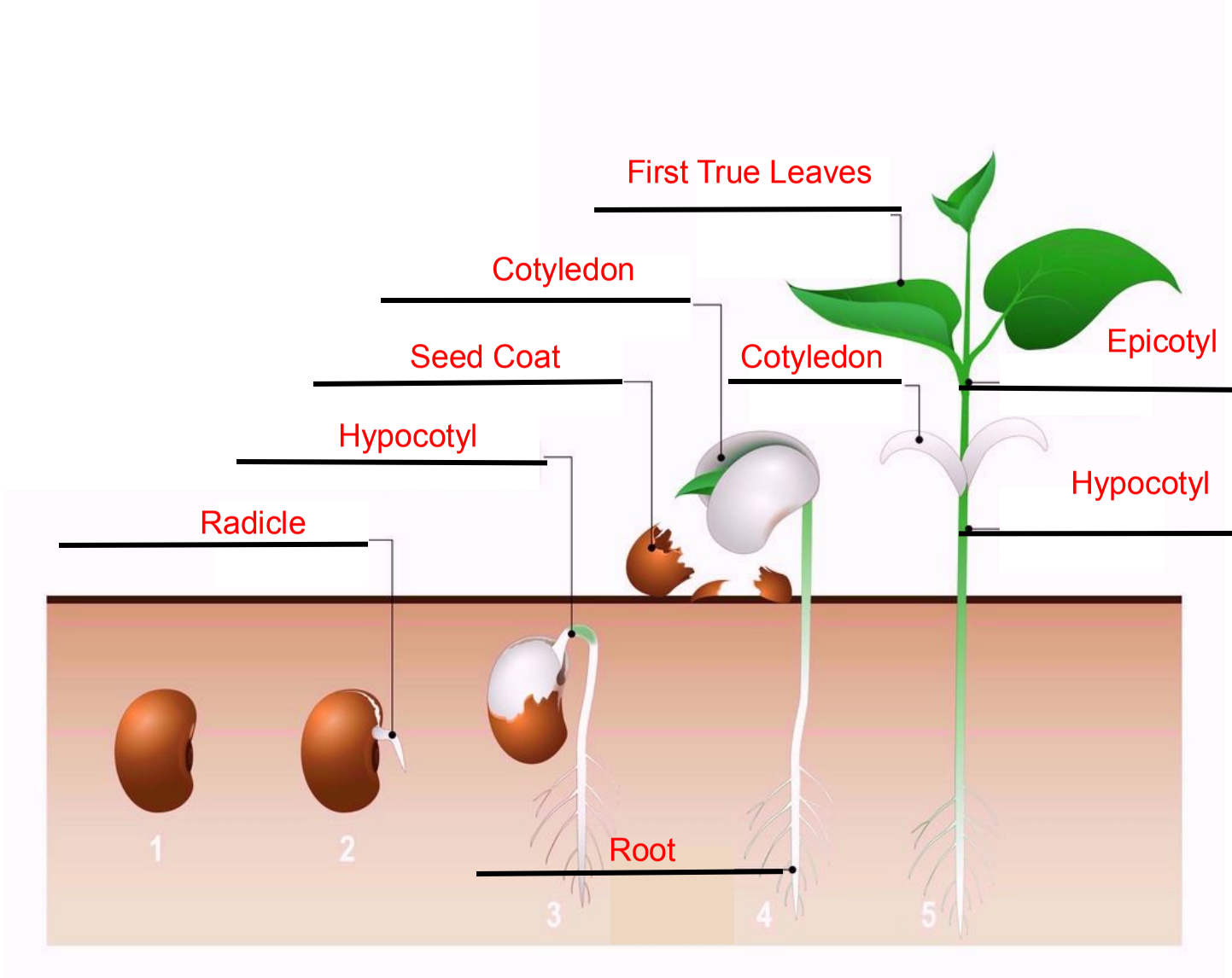
- Cotyledon
- Epicotyl
- First true leaves
- Hypocotyl
- Radicle
- Root
- Seed Coat

A Priceless Collection

Activity 3 Worksheet 2: Seed Germination

ANSWER KEY

Name: _____ Date: _____



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- First true leaves
- Hypocotyl
- Radicle
- Root
- Seed Coat

"This is history in the making": Cherokee Nation becomes first U.S. tribe to preserve culturally important seeds in Arctic "doomsday" vault

First published on February 8, 2020 / 3:29 PM,

Sophie Lewis

Cherokee White Eagle Corn (Photo: Cherokee Nation)

For more than a decade, the Svalbard Global Seed Vault — also known as the "doomsday" vault — has collected and maintained the world's largest collection of diverse crops. This week, the Cherokee Nation became the first tribe in the United States to be invited to deposit samples in the vault.

According to a Cherokee Nation press release, the tribe's secretary of natural resources has collected nine samples of heirloom crops to send to the long-term seed storage facility, which is located deep inside a mountain on a remote island halfway between mainland Norway and the North Pole. The vault was built in 2008 to withstand man-made and natural disasters and is part of an international effort to ensure the preservation of a wide variety of plant seeds.

The vault has the capacity to store 4.5 million varieties of crops and currently holds nearly 1 million samples from nearly every country in the world. In the case of a catastrophe, crops from the vault could provide food for humans, however, it also serves to protect crops that are becoming endangered due to climate change.

Included in the Cherokee Nation samples is Cherokee White Eagle Corn, the tribe's most sacred corn. They also sent Cherokee Long Greasy Beans, Cherokee Trail of Tears Beans, Cherokee Turkey Gizzard black and brown beans, Cherokee Candy Roaster Squash and three other varieties of corn.

Every variety sent to the vault predates European settlement in the U.S., officials said.

"This is history in the making, and none of it could have been possible without the hard work of our staff and the partnership with the team in Norway," said Cherokee Nation Principal Chief Chuck Hoskin Jr. "It is such an honor to have a piece of our culture preserved forever. Generations from now, these seeds will still hold our history and there will always be a part of the Cherokee Nation in the world."

Luigi Guarino, director of science for the Global Crop Diversity Trust, reached out to the tribe's Senior Director of Environmental Resources Pat Gwin after hearing a 2019 National Public Radio interview about the Cherokee Nation's heirloom seed bank program.

The seeds will be deposited on February 25 with the 2020 collection.

"He sent me an email and said they would be honored to have the tribe's seeds in the seed vault," said Gwin. "This is a tremendous opportunity and honor for the tribe. Additionally, knowing the Cherokee Nation's seeds will be forever protected and available to us, and us only, is a quite valuable thing indeed."