A PRICELESS COLLECTION

GRADE LEVEL: 6-8 **SUBJECT:** Science

NATIONAL STANDARD(S): **THEME:** Seed Research
(6-8) SC; 4.5-6, 5.1, 5.5-6, 6.5, 7.1, 7.4, 9.3, 14.1-5, 15.2-3, 16.1, 16.5

FOOD AND FIBER TOPIC: I-D, III-B,C,E

LEARNER OBJECTIVES:

The student will read a story about the life of Russian plant breeder Nikolai I. Vavilov and the national seed bank he established

VOCABULARY

cultivated— The planting, tending, harvesting, and improving of plants.
gene bank— A place where seeds are preserved under dry, cool conditions and where other plant materials are kept in test tubes or in fields.
gene pool— The genetic base available to plant and animal breeders for stock improvement.
genes— The simplest unit of inheritance.
genetic erosion— The loss of genes from a gene pool due to the elimination of populations.
genotype— The genetic makeup, expressed and latent, of an organism.
hybrid— The offspring of genetically dissimilar parents or stock, especially the offspring produced by breeding plants or animals of different varieties, species, or races.
monoculture— Cultivation of a single crop, such as wheat or cotton, to the exclusion of other possible land uses.
plant breeder—A person who develops new or improved strains in plants, chiefly through controlled mating and selection of offspring for desirable traits.
varieties— Subdivisions of a species consisting of naturally occurring or selectively bred populations or individuals that differ from the remainder of the species in certain minor characters.

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. By well before the 20th Century, however, all but the orange ones had disappeared. 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 so at least something would make it to harvest through drought, flood or 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 grow more crop 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 the physical uniqueness of each plant from other plants. Some plants are taller than others or hold onto their seeds longer; while others can withstand hotter weather or produce fruit faster than others. A genotype is the distinct and unique combination of genes in an organism.

Plant breeders are concerned with genetic erosion because they use the genetic material found in plants to improve the crops that provide us with food. 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 resistant hybrids before planting time in spring, 1971.

A gene bank is a place where seeds are preserved under dry, cool conditions and where other plant materials are stored 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 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 USSR 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.

STEP-BY-STEP INSTRUCTIONS

1. Have each students put bean, pea, radish or clover seeds into two baggies and place one baggy in a freezer and the other in a room where it will not be disturbed. Leave the baggies in place for one week.
2. After a week, have students plant the seeds. Label the ones stored in the freezer "frozen" and the other ones "room temperature." Have students observe and record the sprouting results.
3. After the seeds have been planted for a week, ask students to share 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.)
4. Review genetics with students and write the following terms on the chalkboard: "gene;" "gene pool;" "genotype;" "genetic erosion;" "gene bank;" "hybrid;" "plant breeder." Discuss their meanings. (See Glossary.)
5. Before sharing the background material, write the name of the Russian geneticist Nikolai (***nick*** *oh lye*) I. Vavilov (*vah* ***vee*** *loff*) on the board and pronounce it for students to hear.
6. Hand out student worksheets. Have students read Student Worksheet A independently and then answer the questions on Student Worksheet B.
7. When students have completed the assignment, use the questions on Student Worksheet B to lead a classroom discussion on the importance of gene banks.

RELATED ACTIVITIES

1. Have students brainstorm to come up with a list of growing conditions in your area that would affect plant growth (extremely hot summers, high winds, rocky or clay soil, long periods without rain, insect pests, length of growing season). Then have students interview gardeners in the area or contact your local Cooperative Extension Service office to add to the list and find out what varieties of common vegetables grow best under these conditions.
2. Have students research the Irish Potato Famine of the late 1840s. What was the cause? Ask students to suggest how this tragedy could have been prevented.
3. Have students make a list of all the food plants they can think of and count them. Then have them figure what percentage that is of the approximately 10,000 edible plants available to us.
4. Have students write for information about the seed banks listed on Student Worksheet B.

RESOURCES

Student Books

Bates, J. (1991). Seeds to Plants: Projects with Biology. Watts.

Parkison, R. F. (1988). Seeds and Seeds and Seeds. Little Wood.

Sabin, L. (1985). Agriculture. Troll.

Tant, C. (1992). Seeds, Etc. Biotech.

Teacher Resources

Kids in Bloom, Variety Seeds, PO Box 344, Zionsville, IN 46077, 317-290-6996 (seed company offering heirloom vegetable, herb and flower seeds).

Related Internet Websites

"Calgene, Inc.," Company which develops genetically-engineered plants and plant products for the food, seed and oleochemical industries. *http://www.calgene.com*

"BIOSIS," Electronic public debate about biotechnology. Issues include genetic screening, bioengineered foods and biotechnology in the environment. *http://www.scicomm.org.uk/biosis/hi-tech.html*

"1900 - 1953 - Converging on DNA," Timeline of genetic accomplishments. *http://outcast.gene.com/ae/AB/BC/Timelines/1900-1953.html*

EVALUATION

Were the students able to read and understand the subject of the reading? An answer sheet is provided for complete answers to student worksheet questions.

ACKNOWLEDGMENT

This lesson adapted from Oklahoma Ag in the Classroom, Department of Agricultural Education, Communications and 4-H Youth Development, Oklahoma State University, Stillwater, OK 74078.

Name_____

A Priceless Collection A

Read the following true story. Use the information to complete the worksheet on Student Worksheet B.

A gene bank is a place where seeds and plant materials are preserved. There are collections of seeds and plant material housed in gene banks all over the world. These banks provide plant breeders with the materials 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 USSR and in over 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 perished during the World War II Seige of Leningrad. For 880 days Hitler's forces shelled the city. When shelling began, institute workers duplicated the most important specimens, fearing they might be destroyed. They harvested underdeveloped potatoes to save as seed and transported them to the institute's basement, with the help of some regiments of the Russian army.

When winter arrived, there was little food and nothing with which to heat the buildings that were left 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 specimens.

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 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 had been imprisoned 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 interrogated, charged with high treason and espionage, and sentenced to death. On January 26, 1943, he died of malnutrition in a Saratov 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 remains one of the most important of all the gene banks in the world.

Adapted from Oklahoma Ag in the Classroom.

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Name_____

A Priceless Collection B

Rice is the crop that feeds the majority of the world's people. Using another world map, locate the following seed banks. Glue a kernel of rice to mark the spot and then draw a line to the institute name.

- National Seed Storage Laboratory (NSSL), Colorado State University, Ft. Collins, CO, USA
- National Small Grains Collection, Aberdeen, ID, USA
- Ethiopia Seed Bank, Addis Ababa, Ethiopia
- International Center for the Improvement of Maize and Wheat (CIMMYT), Mexico City, Mexico
- Peru Seed Bank, Huancapi, Peru
- The International Board for Plant Genetic Resources (IBPGR), Rome, Italy

Answer the questions below after you have read the information on Student Worksheet A.

Why are gene banks important? _____

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Why did gene bank workers move underdeveloped potatoes to the basement of the Institute of Applied Botany and New Crops during the Seige of Leningrad? _____

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Why was no one allowed to be alone in a room where the seeds were stored during the seige? _____

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

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A Priceless Collection (answers) B

Rice is the crop that feeds the majority of the world's people. Using another world map, locate the following seed banks. Glue a kernel of rice to mark the spot and then draw a line to the institute name.

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- Peru Seed Bank, Huancapi, Peru
- The International Board for Plant Genetic Resources (IBPGR), Rome, Italy

Answer the questions below after you have read the information on Student Worksheet A.

Why are gene banks important?Gene banks are important because they provide plant breeders with the materials they need to improve food crop varieties so we will have plenty of food to eat.

Why did gene bank workers move underdeveloped potatoes to the basement of the Institute of Applied Botany and New Crops during the Seige of Leningrad?Gene bank workers moved underdeveloped potatoes to the basement of the institute so they would not be destroyed by the shelling by Hitler's forces during the Seige of Leningrad.

Why was no one allowed to be alone in a room where the seeds were stored during the seige?No one was allowed to be alone in a room with seeds during the seige so no one would eat the seeds.

Explain why workers starved rather than eat the rice and potatoes stored at the institute.Workers did not eat the rice and potatoes stored at the institute because they realized they could not be replaced.

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