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To accompany the peer-reviewed article by Geoffrey C. Hawtin, Ph.D. and Jeremy Cherfas, Ph.D.:
“Plant Genebanks: Food Security” (April 2003)

http://www.actionbioscience.org/biodiversity/hawtin_cherfas.html

Maintaining Plant Genebanks (June 2003)

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Grades & Levels:

- **Handout 1:** Grades 9-12 (general)
- **Handout 2:** High school (advanced/AP) - undergraduate (year 1)

Time Recommendations:

- 1 class period for article review and discussion and projects preparation
- up to 1 week for project completion in handout assignments
- 1 class period to conduct group presentations (handout 2)

NSES (USA) Content Standards:

- NSES 2.2. Science as Inquiry: understanding about scientific inquiry
- NSES 4.2 Life Science: molecular basis of heredity
- NSES 6.2. Science & Technology: understanding about science & technology
- NSES 7.3. Science in Personal/Social Perspectives: natural resources
- NSES 7.6. Science in Personal/Social Perspectives: sci. and tech. in local/national/global challenges

Learning Objectives: Students will...

- research the science behind and the need for plant genebanks
- consider the rationale for gaining ownership over scientific information
- formulate an opinion about the costs and uses of high tech scientific applications
- understand the implications of reliance on biotechnology, in particular by developing nations

Key Words Include:

accessions (plant), agricultural ethics, conflict of interests, crops, cryopreservation, cultivate, ethnobotany, *ex situ*, food security/supply, genebank, genes, germination, *in vitro*, liquid nitrogen, plant agriculture, plant diversity, recalcitrant, supply and demand

Preparation

Article Discussion:

- Distribute or ask students to download and read the article by Geoffrey C. Hawtin and Jeremy Cherfas at: http://www.actionbioscience.org/biodiversity/hawtin_cherfas.html
- Follow the reading with question about the article, provided on page 2.

Student Handout 1:

- Use the by Hawtin/Cherfas article as background to guide students through activities on Handout 1.
- Activities can be assigned as group projects, to be done in class, or as take home assignments.
- Provide at least 30 minutes for completion of projects if they are being done in class.

Student Handout 2:

- The handout provides two activities that require focused research.
 - The projects in this handout can be graded on accuracy, completeness, and quality of work. They can be assessed using multiple-choice questions asking facts about genebanks and views presented in class. A short essay inquiring about the activity's learning objectives would be a way to test higher-order learning.
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For Educators: Article Discussion

About the article by Geoffrey C. Hawtin, Ph.D. and Jeremy Cherfas, Ph.D.:
“Plant Genebanks: Food Security”

http://www.actionbioscience.org/biodiversity/hawtin_cherfas.html

Article Content Questions:

1. How is plant DNA preserved in genebanks?
2. What was Nikolai Ivanovich Vavilov's contribution to plant conservation?
3. Why are some crops not suitable for genebank preservation?
4. Describe how seeds are stored in plant genebanks.
5. How are tubers and seedless plants stored in genebanks?
6. How do plant breeders benefit from genebanks?
5. What are some difficulties that developing nations have in maintaining crop genebanks?
6. Give four reasons for placing crops in genebanks.
7. Explain two problems of storing crops in genebanks for long periods of time.
8. Are plant genebanks as secure a source as they should be? Explain.

Article Extension Questions:

1. What do you think would be the most important plants to bank for your nation? Why?
2. How do genebanks increase the ability to provide greater crop diversity?
3. Why do you think there are over 100,000 varieties of rice and its relatives stored in genebanks?
4. How could genebanks limit the need to seek a greater diversity of crops in the future?
5. Could it be possible to maintain genebanks for agricultural animals? Speculate how.
6. Speculate the possible impact of genetically-modified plants on plant genebanks.

Maintaining Plant Genebanks

Student Handout 1

1. Debate

Use an Internet search engine to get background information for one of the following viewpoints:

- “Traditional plant genebanks are obsolete. Most of the seeds being stored can be replaced by simply storing their extracted DNA.”
- “Plant genebanks are done primarily for the profit of large seed companies with the facilities to maintain seeds. Few countries have the resources to manage genebanks at government expense.”

Discuss or debate the above viewpoints.

2. Create a Company

You just graduated with a Masters of Business Administration degree and got a job with a large seed company. Your first assignment is to design a plant genebank for Mexico. Produce a planning chart that shows what you need to investigate to operate a profitable genebank company that serves Mexican agriculture. Keep in mind that Mexico grows a variety of agricultural plants and that the farmers do not have much money to pay for agricultural products.

3. Biography

Write a biography about one of the following people and include your view of why the person was important to plant conservation and/or crop agriculture:

- Nikolai Ivanovich Vavilov
- Carolus Linnaeus
- Gregor Mendel
- John Bartram
- Joseph Banks
- Norman Borlaug

Maintaining Plant Genebanks

Student Handout 2

1. *Genebanks for Developing Nations Symposium*

Most crops in use today are stored in genebanks to prevent their loss in case a disaster destroys existing crop reserves. Agricultural researchers comb remote areas of many countries collecting the purported ancestors of many crops plants in order to preserve potentially valuable plant species. They believe these plants contain useful genes that may have been lost during domestication of the plants as crops. A symposium has been called for special interest groups to explore the issues associated with feeding developing nations. For the symposium:

a) Students are divided into the following 5 special-interest groups:

- a group of government representatives for developing nations
- a group of government representatives for industrialized nations
- a group of corporations that own patents on many crop plants consumed in developing nations
- a consortium of non-governmental agencies interested in feeding the poor
- a private group that supports free enterprise

b) Your group will be representing the views of the group chosen, which has special concerns about the accessibility and cost of food in developing nations. Your group must have a brief, compelling argument that can be presented in 5 minutes at the symposium.

c) Research background information and compose summaries of your justifications for *favoring or opposing the ownership of DNA sequence information*.

d) Present your group's view in class within the time limit.

e) Allow other groups to ask you questions in the time remaining in class, as determined by your teacher. Be prepared to defend your group's view.

2. Cryopreservation Service

Your group is launching a business that offers cryopreservation services for certain agricultural plants. Prepare a business plan and a company brochure. Include the following in the brochure:

- an explanation of cryopreservation and its benefits to agriculture
- the different services/procedures you offer, e.g., cell lines or DNA cryopreservation