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To accompany the article "The Weight of a Petal: The Value of Botanical Gardens"
by H. Bruce Rinker (February 2002)
http://www.actionbioscience.org/biodiversity/rinker2.html

The Value of a Garden (November 2004)

Lesson by Marianne E. Krasny, Ph.D., professor
Department of Natural Resources, Cornell University, Ithaca, NY
Paul Newton, lecturer
Department of Applied Economics and Management, Cornell University, Ithaca, NY
Linda Tompkins, extension associate
Department of Education, Cornell University, Ithaca, NY

Grades & Levels

- **Handout 1:** high school (all levels)
- **Handout 2:** high school (advanced/AP) – undergraduate (year 1–2)

Time Recommendations

- **Handout 1:** 1–3 class periods for most activities
- **Handout 2:** 1–2 weeks for each activity (some time spent on out-of-class research)

NSES (USA) Content Standards, 9–12

- 4.4. Life Science: Interdependence of organisms
- 7.3. Science in Personal & Social Perspectives: Natural resources
- 8.1. History and Nature of Science: Science as a human endeavor
- 8.3. History and Nature of Science: Historical perspective

NSES (USA) Content Standards, 5–8

- 4. Life Science
- 8. History and Nature of Science

Note: View the NSES content standards on this site to choose other curricular applications for additional activities at: http://www.actionbioscience.org/educators/correlationcharts.html

Learning Objectives: After completing handout 1, students will

- understand the various services different types of gardens provide to humans
- develop the ability to describe changes among factors in gardens using feedback loops
- understand the role of Carl Linnaeus in the history of taxonomy

After completing handout 2, students will

- understand the causes of species declines and extinctions
- understand the myriad of efforts being used to preserve species
- critically evaluate the arguments set forth in a scientific article
- understand the contributions of community and botanical gardens to conservation and the socio-cultural well being of communities

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Key Words Include: Aesthetic, biodiversity, botanical, coevolution, conservation, decomposition, dissemination, ecology, ecosystem services, ethics, ex situ, feedback loops, nomenclature, pollinators, preservation, propagation, species, taxonomy

Preparation

Article Discussion: Distribute or ask students to download and read the article by H. Bruce Rinker: http://www.actionbioscience.org/biodiversity/rinker2.html Follow the reading with questions about the article, provided below.

Student Handout 1:

- In activity 1, students will make lists of different types of gardens. Encourage the students to be creative and not limit themselves to gardens around their own homes. Refer students to "useful links for student research" in the "educator resources" section at the end of Rinker's article for more information on community, school, and botanical gardens.
- Activity 2 asks students to draw behavior-over-time graphs and to diagram feedback loops (refer to the PowerPoint presentation diagrams, see below). Feedback loops are used to show dynamic relationships among different factors in a system. For example, they can be used to understand the relations between soil quality or seed availability and flower production in a garden. Once students understand these relationships, they can predict how varying one factor will affect another factor. This information can be used to help solve problems, such as how to promote the growth of a particular plant in a garden.
- Activity 3 asks students to research the contributions Carl Linnaeus made to taxonomy and gardens.

Student Handout 2: The article by Rinker contains a number of statements that might be construed as supporting a particular point of view. In activity 1, students are asked to critically review Rinker's article. Activity 2 focuses on the differences between botanical and community gardens.

PowerPoint Presentation: See this downloadable presentation in the "educator resources" section at the end of Rinker's article. This presentation is useful for activity 2 in Student Handout 1 and activity 3 in Student Handout 2. It is suggested that educators work through the slides with students to familiarize them with the feedback loop process. Explanatory slides are provided, as well as examples of graphs, in the presentation.

The Value of a Garden

For Educators: Article Discussion

About the article by H. Bruce Rinker: "The Weight of a Petal: The Value of Botanical Gardens"
http://www.actionbioscience.org/biodiversity/rinker2.html

Article Content Questions

1. What are some of the different purposes of botanical gardens?
2. How have the purposes of gardens changed over time?
3. What did the Linneaen garden contribute to the history of botanical gardens?
4. Why are plant species in jeopardy?
5. How do botanical gardens help to preserve rare plants and plants that are extinct in the wild?
6. How does the author describe the difference between preservation and conservation?
7. Summarize the four reasons the author gives for why might humans want to conserve natural resources.
8. How do nonindigenous, invasive plant species, i.e., alien species that invade the habitats of other plants, affect biodiversity?

Article Extension Questions

1. What is biodiversity?
2. The author quotes Loren Eiseley: “The weight of a petal changed the face of the world and made it ours.” Discuss what Eiseley’s statement implies.
3. What other ways, besides preserving species in botanical gardens, do humans use to prevent rare plants from becoming extinct?
4. How do humans preserve rare animals?
5. What are seed banks? What is their role in conservation of plant species? How does international conflict, such as the war in Afghanistan, affect seed banks and our ability to conserve plant species?

Personal Viewpoint Questions

1. Can botanical gardens play an important role in conserving biodiversity? Why or why not?
2. Can zoos play an important role in conserving rare animals? Why or why not?
3. The author states, “two-thirds of the world's plant species are in danger of extinction during the course of the 21st century.” What do you think are the implications of this loss to animals and humans?

The Value of a Garden
Student Handout 1

1. All Kinds of Gardens

- In cooperation with other class members, brainstorm a list of different gardens. For example, home gardens, botanical gardens, community gardens, gardens at retirement communities for senior citizens, Japanese gardens.
- Next choose one of the gardens on the list you created. Write all the benefits provided by that garden to people, neighborhoods, and the overall ecosystem. For example, does the garden provide food? A place for people to talk with people from other cultures? An "outdoor lab" where learning takes place? A place to conserve genetic diversity?
- Repeat the previous step for other types of gardens on your list.
- Compare notes and discuss how benefits differ for different types of gardens.

2. Future of a Garden

Choose a community garden in your neighborhood or from a website. Is there one aspect of the garden you would like to see ensured for the future? For example, you might like to see more kids involved in the garden, or have more concerts and cultural events there. Feedback loops can be used to help you answer this question. Refer to the PowerPoint presentation, in the "educator resources" section at the end of Rinker's article, for an example of how to hypothesize feedback loops that can create a desirable future for some aspect of the garden of interest to you. The example in the presentation will help you understand how feedback loops and interactions among them may have caused past changes, and can cause desired future changes, in flower production in a school flower garden. Once you understand how feedback loops work, you can apply them to another issue of interest to you. The PowerPoint presentation can be found here: http://www.actionbioscience.org/biodiversity/rinker2.html

3. Who was Linnaeus?

Carl Linnaeus played an important role in the development of gardens and of the science of taxonomy. Write a short story or biography of this scientist and his contributions.

The Value of a Garden
Student Handout 2

1. Critical Review
The author of the article makes a number of statements. Work with a group of fellow students to complete the following activity.

- Choose one of the topics below.
- Your job is to determine what research exists to support the statements made by the author of the article.
- After investigating the author's statements, discuss with your classmates whether you agree with the author.

Topic 1: Ecosystem services: Nature vs humans?
When talking about ecosystem services, the author states:

> It is near-to-impossible to place a dollar value on these benefits, and attempts to replace them with human technologies have fallen short. Mangroves are superior to seawalls, protecting our shorelines from wave erosion and acting as a resilient living barrier during hurricanes. Bacteria return nitrogen gas from our atmosphere to all other living things, where it is essential for the construction of proteins. No invention has been able to imitate that ancient global function.

Evaluation: Choose a technology designed to provide an ecosystem service (e.g., constructed wetlands to help filter agricultural runoff). What would be the equivalent ecosystem component that provides the same service? What are some of the advantages and disadvantages of the human-made service?
Discussion: Do you agree with the statement that human technologies can never provide the same benefits as those provided by nature?

Topic 2: Species declines: Causes and solutions?
The author states:

> These plant species are in jeopardy because of a burgeoning human population that then affects proximate causes such as deforestation, habitat loss, the spread of invasive species, and agricultural expansion.

Later, the author states:

> In short, the plants forming the basis of botanical gardens' core mission and ethics are under serious threat around the globe. A solid commitment to education and ethics could stem this appalling trend, launching botanical gardens as leaders in ecological stewardship.

Evaluation: Choose a rare or endangered plant species. Research the efforts being made to preserve the species. Then develop a list of preservation efforts in order of how important you think they are in conserving the species. What is the role of botanical gardens and zoos relative to other efforts to conserve species?
Discussion:
Do animal breeding and plant propagation programs have a chance to conserve biodiversity over the long term? What is the role of education relative to these and other efforts? Do you agree that a commitment to education and ethics could stem the trend of species extinctions, and that botanical gardens can be leaders in ecological stewardship?

2. Community Gardens
Community gardens provide an opportunity for people who aren't able to garden around their home (e.g., they don't have a yard, they live in an apartment building in a city) to grow vegetables, fruits, and flowers. But these gardens provide much more than a place for growing food and flowers. They often are sites where people from different walks of life come together to share stories, listen to concerts, and teach children about the outdoors. In some countries, such as Bosnia, community gardens even play a role in rebuilding society after ethnic conflict—they are sites where people of different ethnicities can come together and engage in the important work of producing food.

If possible, visit a community garden and a botanical garden. Also conduct a "virtual visit" of community gardens featured on the Garden Mosaics or another community garden website, and of botanical gardens you find on the Web. Write an illustrated report comparing contributions of community gardens and botanical gardens to

- conservation of genetic diversity
- building the social fabric of the community
- contributing to the cultural life of the community
- providing places for relaxation
- educating youth and community members
- helping community members develop new skills (e.g., leadership, community organizing, teaching)

3. Feedback Loops
Choose a community garden in your neighborhood or from a website. Is there one aspect of the garden you would like to see ensured for the future? For example, you might like to see more kids involved in the garden, or have more concerts and cultural events there. Feedback loops can be used to help you answer this question. Refer to the PowerPoint presentation, in the "educator resources" section at the end of Rinker's article, for an example of how to hypothesize feedback loops that can create a desirable future for some aspect of the garden of interest to you. The example in the presentation will help you understand how feedback loops and interactions among them may have caused past changes, and can cause desired future changes, in flower production in a school flower garden. Once you understand how feedback loops work, you can apply them to another issue of interest to you. The PowerPoint presentation can be found here: http://www.actionbioscience.org/biodiversity/rinker2.html.

