

## actionbioscience.org lesson

To accompany the peer-reviewed interview with E.O. Wilson, Ph.D.:

“Speciation and Biodiversity” (Feb. 2002)

<http://www.actionbioscience.org/biodiversity/wilson.html>

---

### **Biodiversity: Should It Matter to Me?** (June 2002)

**Lesson by JoDale Ales, Ph.D.,**

science educator/educational consultant,

Baton Rouge Community College, Baton Rouge, LA

Educator’s section: *p. 1-3*

Student handout 1: *p. 4*

Student handout 2: *p. 5*

#### **Grades & Levels:**

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

*Note: It is recommended that both handouts 1 and 2 be used in advanced/AP and undergraduate classes.*

#### **Time Recommendations:**

- **Handout 1:** 1 week (50 minute classes)
- **Handout 2:** up to 2 weeks

#### **NSES (USA) Content Standards, 9 – 12 :**

- NSES 1.1. Unifying Concepts & Processes: systems, order & organization
- NSES 1.4. Unifying Concepts & Processes: evolution & equilibrium
- NSES 4.3. Life Science: biological evolution
- NSES 4.4. Life Science: interdependence of organisms
- NSES 7.3. Science in Personal & Social Perspectives: natural resources

*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:** Students will...

- apply economic principals to conservation
- demonstrate an understanding of speciation, extinction, and their relationship to biodiversity
- demonstrate the complexity of environmental problem solving
- research and discuss the characteristics of global biodiversity hotspots.
- demonstrate an awareness of the effects of human activity on biodiversity
- propose solutions for sustaining biodiversity

#### **Key Words Include:**

allopatric speciation, biodiversity, bioprospecting, chronospecies, coadaptation, conservation, costs & benefits, economics, endemic species, extinction, goods & services, hotspots, incentives & rewards, markets, ownership, polyploidy, scarcity, speciation, species, subspecies, sympatric speciation, values

## Preparation

### Interview Discussion:

- Students should have a prior knowledge of genetics, including mutations and recombination; sexual & asexual reproduction; primary & secondary succession; food webs; and ecosystems.
- Students should read the interview with E. O. Wilson, "Speciation and Biodiversity," which can be printed from [www.actionbioscience.org/biodiversity/wilson.html](http://www.actionbioscience.org/biodiversity/wilson.html)
- Discussion questions may be answered during a class discussion following the reading or may be reviewed in class after individually answering the questions as a homework assignment. Questions are provided on page 3.

### Handout 1: high school (general level)

- Student groups follow the activity guidelines in Student Handout 1.
- It is suggested that activity #1B in Student Handout 1 be performed by the entire class; however, this activity can be allocated to a group. It involves a large-scale map, so mural materials or a large chalkboard is required. Sample maps and information about hotspots are readily available on the Internet. See *Useful Links* in the "Educator Resources" section at the end of the Wilson interview.

### Handout 2: high school (advanced/AP) – undergraduate (year 1)

- It is recommended that both handouts 1 and 2 be used in advanced/AP and undergraduate classes. (Students should complete Student Handout 1 in less time than the general-level high school students.)
- Introduce basic economic principles to guide students through the activities in Student Handout 2. The information for some of the activities was taken from the following source: Reinke, R. and Wentworth, D. (2001). "Combining economic reasoning with environmental issues: A student perspective." *Economics for teachers: A conference on understanding the mystery of the environment and the economy*. New Orleans, LA: The Foundation for Teaching Economics. (The foundation has a web site that can provide additional information.)

## For Educators: Interview Discussion

About the interview with E. O. Wilson, Ph.D.: "Speciation and Biodiversity"

[www.actionbioscience.org/biodiversity/wilson.html](http://www.actionbioscience.org/biodiversity/wilson.html)

### Content Questions:

1. In your own words explain the classical definition of a *species*.
2. Identify and describe some of the exceptions to the idea that a species is genetically isolated and evolving on its own?
3. What is a *subspecies*? Use an example to explain the difficulty of defining a subspecies.
4. Explain the term *chronospecies*.
5. What two types of events result in new species moving rapidly into an area?
6. What changes can occur in a species after it first populates an area? Name the two factors that cause this to happen and explain why they have this effect.
7. What is the final step that occurs in the population of a new area?
8. Use a graphic aid such as a flow diagram to show the three stages in the cycle of biological diversity as it occurs in an uninhabited area.
9. Use an example to describe *coadaptation*.
10. Describe some of the factors that help determine the number of species in an area.
11. Explain the acronym *ESA*.
12. Distinguish between *sympatric speciation* and *allopatric speciation*. What is the predominant mechanism of speciation, behavior, or geographic isolation?
13. Explain the mechanism that can result in rapid speciation in plants.
14. Give examples of how sympatric speciation can happen relatively quickly.
15. In one sentence, describe what Daniel Simberloff and E.O. Wilson did in their historic experiment in the Florida Keys.
16. Simberloff and Wilson concluded from this experiment that there was a constant relationship between the number of species that colonized the island and the diversity of species when compared to the original populations on the island. What was that relationship?
17. How does population size affect the health of a species?
18. If new species are forming, why should we worry about other species becoming extinct?
19. Identify several global biodiversity hotspots and explain why we should focus conservation efforts there.
20. How can environmental policy and economic growth work together to sustain biodiversity?

### Extension Questions:

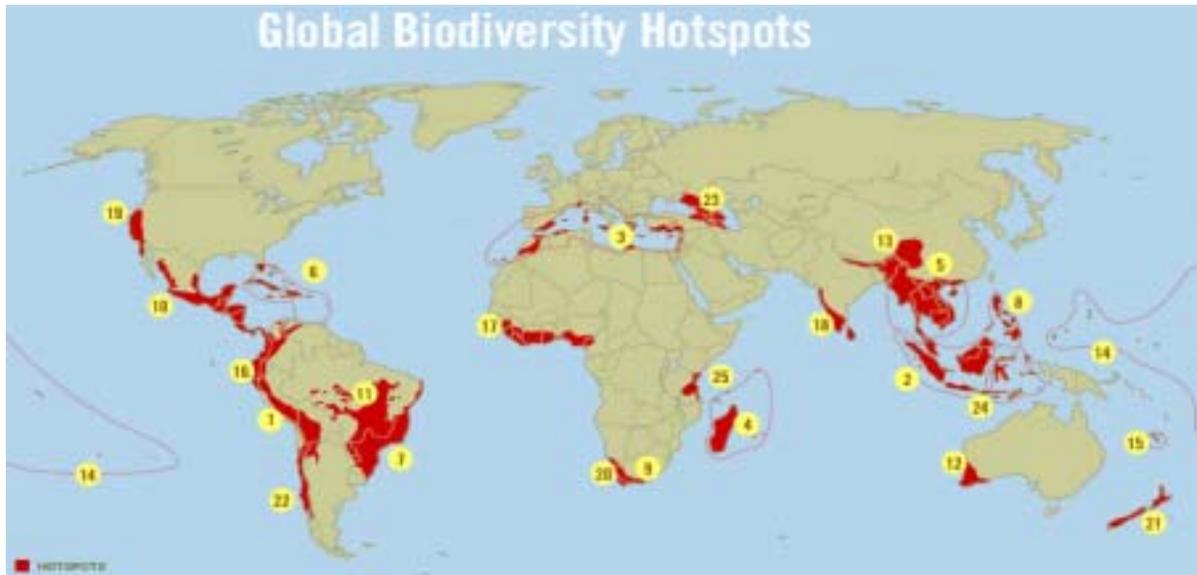
1. Is it important to be concerned with species extinction? Give reasons to explain your opinion.
2. How do you think genetic engineering might affect speciation?
3. On a scale of 1 to 10 with 10 as the ranking for the greatest biodiversity, rank the biodiversity of the region where you live. Give reasons for your ranking.
4. Discuss the relative effects of energy, stability, and area on this region. (Think of energy in terms of the number of autotrophs (producers) in the area.)
5. Name one endangered or threatened species in your region and explain the reasons for preserving this species.. What efforts are being made to preserve it and how successful are these efforts? Access the website of the Department of Wildlife and Fisheries, or other appropriate agency in your country, state, province, or region for this information.
6. Do you think you as an individual should be concerned with the loss of biodiversity in biodiversity hotspots located far away from where you live? Explain your reasoning.

# Student Handout 1

## 1. Hotspots

A) Find out what criteria a geographic area must meet in order to be considered a *biodiversity hotspot*? Then, look at the map below to find a hotspot on your continent. From your research,

- include information about how this hotspot meets the criteria
- describe what is being done to protect this particular area



Source: Conservation International

1. Tropical Andes	2. Sundaland	3. Mediterranean Basin	4. Madagascar & Indian Ocean Islands	5. Indo-Burma
6. Caribbean	7. Atlantic Forest Region	8. Philippines	9. Cape Floristic Province	10. Mesoamerica
11. Brazilian Cerrado	12. Southwest Australia	13. Mountains of South-Central China	14. Polynesia/Micronesia	15. New Caledonia
16. Chocó-Darién-Western Ecuador	17. Guinean Forests of West Africa	18. Western Ghats & Sri Lanka	19. California Floristic Province	20. Succulent Karoo
21. New Zealand	22. Central Chile	23. Caucasus	24. Wallacea	25. Eastern Arc Mtns & Coastal Forests of Tanzania & Kenya

B) This is a whole class project whereby teams choose a certain number of hotspots for their research so that all 25 hotspots are allocated. Duplicate the above map on mural-size paper or draw it on the chalkboard. Using index cards, each team will add the following written information to the map and will present their findings to the class for discussion:

- location of the hotspot and type of ecosystems found there
- a description of at least one endemic plant species and one animal species found there
- a general description of its socio-economic conditions
- human induced and/or natural reasons why species biodiversity is decreasing in that region

## 2. Purchase Power

Ownership rights contribute to the complexity of environmental decision-making. Property rights may allow a landowner to cut down all of the virgin trees on his/her property, for example. In order to prevent this negative effect, ownership can be bought or sold. Through Internet research, find a government agency or environmental group that buys property in order to sustain ecosystems. Using the organization as an example, create a campaign to buy environmentally-sensitive land in your region to sustain its ecosystem. Work out the economics of your venture, calculating how much money you would need to raise in order to accomplish your mission.

## Student Handout 2

### 1. Economics and the Environment

In a team, decide how you will present the following topics to the class, e.g., debate, speech, display. Choose one of the following topics for your presentation:

#### a) Cost/Benefit Analysis

Economics tells us that we must carefully consider the costs and benefits of our choices and pick the one that has the best cost to benefit ratio. Some costs and benefits are subjective, based on how one values things; some are objective, such as dollar amounts. Explain how a cost to benefit analysis works. Then provide at least 4 real-world examples of companies dealing with this type of analysis for environmental decision making, including what factors would be under consideration. For example, what costs and benefits would a chemical company evaluate in its decision whether or not to further decrease air pollution at one of its sites?

#### b) Supply and Demand

Resources on Earth are limited and finite and environmental resources include things like clean water and air, productive soil, and plant and animal species. Explain how supply and demand works and provide at least 8 examples of how it can be detrimental to the environment. For example, we might choose to cut down trees in a virgin forest in order to have wood to build houses.

#### c) Rewards and Incentives

Rewards and incentives drive cost-benefit decisions. Because we value things differently, people may not consider the same thing to be a reward or incentive. Explain how rewards and incentives can be used to drive environmentally-friendly economic decisions, providing at least 8 environmental examples. For example, a coffee company selling products harvested by indigenous people in order to gain goodwill and/or a tax break.

### 2. Biodiversity Soapbox

Sadly, not enough people in the world understand the concept of biodiversity. For example, a recent survey revealed that only about 20% of Americans know what biodiversity is. If you were invited to make a public presentation about biodiversity to the general public, how would you do it?

- prepare an outline of your presentation, listing key points and examples
- consider how you would emphasize the six points of “environmental reasoning” below for protecting biodiversity

#### *Useful Guide to Environmental Reasoning*

1. Environmental problems result from choices people make.
2. Incentives influence choices.
3. Efficient solutions to environmental problems are preferable to inefficient solutions.
4. Markets can contribute positive solutions to environmental problems.
5. Private property ownership can contribute to environmental solutions.
6. You can't do just one thing.

Adapted from *Capstone: The Nation's Economic Course*, Reinke et al. (1989)

Now get on a soapbox and test your presentation in class!