actionbioscience.org lesson

To accompany the article "Ring Species: Unusual Demonstrations of Speciation"
by Darren E. Irwin, Ph.D. (Aug. 2002)
http://www.actionbioscience.org/evolution/irwin.html

Evolution in a Ring (July 2005)

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Grades & Levels

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

Time Recommendations

- **Article discussion questions:** 20–40 minutes (more time will be required for discussion if students have not read the article before class time)
- **Handout 1:** 40–60 minutes for Internet research for part A; 20–30 minutes for part B
- **Handout 2**: two class periods of 40–60 minutes

NSES (USA) Content Standards, grades 9–12

- 1.2. Evidence, models, and explanation
- 1.3. Change, constancy, and measurement
- 1.4. Evolution and equilibrium
- 2.2. Understanding about scientific inquiry
- 4.3. Biological evolution
- 4.6. Behavior of organisms

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

Learning Objectives: Students will

- articulate a definition for ring species
- relate the concept of ring species to natural selection and speciation
- understand the role of geography, habitat, and climate in species formation and adaptation
- relate the importance of rare and isolated species to human development and activities

Key Words: adaptation, evolution, common ancestor, divergence, geographic isolation, geographic variation, intermediate species, reproductive isolation, ring species, speciation

Preparation

Article Discussion: Use the questions on page 2 for class discussion of the article. They may be used in several ways. It is suggested teachers provide the content questions to general level students(grades 9–10) and have them work in pairs or groups; advanced students might be asked to summarize the article using their own observations. The content questions can then be used to prompt class discussion. Extension and Personal Viewpoint Questions are better discussed in small groups. Refer to

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the Active Learning Links in "Useful links for educators" for guidelines on helping students work in groups through article questions and activities.

Handouts 1 and 2: Refer students to "Useful links for student research" found at the end of the article. Web resources are provided that will help students with their research on the activities in the handouts. You may want to provide a grading rubric to the students before they choose activities so that they know what will be assessed. For activities where students talk about each other's research, you may want to suggest peer questioning methods. Refer to Assessment Resources in "Useful links for educators" at the end of the article page for links to assessment tools, rubrics, and peer editing suggestions.

For Educators: Article Discussion

About the article "Ring Species: Unusual Demonstrations of Speciation" by Darren E. Irwin, Ph.D.
http://www.actionbioscience.org/evolution/irwin.html

Article Content Questions

1. What is meant by the term "geographic isolation"?
2. Explain the geography/habitat distribution that can produce a ring species.
3. What role does DNA play as evidence for speciation?
4. Why would a map be important for identifying possible ring species?
5. In what way are museum specimens helpful in determining ring species?
6. Why would song variation be a particularly important way to measure species differences? Why are birds with different songs likely to be different species?
7. Why is it significant to demonstrate evolution of new species, rather than changes within the same species?
8. Why are ring species rare?
9. What do ring species teach us about the importance of habitat conservation?
10. In what habitat types are the known examples of ring species found?

Extension Questions

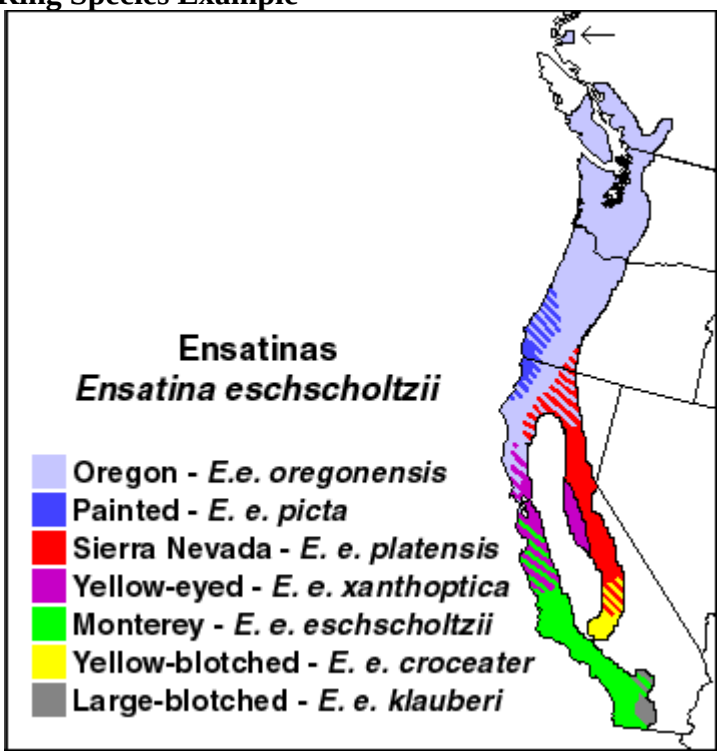
1. Summarizing the principles in the article, give a definition for speciation.
2. What role does geographic isolation play in the development of new species? Describe the process in your own words.
3. If other ring species exists, in which parts of the world would you expect to find them?
4. How would you go about finding possible new ring species?
5. Would you expect to find ring species in aquatic habitats? Why or why not?
6. Is it possible scientists will find fossil evidence of ring species? Why or why not?

Personal Viewpoint Questions

1. In your opinion, what makes this recent research important?
2. Given the rarity of ring species, should any additional importance be placed on the protection of the salamanders in California? Should each unique type be protected? How would you balance salamander protection with individual property rights?

Evolution in a Ring
Student Handout 1

A. Ring Species Example



Source: Northern Prairie Wildlife Research Center. 1997. Checklist of Amphibian Species and Identification Guide. An Online Guide for the Identification of Amphibians in North America north of Mexico. North American Reporting Center for Amphibian Malformations. Jamestown, ND: Northern Prairie Wildlife Research Center Home Page. http://www.npwrc.usgs.gov/narcam/idguide/ (accessed 30 Sept. 2002). Reprinted with permission.

Working in small groups, examine the map shown above. The map illustrates the well-studied example of a ring species, the salamander *Ensatina escholtzii*, of the Pacific Coast region of the United States. Based on reading the article and interpreting the map, answer the following questions:

1. What level of classification do the different colors represent?
2. Which populations are able to breed with each other? Which cannot?
3. Why is there a large gap between the eastern and western populations?
4. A tiny isolated population of *E. e. oregonensis* exists in the north. What problems might result from this isolation?
5. Scientists have taken samples for genetic analysis of the different populations and compared them to each other. Make a prediction regarding which populations are most similar to each other on the genetic level.

If you have access to the Internet, conduct the following group research, extending your knowledge of the article and the map. Assign roles to each student in your group, such as weblogger, note taker, and so on.

1. Access the *E. escholtzii* page on santarosa.edu (listed under "Useful links for student research" at the end of Irwin's article). This site summarizes research done on the salamander populations in California. Find the genetic distances map, linked to the "enzyme analysis" page. Check the results against your prediction from number 5 above. Were you correct? Why or why not?
2. Access the North American Amphibian Guide (listed under "Useful links for student research"). Use the guide to find pictures of as many *Ensatina* subpopulations as you can. Print them out and arrange them in geographic order, or copy the images and arrange them with a computer program.

B. Ring Species News

Write a short article suitable for a local newspaper with the headline: "Why are ring species interesting?" Exchange articles with another student. Compare and discuss each other's views.

Evolution in a Ring
Student Handout 2

A. Ring Species and Geography

Form a small group. Assign roles for each student, such as book researcher, web resources investigator, principal author, map maker, and so on.

Using book and Internet map resources (suggestions are listed below), attempt to locate two or three areas where ring species might be found. Base your predictions on geography, habitat, and state of development.

Write a proposal documenting your predictions. Include a map of the area you have identified, with supporting evidence. Discuss the geography that creates possible ring species, habitats where they might be found, and the type(s) of development in the area. Include an outline for how you might document the presence of any ring species in the area.

Sample resources

Maps/Geography

- *Goodes World Atlas*. Rand McNally, 2003 or other edition..
- *Geography: Realms, Regions and Concepts*.. H. J. de Blij, Peter O. Muller. Willey and Sons, 1999 or 2003.

Habitats/Ecosystems

- *Ecoregions: The Ecosystem Geography of the Oceans and Continents.* Robert G. Bailey. Springer-Verlag Telos, 1998.
- Also see websites listed under “Useful links for student research” at the end of Irwin’s article.

B. Ring Species and the Public

How would you explain ring species to people with little scientific background? Write an illustrated article suitable for a local paper on one of these topics:

- How a single species changes through time.
- How a single species becomes two or more species.

C. “What if?” Scenarios

Choose one of the following scenarios for your project:

- Suppose the planned development of a shopping mall threatens habitat for the variant of salamander found in southwestern California, which cannot interbreed with its counterpart in the southeast. Write a brief statement supporting or opposing the development, based on your knowledge of ring species.
- Imagine you are a researcher who wishes to search for ring species in a new location. You require funding for your research. Write a brief proposal that explains what you hope to do, giving adequate justification for the importance of the research.

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