Lesson Title: Adaptive Radiation and Speciation

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Grade Level: 12  Subject Area: Ecology/Evolutionary Biology

Time Allotted for the Lesson:
This lesson will be completed in a single one-hour class period.

Short Description of Lesson:
This is lesson 3 in a five-lesson unit on biodiversity. In this lesson, students will learn about species adaptations, adaptive radiation, and speciation.

Classroom Layout and Grouping of Students:
All instruction will take place in the classroom. Students will view videos as a class via a Smartboard projector; participate in class discussions as a group; and review parts of the online Evolution 101 tutorial and interact with two online simulations via individual computers at their desks.

State Curriculum Standards met in this lesson:

State of Wisconsin Science Standard F: Life and Environmental Science
Performance Standards - Grade 12
Content Standard: Students in Wisconsin will demonstrate an understanding of the characteristics and structures of living things, the processes of life, and how living things interact with one another and their environment.

BIOLOGICAL EVOLUTION
F.12.5. Understand the theory of evolution, natural selection, and biological classification
F.12.6. Using concepts of evolution and heredity, account for changes in species and the diversity of species, including the influence of these changes on science, e.g. breeding of plants or animals

National Education Technology Standards for Students (NETS•S) met in this lesson:

ISTE NETS for Students (2007)

3. Research and Information Fluency
Students apply digital tools to gather, evaluate, and use information. Students:
  a. plan strategies to guide inquiry.
  b. locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.

Instructional Objectives:
1. When prompted by a quiz question, students will define adaptive radiation and describe one example of adaptive radiation.
2. When prompted by a quiz question, students will describe one example of a trait that is not an adaptation.
3. Students will complete the online Adaptive Radiation and Speciation Lesson Review quiz with 100% accuracy.

Materials, Resources, and Technology:

Materials and resources needed for this lesson:
1. Classroom setting (chairs and desks)
2. Biodiversity Unit syllabus (printed handout)
3. Final project (Google Presentation) instructions and list of topics
4. Signup sheet in Google Spreadsheet for final project groups

Graphics needed for this lesson:
1. Advance organizer
2. Adaptive radiation finches graphic

Technology resources needed for this lesson:
1. Instructor and student computers with an Internet connection
2. Smartboard projector
3. Flash players on computers

Web addresses needed for this lesson:
1. Evolution 101 Defining Adaptation tutorial: [http://evolution.berkeley.edu/evolibrary/article/0_0_0/misconcept_06](http://evolution.berkeley.edu/evolibrary/article/0_0_0/misconcept_06)
2. “Understanding Evolution” Misconceptions About Natural Selection and Adaptation tutorial: [http://evolution.berkeley.edu/evolibrary/article/misconcept_01](http://evolution.berkeley.edu/evolibrary/article/misconcept_01)
4. “Understanding Evolution” Speciation tutorial: [http://evolution.berkeley.edu/evolibrary/article/0_0_0/evo_40](http://evolution.berkeley.edu/evolibrary/article/0_0_0/evo_40)

Student’s Present level of Performance and Knowledge:

Students must know how to navigate the Web and have a basic understanding of biology and genetics from their high school biology class. In addition, they should have completed lessons 1 and 2 of the Biodiversity Unit, which introduced the concept of species adaptations.
**Instructional Procedures:**

**Lesson Set:**

The teacher will introduce the lesson by showing the class the short PBS NOVA video, “Evolution in Action: Salamanders” (3:21) via the Smartboard projector. This video describes the adaptations of a salamander species as it spread out to different geographic locations of California. These adaptations represent an adaptive radiation event that is evolving into a speciation event. The video serves as a review of lesson 2 content and an introduction to the content of lesson 3. A short class discussion will follow.

**Techniques and Activities:**

1. Following the lesson set, the teacher will direct the students to the Biodiversity Unit Website and review the Advance Organizer graphic. The teacher will point out that lesson 3 covers the topics of adaptive radiation and speciation.

2. The teacher will direct the students to the Adaptive Radiation graphic and have the students scroll through it. Then the teacher will explain that the graphic depicts how adaptive radiation can lead to speciation. The teacher will give the students 5 minutes to read the short article by Dolph Schluter that explains how Darwin’s finches represent the adaptive radiation-to-speciation transition.

3. The teacher will direct the students to the Evolution 101 Website and give them 20 minutes to review the following tutorials: Defining Adaptation, Misconceptions About Natural Selection and Adaptation, Triggering Adaptive Radiation, and Speciation. If the students have time, they can also read through the “sidetrips” that are part of this tutorial. The teacher will remind the students that the Understanding Evolution Glossary is a good reference tool for learning terminology.

4. The teacher will show the class the YouTube video “Facts of evolution: Speciation and extinction” (9:18).

5. The teacher will direct the students to the Adaptive Radiation and Speciation Lesson Review quiz posted on the Biodiversity Unit Website and tell them to take the quiz and check their answers. The teacher will ask the students if they have any questions about the quiz or any of the lesson materials.

6. In the final five minutes of the class period, the teacher will remind the students that they will have one graded assignment for the Biodiversity Unit: to prepare a Google Presentation about biodiversity that will be presented to the class. The teacher will refer to the final project/presentation assignment instructions and point out the sign-up sheet. The teacher will remind the students to be thinking about which topic interests them the most throughout the lesson, because they will need to choose a topic at the end of this lesson. The following are the presentation topics:
   - How do the mechanisms of change in evolution lead to species diversity?
   - How does phylogeny work?
   - Why should people care about protecting species biodiversity?
   - How do people in Wisconsin benefit from species biodiversity?
   - What is a biodiversity hotspot?
   - Describe one of the world’s biodiversity hotspots (other than Madagascar) and explain why it is designated as a hotspot (2 groups; each must choose a different hotspot)

**Lesson Closure:**

In the final two minutes of the second class period, the teacher will explain that lesson 4 will cover
phylogeny, a form of identifying species by their relationships to each other on the “tree of life.”

Adaptations for Special Learners:

Screen reader technology will be available for students who have low vision. The YouTube videos are provided with closed captioning for students who have hearing difficulties; for those who do not, the teacher could contact the video sponsors and ask them to provide a transcript and/or closed captioning in their videos. For the small group activity, students with sight or hearing difficulties will be placed in groups with students who do not have these difficulties so the group members can assist them.

Supplemental Activities - Extension and Remediation:

Supplemental extension activities:

“Darwin and Natural Selection” tutorial (Palomar College Dept. of Behavioral Sciences):
http://anthro.palomar.edu/evolve/evolve_2.htm

“Species, speciation and the environment” ActionBioscience article:
http://www.actionbioscience.org/evolution/eldredge.html

Remediation activities:

YouTube video “A look at the finches of the Galapagos Islands”:
http://www.youtube.com/watch?v=l25MBq8T77w&feature=related (2:11, closed captioning available)

Three-topic tutorial on speciation, including two interactive case studies:
http://ats.doit.wisc.edu/biology/ev/sp/sp.htm

Assessment/Evaluation:

For this lesson, students will self-evaluate their understanding of ideas from the lesson via the online Adaptive Radiation and Speciation Lesson Review quiz.

Student Products:

Students will not be completing a product for this lesson. Instead, they will be working on a project for completion at the end of the five-lesson Biodiversity Unit. During this lesson, the teacher should remind the students that they will need to apply knowledge from this lesson to the final project for the Biodiversity Unit that will be in the form of a Google Presentation. Therefore, students are encouraged to continue thinking about the project.