

Astrobiology

An Integrated Science Approach

Jodi E. Asbell-Clarke
Teon E. Edwards
James L. Larsen
Jeffrey F. Lockwood
Christopher H. Randall



TERC

Astrobiology: An Integrated Science Approach

Sample Copy

Copyright © 2005 TERC. All Rights Reserved

Permission is hereby granted to teachers and students through June 30, 2006 for reproduction for their own classroom use only and not for sale or distribution.

Major funding for this project provided by the National Science Foundation (ESI-9730728).

Additional support provided by NASA Ames and the Origin Forum at the Space Telescope Institute.

For Ordering Information Contact:

TERC
Astrobiology Order Fulfillment Department
Tsana Dimanin, Project Coordinator
2067 Massachusetts Avenue
Cambridge, MA 02140

Phone: 1-617-873-9874

Web Site: <http://astrobio.terc.edu>



History of Life on Earth

Setting the Stage (Teacher Notes)

This chapter is designed to get students thinking about life on Earth and what it might tell us about life on other planets. Students will be dealing with concepts that some may be uncomfortable with. For example, topics like the beginnings of life on Earth and the evolution of life can be provocative, but controversy can be avoided or minimized if you exercise care and control. Be sure to stress that it is not your intention to question personal and religious beliefs. This unit presents the scientific perspective on the most current data, evidence, and theories. Impress upon your students that the goal here is to examine the story of life on Earth through the lens of scientific inquiry.

Many of the major threads of this course, in particular the life, habitability, and energy threads, are central to this chapter. The scientific inquiry thread is also stressed, with emphasis on the importance of inferences based on data. In some cases, especially in evolutionary science, inferences may not be directly testable until new technology and tools enable us to devise more sophisticated ways of collecting and analyzing data. For example, new tools are being developed that extend our ability to extract data from the geological and fossil record. This effort is producing further evidence of how life evolved on Earth and of the important events associated with its evolution.

Geological and fossil data show that life evolved from non-living matter under extreme conditions as soon as the basic requirements of water, raw materials, and an energy source were available. The challenge for astrobiologists is to see if conditions conducive to a similar evolution of life might exist on other worlds.

Challenge

The challenge for this chapter is somewhat broader than earlier challenges. Students reflect on what they have learned not only from this chapter, but also from chapters four through seven as well as from resources available on the Internet. Using a WebQuest, students produce and submit storyboards for a documentary about the possibility of life on other worlds based on our current understanding of life on Earth.

Preparation

1. Make sure you have access to computers and the Internet for this activity.
2. Review the *WebQuest—Life on Earth* prior to class. Decide upon the best way to group your students into teams. Teams of three work well for this project.
3. It can be helpful to pre-assign students to specific jobs and teams. This can serve to distribute students based on the makeup of your class. For example, you can balance teams so each has at least one member who is artistic, one who is a good facilitator and organizer, and one who is comfortable using the Web.
4. If you have limited access to computers in your classroom, you can also print out the Web pages for use in this activity
5. Make enough copies of the blank storyboard template to supply at least ten for each student. To prevent waste, don't give the students all their template copies before they start. Encourage students to discuss and plan, using regular sheets of paper, before they put their first draft on the templates.

Recommended Procedure

Designing the Storyboards

1. Assign students to teams and direct them to go to the *WebQuest – Life on Earth*, which is accessible from the Astrobiology Curriculum Web page for this chapter. They should read the following sections:
 - *Introduction*
 - *Challenge*
 - *Process*
 - *Exhibit*
2. Ask students if they have any questions regarding what is expected of them. Review your expectations for storyboards and explain how you will evaluate the project. You may use our rubric (found in the student guide as well as on the Web site) for grading or have the class develop one of its own.
3. Have students decide which of the jobs, described on the *Process* page, they are going to take. If you have pre-assigned the jobs, inform students of their roles.
4. Have students spend some time brainstorming the elements of a good documentary. Discuss the brainstorming results in class and make a list on the board. Keep this list handy for student reference.
5. Use the rest of the class period as time for students to review the resources and plan the process for developing their storyboards.
6. When they have completed their research, let students work on the first draft of the storyboards in class or as homework.
7. Submit the first drafts for peer editing, and encourage revisions.
8. Recommend that students use color in their final products and strive for the highest quality they can.
9. When teams have completed their storyboards, they should make their presentations.

Evaluation and Presentation of Storyboards

1. A sample rubric you may use is included online with the WebQuest and is also reproduced in the teacher and student guides. However, you may decide modify the sample rubric or develop your own with input from your students. Just make sure that students understand how their storyboards will be graded based on the points awarded in the rubric you use.
2. Have students display or present their storyboards.
3. To be consistent with the WebQuest's theme—"a movie producer and a CEO of a computer company are sponsoring a contest" invite an administrator to act as the producer. You should be the CEO.
4. Invite parents and other students to come and view student storyboards. Encourage the visitors, audience, and administrators to comment on the displays.
5. Have students read the *Conclusion* section of the WebQuest. If you have time, use one of the suggested follow-ups to this activity.

Sample Challenge Rubric

	Beginning 1	Survival 2	Accomplished 3	Exemplary 4	Score
Contribute					
Research & Gather Information	Does not collect any information related to topic.	Collects minimal information—some relates to topic.	Collects basic information—most relates to topic.	Collects information beyond the basics—all relates to topic.	
Shares Information	Does not relay any information to team.	Relays very little information—some relates to topic.	Relays some basic information—most relates to topic.	Relays a great deal of information—all relates to topic.	
On Time	Does not complete assignments on time.	Is consistently late in completing assignments.	Completes most assignments on time.	All assignments completed on time.	
Takes Responsibility					
Fulfills Assigned Job	Does not perform duties associated with job.	Completes very few duties associated with job.	Performs nearly all duties associated with job.	Performs all duties of assigned job.	
Participates in Presentation	Does not contribute during presentation.	Contributes little or irrelevant information during presentation.	Contributes some information during presentation—most is relevant.	Contributes extensively to presentation—all information is relevant.	
Teamwork	Always relies on others to do the work.	Rarely does the assigned work—often needs reminding.	Usually does the assigned work—rarely needs reminding.	Always does the assigned work without having to be reminded.	
Quality of Presentation					
Mastery of Material	Presentation did not exhibit an understanding of key questions.	Presentation exhibited some understanding of key questions.	Presentation exhibited basic understanding of key questions.	Presentation exhibited understanding of key questions and raised new ones worth pursuing.	
Attention to Detail and Creativity	Presentation was messy and not well organized.	Presentation was neat but not well organized.	Presentation was neat and well organized.	Presentation was neat, well organized, and showed extensive creativity.	
Overall Quality	Presentation showed minimal understanding of what class defines as quality.	Presentation exhibited basic understanding of what class defines as quality.	Presentation exhibited near mastery of what class defines as quality.	Presentation exhibited mastery of quality and raises the level in a unique way.	

Total: