



“Tales of the Resolution”

Overview

These educational activities are designed to support mastery of the College and Career Readiness anchor standards identified in the Common Core State Standards for English & Literacy in Science (http://www.corestandards.org/assets/CCSSI_ELA%20Standards.pdf). We provide sample reading, writing and activity prompts focused on “Tales of the Resolution,” a series of graphic novels about the *JOIDES Resolution (JR)*, the scientific ocean drilling ship operated by the International Ocean Discovery Program (IODP).

“Tales of the Resolution” are designed by Carl Brenner (Borehole Research Group, Lamont-Doherty Earth Observatory of Columbia University) in collaboration with educators sailing on the *JR*. He creates “Tales of the Resolution” using a commercial program, “Comic Life” (<http://plasq.com/> and <http://plasq.com/education>).



“Tales of the Resolution” are available online at:

- The *JOIDES Resolution* website: <http://joidesresolution.org/node/263>.
- Lamont Doherty Earth Observatory Borehole Research Group website: <http://www.ldeo.columbia.edu/BRG/outreach/media/tales/index.html>, and
- Earth2Class <http://earth2class.org/site/whats-the-role-for-graphic-novels-in-science-education-with-carl-brenner/>.

Target Ages

Grades 6th-12th grade and gifted and talented students in 3rd-5th

Time

45 minutes to 1 hour per episode

Author

These suggested supplementary reading materials are written by Michael Passow (Dwight Morrow High School and School of Rock participant).

Special Acknowledgement

Carl Brenner (Lamont Doherty Earth Observatory Borehole Research Group); Sabreena Britt (Effie Yeaw Nature Center); John Meyer (Oregon Connections Academy)

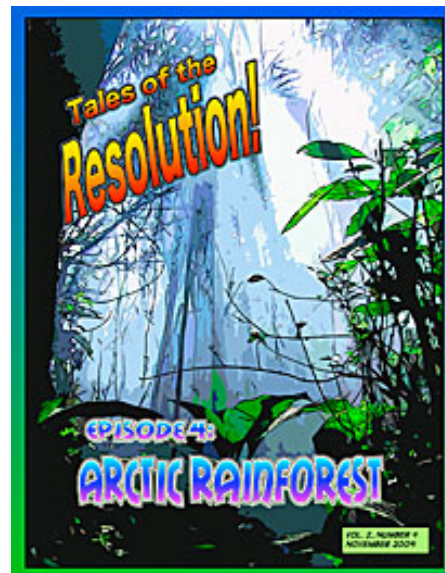
To date, six episodes have been issued.

Episode 1: Tales of the Resolution (Oct 2008) ”
(<http://joidesresolution.org/node/3309>)

The reader is introduced to the ship and its history of discovery. At that time, the JR was about to undergo a major re-fitting after two decades of scientific ocean drilling.

Episode 2: Re-Fit Madness (Feb 2009)
(<http://joidesresolution.org/node/3310>)

The focus of this episode is on the renaissance of the JR undertaken in Singapore. It provides a rare description of how science research at sea sometimes requires the re-engineering of the ship itself. Taking on such an effort is possible through the highly coordinated efforts of thousands of scientists, engineers, technicians and other workers.



Episode 3: Resolution Reloaded (June 2009)
(<http://joidesresolution.org/node/3311>)

This episode provides colorful explanations of the JR's drilling and borehole logging operations, lab equipment, and range of skills required of personnel aboard the ship and glimpses of life during an expedition.

Episode 4: Arctic Rainforest (November 2009)
(<http://joidesresolution.org/node/3312>)

Read about an expedition in the Pacific that investigated questions about major climate changes during the past 50,000,000 years through the study of carbonate microfossils and borehole logs. Learn how their sites were selected and why microfossils are important indicators of age and climate change.

Episode 5: Choose Your Own Tale of the Resolution—Jobs on the JR (June 2011)
(<http://joidesresolution.org/node/3314>)

The reader can select to follow a scientist, an engineer or a welder through a re-creation of an expedition where a problem that threatened the success of the research was identified and, through their combined skills, successfully solved.

Episode 6: In Search of Ancient Lava Flows (April 2012)
(<http://joidesresolution.org/node/3313>)

Expeditions at sea do not always go as planned, so this Tale relates what happened when the drill became stuck in the ocean bottom. The reader finds out how the staff on the JR dealt with this unexpected problem. This episode also focuses on how and why we investigate ancient lava flows.



Suggestion

Ideally, you and your students should begin with Episode 1 and work through them in order to develop a familiarity with the scientific and technological goals. However, much can still be gained reading them individually or in a different sequence.

These Lesson Plans include *Student Pages* with suggested questions and activities to accompany the readings, and *Teacher Pages* with suggested answers to the questions and other information useful for implementing the curriculum. We recognize that you the teacher are the expert on what would work best in your classroom, so feel empowered to modify these Lesson Plans for your situation.

Objectives of the Graphic Novels:

1. Scientific ocean drilling retrieves rock and sediment cores that can be used to infer important patterns of climate and Earth events in the geologic past.
2. Geophysical instruments lowered into the hole from which cores have been retrieved can provide additional valuable information about the nature of ocean sediments and Earth's history.
3. Scientists work with engineers and technicians to develop strategies and create instruments necessary to solve problems, even under the extreme conditions of conducting research out at sea.
4. Science and other subjects provide effective formats to help students meet Common Core ELA standards for college and career readiness, reading and writing.

Lesson Objectives:

1. To enhance literacy in science
2. To have students answer critical thinking questions and comprehension questions related to each episode of the Tales of Resolution
3. Students will be able to comprehend the scientific graphic novels by answering the questions with 90% accuracy.

Extensions:

1. Have students write down follow-up questions for other students to answer.
2. Have students write down questions they would like to ask the characters/people in the episode.
3. Use the JR Playing Cards
<http://joidesresolution.org/node/3133>
4. HardCORE Writing
<http://oceanleadership.org/education/deep-earth-academy/educators/classroom-activities/grades-5-8/hardcore-writing-leg-171-pencil/>
5. Explore Careers at Sea: Conducting Science on the JR
<http://joidesresolution.org/node/3126>
6. Explore the different expedition of the JR at www.joidesresolution.org



Materials

- Computer access to Tales of the Resolution graphic novels <http://joidesresolution.org/node/263> or <http://www.ideo.columbia.edu/BRG/outreach/media/tales/index.html> and other referenced websites.
- Teacher Pages
- Student Pages
- One lesson includes suggestions for enrichment that involve making a model ACORK, but selecting what materials to use is part of the challenge.
- If desired, your school could purchase Comic Life licenses so students can create their own novels. (<http://plasq.com/> and <http://plasq.com/education>)
- Some of the episodes suggest using additional materials
- Exit Slips to share what they learned.

SAMPLE EXIT SLIP:

What I enjoyed most from reading this episode was
Two questions I have are

Standards & Literacy Principles: Different episodes can be used to introduce and/or expand a range of standards and literacy principles. Below is a list of potential connections that can be made:

Next Generation Science Standards Performance expectations

- MS-ESS1-4: Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6 billion-year-old history.
- MS-ESS2-2: Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
- MS-ESS2-3: Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.
- MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- HS-ESS1-5: Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.



- HS-ESS2-1. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.

Next Generation Science Standards Disciplinary Core Ideas

- ESS1C: The History of Planet Earth
- ESS2.A: Earth Materials and Systems
- ESS2.B: Plate Tectonics and Large-Scale System Interactions
- ESS2.D: Weather and Climate
- ESS2.E: Biogeology
- ESS3.d: Global Climate Change
- PS4.1: Wave Properties
- ETS1.b: Designing Solutions to Engineering Problems

Next Generation Science Standards Crosscutting Concepts

- Patterns
 - Empirical evidence is needed to identify patterns.
- Scale, Proportion, and Quantity
 - Patterns observable in one scale may not be observable or exist at other scales.
- Stability and Change
 - Change and rates of change can be quantified and modeled over very short or very long periods of time.
- Interdependence of Science, Engineering, and Technology
 - Science and engineering complement each other in the cycle known as research and development. Many R & D projects may involve scientists, engineers, and others with wide ranges of expertise.

Earth Science Literacy Principles

- Big Idea 1. Earth scientists use repeatable observations and testable ideas to understand and explain our planet,
- Big Idea 3. Earth is a complex system of interacting rock, water, air, and life.
- Big Idea 4. Earth is continuously changing.
- Big Idea 6. Life evolves on a dynamic Earth and continuously modifies Earth.

Ocean Literacy Essential Principles

- Principle 1: Earth has one big ocean with many features.
- Principle 2: The ocean and life in the ocean shape the features of Earth.
- Principle 7: The ocean is largely unexplored.

Climate Literacy: The Essential Principles of Climate Science

- Principle 4: Climate varies over space and time through both natural and man-made processes.
- Principle 5: Our understanding of the climate system is improved through observations, theoretical studies, and modeling.
- Principle 7: Climate change will have consequences for the Earth System and human lives.



Reading Standards for Literacy in Science and Technical Subjects 6–12

http://www.corestandards.org/assets/CCSSI_ELA%20Standards.pdf

Use *Tales of the Resolution* episodes and reading questions to address these standards:

Key Ideas and Details

1. Cite specific textual evidence to support analysis of science and technical texts.
2. Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions
3. Follow precisely a multistep procedure when carrying out experiments, taking measurements or performing technical tasks.

Craft and Structure

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grade-appropriate texts and topics
5. Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic.
6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text.

Integration of Knowledge and ideas

7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
8. Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.
9. Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

Range of Reading and Level of text Complexity

10. Read and comprehend science/technical texts in the grade-appropriate text complexity band independently and proficiently.

College and Career Readiness Anchor Standards for Writing

[See http://www.corestandards.org/assets/CCSSI_ELA%20Standards.pdf, pp. 63 – 66 for more details.]

The grades 6–12 standards define what students should understand and be able to do by the end of each grade span. They correspond to the College and Career Readiness (CCR) anchor standards below by number. The CCR and grade-specific standards are necessary complements—the former providing broad standards, the latter providing additional specificity—that together define the skills and understandings that all students must demonstrate.

Text Types and Purposes

1. Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence.
2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
3. Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details and well-structured event sequences.



Production and Distribution of Writing

4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.
6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

Research to Build and Present Knowledge

7. Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.
8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
9. Draw evidence from literary or informational texts to support analysis, reflection, and research.

Range of Writing

10. Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.