Tales of the Resolution Teacher Page

(Answers are in italics)

Lesson Plan for Episode 1 "Tales of the Resolution"

(http://joidesresolution.org/node/3309)

After reading the episode, either in a screen or print version, students demonstrate their understanding by answering reading comprehension questions. The following sample questions can be modified based on academic level and learning styles of individual classes and students.

1. What are three important reasons for operating the *JR*?
   1. *To explore earth's history and structure*
   2. *To drill into the seafloor for core samples*
   3. *To cut core samples into sections for study*

2. Four steps in collecting seafloor materials include:
   W) A cylinder of mud or rock (core) fills the drill pipe in 9.5 m (30-ft.) sections
   X) Cores are brought up to the ship and prepared for study.
   Y) Rotating cones on the bit rotate as the drill string rotates
   Z) The drill bit is lowered to the seafloor on the end of a drill string

   What sequence of letters represent the correct order of these steps? *ZYWX*

3. Which of the following can be discovered by borehole data?
   (C) Physical characteristics of the sediments or rocks that were cored

4. When did scientific ocean drilling for Earth Science research begin? How long has ocean drilling for earth science research been conducted?
   1968
   Answers will change

5. What do scientists call the data collected from specialized tools sent down the borehole?
   logs

- Use the sample "exit slip" to share what they learned.

Teacher Page: Episode 2

(Answers are in italics)

Lesson Plan for Episode 2 "Re-Fit Madness"

(http://joidesresolution.org/node/3310)

After reading the episode, either in a screen or print version, students demonstrate their understanding by answering reading comprehension questions. The following sample questions can be modified based on academic level and learning styles of individual classes and students.

1. During its first 20 years of exploration, the *JOIDES Resolution* made many discoveries. Some of these are included in an online activity called "Treasure Chest of Cores" (http://joidesresolution.org/node/273).

Select one or more of these and explain their importance in deciphering Earth's history.

Answers for each core sample option:

Leg 171: This core shows the impact of an asteroid hitting earth 65 mya and the micro-organisms that went extinct at that time. It is important for understanding what animal lineages existed and evolved into current life forms.

Leg 158: This core shows that hydrothermal ores are deposited both above and below sediments. This is important for analyzing sediment data and earth's history.

Leg 183: This core shows land crust found in the middle of the Indian Ocean surrounded by volcanic rock. This is important because it tells us that a piece of a continent broke off and was covered by volcanic lava flows and then covered by ocean. It shows a historical event.

Leg 208: This core shows 2 very distinct physical properties that show evidence for a massive, quick warming event with release of gases from the ocean. It is important as a major historical event on earth that affected life. Could this happen again then since it happened in the past?

Leg 165: The physical changes across this core support that climate change initiating in Greenland affected the tropical regions of Venezuela. It is important because it teaches that tropical areas have a correlation to climate change.

Leg 169: This core shows a large copper deposit. It was the first one found of this size and was important to learning how copper mineralizes and helping the mining industry on land.

2. Match each part of the *JOIDES Resolution* with what happens in that location.

1. Area in the rear of the ship where helicopters can land and take off — *D. Helipad*
2. Bottom of the ship that floats in the water — *E. Hull*
3. Captain and crew control the ship, science operations are planned — *B. Bridge*
4. Kitchen and dining area — *G. Mess and galley*
5. Multi-story structure that contains the scientific laboratories — *F. Labstack*
6. Rooms where crew and scientists sleep — *A. Accommodations*

7. Tower-like structure that can lift and position the drill string *C. Derrick*

3. Re-fitting the JR involved many steps that had to be carried out in an organized order. Below is an alphabetical list of 18 important steps. Read the episode and make notes to learn what happened during the re-fitting. Use the list below to show the sequence of events by listing each step's letter in the correct order in the table. Give a reason why each step had to happen before the next step.

Step	Letter	Reason this step goes before the next step
1	***O.***	*The derrick, the largest body on the ship, had to be removed first for refurbishing before any other demolition began because it was in the way.*
3	***C.***	*Demolition of the bridge had to be done before it could be replaced.*
4	***P.***	*The refurbished derrick was replaced.*
5	***R.***	*It was then towed into the dry dock.*
7	***N.***	*Being dry and accessible, the propellers were transported to shore and cleaned.*
8	***Q.***	*The hull was repainted while the propellers were off and cleaned.*
12	***I.***	*A new bridge was put in after the accommodations underneath were finished.*
13	***F.***	*Installation of electrical lines now that walls were in place.*
15	***B.***	*Construction within the bridges and labs took place because it is inside of the larger structures*
16	***M.***	*Placement of lifeboats on the outside took place.*
17	*K.*	*New Galley and Mess Hall went in for food on board. You do not want food to spoil during construction.*
18	***G.***	*Ship leaves the dry dock for sea trials to test everything out.*

Use the sample "exit slip" to share what they learned.

Teacher Page: Episode 3

(Answers are in italics)

Lesson Plan for Episode 3 "Resolution Reloaded"

(http://joidesresolution.org/node/3311)

After reading the episode, either in a screen or print version, students demonstrate their understanding by answering reading comprehension questions. The following can be modified based on academic level and learning styles of individual classes and students.

1. Assessing whether the JR was ready to begin scientific operations after its renovation was a 7-member group. What was the title for this group? What was its acronym? Why do we often use acronyms? *The Readiness Assessment Team (RATS). We use acronyms for note-taking and making it easier to refer to items.*

2. Give two reasons why "outside evaluators" are important in determining the effectiveness of a program. *Outside evaluators will see things that others did not see or for a second set of eyes and brains to catch things that are missed.*

3. Match the job title with the activity:

1. Captain	I. Operates the ship and keeps it safe, and running
2. Core curator	B. Describes and catalogs every core
3. Engineer	C. Keeps the ship and all equipment working
4. First Mate	J. Operates the ship when the captain is not
5. Head of food services (Camp Boss)	G. Supervises the galley and mess
6. Lab office	D . Manages equipment in science labs
7. Logging staff scientist	H. Sends the instrument string into the hole
8. Offshore installation manager	E. Runs drilling operations from shore
9. Scientist	A. Conducts the scientific investigations
10. Senior Tool Pusher	F. Runs drilling operations during the other shift

You can find out more about marine careers from the JR website Resources section (http://joidesresolution.org/node/904).

4. How long is each core when it is brought up and carried to the receiving platform?
   9.5 meters

5. What is the length of each segment after the core is cut? Why is it useful to cut it down?
   150 cm. It is cut to this length to store them and move them easily.

6. Learn more about "What Is a Core?"
   Answers will vary.

7. When cores are retrieved, they are first sent through a series of instruments. Complete the table by writing a brief description of what can be measured by each instrument.

Instrument	Physical properties measured by this instrument
Formation Microscanner	*Measures resistance to electrical current, meaning the texture of the sediment is determined- hard to soft.*
P-wave Logger	*Measures how sound waves travel through the core- the harder the core, the faster sound moves through it.*
Digital imaging system	*Takes a photso of the cores*
Color reflectance system	*Measure the colors of the cores*

8. You can learn more about the value of borehole logging through "It's Not Just the Core that Tells the Hole Story."
   - Use the sample "exit slip" to share what they learned.

Writing across the Curriculum

- Imagine you have been selected to write blogs about the expedition.
  - What would you include in a blog about what life is like aboard the JR during your non-working shift?
  - What would you blog about the scientific activities taking place during this expedition?
- Use the information provided in this episode to write what needs to be done to retrieve a core at the selected drilling site. Begin with hoisting the stored pipes into a vertical position, and end with the core being carried to the receiving platform.

Teacher Page: Episode 4

(Answers are in italics)

Lesson Plan for Episode 4 "Arctic Rainforest"

(http://joidesresolution.org/node/3312)

After reading the episode, either in a screen or print version, students demonstrate their understanding by answering reading comprehension questions. The following can be modified based on academic level and learning styles of individual classes and students. Examples of suitable questions:

1. In this episode, our planet is described as once being a "Greenhouse World," but now is an "Icehouse World." What do scientists mean by these phrases? What evidence has been found that indicates Earth was much warmer 50 million years ago than it is now?
   In the Greenhouse World, temperatures were much warmer and there were no ice caps at the poles. There were swamp forests full of alligators and tortoises. Evidence: fossils from these creatures have been found in 50-million-year-old rocks. During the Icehouse World, we have ice caps at the poles.

2. What are some kinds of materials scientists try to obtain from sea floor cores to determine past climate conditions? Why are these useful to interpreting ancient climates?
   They collect ocean sediments – these contain a record of past climate conditions.

3. Why did the scientists on this JR expedition choose this particular study area?
   It is rich in sediments that contain a record of climate change over the past 53 million years. Sediments from latitudes closer to Antarctica have moved up towards the equator over time.

4. Whose job is it on a JR expedition to determine the age of the core materials? What do they use to estimate the sediment age?
   Biostratigraphers do this by looking at samples under a microscope to see which species of microfossils are present. By identifying the species present, they can estimate the sediment age.

5. Give a brief explanation of why the older parts of the cores were dark with no calcium carbonate shells, and the younger upper parts were full of carbonate microfossils.
   The carbonite compensation depth changed

6. Based on the expedition's findings, when did Earth experience a dramatic change from older sediments with no calcium carbonate to young sediments filled with calcium carbonate? What probably happened at that time period?
   At this site about 34 million years ago. Large ice sheets began to develop in Antarctica.

- You can learn more about the expedition by watching the PEAT News Network at http://joidesresolution.org/node/2110.

- Use the sample "exit slip" to share what they learned.

Enrichment:
Read about "The Fate of Calcium Carbonate" on the American Chemical Society website:

http://www.melodyshaw.com/files/The_Fate_of_Calcium_Carbonate.pdf

If you try this experiment, write a "lab report" for your teacher in the appropriate style used in your school. As an alternative, follow this style:

Purpose - Give the reasons why you do this and the key questions.
Procedure - State clearly and concisely the steps you followed.
Results - Present what you found in words and, if appropriate, graphs and tables.
Discussion - Explain the meaning of your results and answers to the key questions.
Summary (Conclusion)- Provide a short recap of what you did and found.
Acknowledgements and References - Thank people who helped and cite print and online references used.

Teacher Page: Episode 5

(Answers are in italics)

Lesson Plan for Episode 5 "Choose Your Own Tale of the Resolution! Jobs on the JR"

(http://joidesresolution.org/node/3314)

This episode uses the choose-your-own story format, so students should try to enjoy it by selecting each pathway consecutively. After reading each story, students should answer questions such as the samples below.

Examples of suitable questions include:

1. An ACORK is a tool system that
   A. floats like a cork on the surface
   B. *penetrates the sediments to collect data from below the seafloor*
   C. rises and falls through the water column
   D. slowly crawls over the sea floor like the Mars rovers

2. What is the purpose of each of these parts? Complete the chart.

Component	**Purpose**
Casing	*Metal pipe that is lowered into the ocean floor to prevent shallow sections of the hole from collapsing*
Cement and bridge plug	*Seals the bottom of the casting, prevents leakage, allows additional instruments to be added*
Data recorder	*Stores pressure and temperature data until they can be downloaded by ROV or submersible.*
Hanger	*Sets the ACORK flush with the seafloor*
Hydraulic umbilical	*Transmits pressures from the formation screens to the seafloor data recorder*
Re-entry cone	*Helps guide the drill string and casing during multiple trips into the hole*
ROV platform	*Where submersibles and ROVs land to collect data and samples*

Screens	*Allow water below the seafloor to reach the sensors while protecting them from sediment*
Well head	*Where additional instruments can be installed*

3. If all goes according to the research design, for how long will the ACORK remain on the sea floor? What are the benefits of conducting research for such a long time period?
   20 years. Get lots of data over time, can be compared to each other and see changes.
4. How, at first, will the data be retrieved? What are longer-term plans to obtain the data?
   What probable assumptions were made to design the data collection in this way?

Data is retrieved by ROV. Later by a fiber-optic cable, allowing data to be received in offices in real time. Assumptions were made that this fiber optic technology will be available in a few years. And that the ACORK will still be working properly!

Writing across the Curriculum

- Imagine you are one of the people from the JR featured in this episode, and have been invited to talk at a school like yours. Below are sets of questions that the students would like to have answered in your talk. Based on what you read in this episode and other knowledge, what would be your answers to the questions?

➢ Questions for the Scientist:
   What is your area of scientific expertise?
   Why is it helpful to have knowledge from many different subjects?
   What do you hope to learn through this expedition?

➢ Questions for the Welder:
   What do you do in your job on the JR?
   Where did you get the experience needed to land this job?
   How do you keep yourself safe when you are welding?

➢ Questions for the Engineer:
   What is your basic job aboard the JR?
   What did you do before this that helped you do your job on the JR well?
   Why is it important to be very precise in your work?

- This episode focuses on a problem with an important piece of the ACORK. Use the information in this episode to write a report about it to the Ocean Drilling Board of Directors. Here are points to include:

- What was the problem?
- Why was it important to correct the problem before the ACORK was put in place?
- How as the problem solved by the engineer?
- How was the problem solved by the welder?

Technology Enrichment

You can't make a real ACORK, but you can make a scale model. Use the diagram provided in the episode as your guide. Here are some questions to consider as you work.

1) Trace or photocopy the diagram of the ACORK on page 3. Decide how you should measure the length of each part in the drawing so you will have the same relative size in your model?
   Be aware that the actual ACORK was over 300 feet (100 m) in length and about 2 ft (0.7 m) in diameter.)
2) What materials will you use to build the model? Describe the advantages and disadvantages of these and other materials?
3) How will you set up the model for display? How will you label the sections?
4) What other information should you include in your finished model to explain what ACORKs can do?

This activity could be presented as a competition among groups in the school, with a "science fair" to share efforts and judge effectiveness.

Teacher Page: Episode 6

(Answers are in italics)

Lesson Plan for Episode 6: "In Search of Ancient Lava Flows"

(http://joidesresolution.org/node/3313)

After reading the episode, either in a screen or print version, students demonstrate their understanding by answering reading comprehension questions. The following can be modified based on academic level and learning styles of individual classes and students. Examples of suitable questions:

1. Use a world map to locate the Louisville Seamounts. In what region of the ocean are they found? What is their approximate latitude and longitude? How far away are they from some better-known geographic locations?
   They are in the southwest Pacific Ocean. 61.9 degrees S/157 degrees W, is where they start at one end. They are east of New Zealand.

2. What scientific questions does this expedition seek to answer?
   Is the hotspot making the Louisville Seamounts moving? Did it move the same way the Hawaiian hotspot moved 80-50 million years ago?

3. When did the Chief Scientist first announce his inspiration for this expedition? Why did it take such a long time before he could put to sea?
   When he was first a graduate student! It took a long time for preliminary research and convincing colleagues that it was worth pursuing.

4. What are seamounts? How do they form? What makes seamounts like the Louisville or Hawaii-Emperor seamounts unusual and worth the effort of this expedition?
   Seamounts are mountains in the ocean. They form as volcanoes. They sometimes break through and become islands. These are unusual because their magnetic particles show systematic change over time and that the hotspot forming them may have moved.

5. What evidence are the scientists looking for in recovered lava flows?
   They are looking for the orientation of the magnetic particles – to see if they are all the same or if the angle has changed over time.

6. This Tale focuses on solving problems that can occur while at sea during an expedition. What was the problem that suddenly developed during the drilling and core recovery?
   The drill string got stuck!

7. How did the JR engineers and drilling crew finally solve the problem of the stuck drill bit?
   They exploded it out!

8. What safety measure did everyone aboard have to take to avoid an accident when the plan for solving the problem was put in place? Why was this necessary?
   Turn in their cell phones. This was necessary because they didn't want anything transmitting a signal that could set off the explosive by accident.

9. Did their solution work? What was the next problem the expedition had?
   Yes, it worked. The next problem was the free fall funnel tipping over.

10. What problem was found at the new hole with regard to the original scientific question? What was recovered? Why couldn't these rocks be used to answer the question?
    The cores were breccias and very few lava flows. Breccias are broken fragments of rocks and did not contain the kinds of evidence needed to answer the question about the lava flows.

11. What do sedimentologists study? Petrologists? Alteration petrologists?
    Sedimentologists study the sediments. Petrologists study rocks. Alteration petrologists study changes in the rocks.

12. After the ship finished this expedition at sea, what plans did the scientists have to continue their research on land?
    They would take more samples and study them back in their own labs.