Los **A**ngeles **U**nified **S**chool **D**istrict
Office of Curriculum, Instruction and School Support
Elementary History-Social Science and
Elementary Science Divisions

Day 4
Survival Solutions

ESSENTIAL QUESTION: What do human beings need to survive and thrive in a new environment?

FOCUS QUESTION: How does a new colony solve problems?

Objective

Students will analyze primary sources to determine how the seventeenth century colonists addressed their problems. They will then investigate different ways to generate oxygen which is one problem faced by space colonists.

Quick Look

- Conceptual Flow: Having identified problems that arose in the early colonies and in the Biosphere students will conduct investigations that generate solutions.

- Summary: This lesson is designed to build on the problems generated in Day 3 and consider possible solutions. Analysis of primary sources indicates that cooperation with Native Americans helped solve the problems of seventeenth century colonists.

  By conducting a simple electrolysis demonstration and setting up an experiment to measure how much oxygen can be harvested from a water plant, such as elodea, students can experience how NASA is solving the oxygen problem for space colonists.

- Time: Approximately 3 ½ - 4 hours

- History Content Standards:
  - 5.4 Students understand the political, religious, social, and economic institutions that evolved in the colonial era.
  - 5.4.1 Understanding the influence of location and physical setting on the founding of the original 13 colonies, and identify on a map the locations of the colonies and the American Indian nations already inhabiting these areas.

- Science Content Standards:
  - LS 5.2f Students know plants use carbon dioxide (CO_2) and energy from sunlight to build molecules of sugar and release oxygen.
  - PS 5.1.i Students know the common properties of salts, such as sodium chloride (NaCl).
  - I & E 5.6.b Develop a testable question.

- I & E 5.6.f Select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations.
- I & E 5.6.g Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.
- I & E 5.6.h Draw conclusions from scientific evidence and indicate whether further information is needed to support a specific conclusion.
- I & E 5.6.i Write a report of an investigation that includes conducting tests, collecting data or examining evidence, and drawing conclusions.
- PS 4.1a Students know how to differentiate among igneous, sedimentary, and metamorphic rocks by referring to their properties and methods of formation (the rock cycle).

- *Common Core State Standards:
  - Speaking & Listening: Grade 5: 1, 2
  - Writing Grade 5: 2, 7, 8, 9, 10
  - Reading Informational Texts Grade 5: 1, 3, 4, 7, 9, 10
    *see Appendix A

- Student Products :
  - Entry on the Historical Problem/Solution Chart
  - Entry on the Biosphere 2 Problem/Solution Chart
  - Data tables (Task 2)
  - Space Colonization Application entry: Physical and Social Survival Needs Assessment
  - Journal Entries

BACKGROUND

History Background

The leaders of the Plymouth colonists made a defensive alliance with Massasoit, chief of the Wampanoags. The agreement, in which both parties promised to not "doe hurt" to one another, was the first treaty between a Native American tribe and a group of colonists. Massasoit prevented the failure of Plymouth Colony and the almost certain starvation that the Pilgrims faced during the earliest years of the colony's existence. By forging a treaty with this tribe, the colonists were able to solve the problems of lack of food and unfriendly neighbors.

Science Background

The oxygen generators aboard the International Space Station (ISS) use electrolysis to separate the oxygen and hydrogen atoms in water molecules. However, it is not as simple as hooking a battery up to 2 electrodes and sticking them in a tank of water. Water is a poor conductor of electricity. If we add table salt to the water it improves the conductivity of the water but produces chlorine gas, not oxygen. In our safe classroom version of electrolysis, we will be producing hydrogen and carbon dioxide, rather than the hydrogen and oxygen generated in the International Space Station. For more information, see "Closing the Loop: Recycling Water and Air in Space" (Teacher Resource 4.2).

Another method of generating oxygen is to harvest the oxygen produced by plants during the process of photosynthesis. Students can set up a controlled experiment that measures oxygen production under two variables:

- Increased light intensity
- Increased amount of carbon dioxide

Teachers may do one or both science investigations followed by a short reading from NASA.

Vocabulary

- **Task 1:** oxygen generator, electrolysis, apparatus, self-contained, electrodes, anode, cathode
- **Task 2:** Elodea
- Additional vocabulary words are embedded and defined in the student informational texts, "Making Oxygen from Water" and "Oxygen From Plants"

Materials

- 17th Century Colonial Survival Solutions Power point (Teacher Resource 4.1)
- Visual Analysis Organizer, Treaty of Massasoit (Student Handout 4.1)
- Making Oxygen from Water (Student Handout 4.2)
- Oxygen From Plants (Student Handout 4.3)
- Elodea Investigation Data Sheet (for Task 2, Student Handout 4.4)
- Large Classroom Historical Problem Solution Chart (Teacher Resource 3.4)
- Large Classroom Biosphere 2 Problem Solution Chart (Teacher Resource 3.5)
- Space Colonization Application (Teacher Resource 1.2 ***This is from Day 1***)

SCIENCE TASK 1: Electrolysis Investigation Materials:

- Closing the Loop: Recycling Water and Air in Space (Teacher Resource 4.2)

For each group of 4:

- **From FOSS 4th Grade Kit, Electricity and Magnetism**
  - ☐ D cell
  - ☐ D cell holder
  - ☐ 3 short copper wires
  - ☐ Bulb and bulb holder
  - ☐ Package of Test Object used in the *insulator/conductors test*

- **From FOSS 5th Grade Kit, Mixtures and Solutions**
  - ☐ Tub of Epsom Salt
  - ☐ 20 Clear plastic cups
  - ☐ 1 Pitcher
  - ☐ 20 Popsicle sticks
  - ☐ 10 Vials and lids

- **From your classroom supplies:**
  - ☐ 2 short pencils sharpened at both ends

- ☐ Masking tape
- ☐ 9v batteries still in their package
- ☐ 150ml water

SCIENCE TASK 2 – Photosynthesis Experiment Materials:
For each group of 2:

- ☐ 8 cm Elodea sprig
- ☐ 2 liters aged tap water (2 liters of faucet water set out for 48 hours)
- ☐ sharp scissors
- ☐ tape
- ☐ rubber bands
- ☐ timer
- ☐ metric ruler
- ☐ pen and paper
- ☐ Elodea Investigation, Lab Record (Student Handout 4.4)

- **From FOSS 5th Grade Kit, Living Systems**
  - ☐ 2 vials (18 x 175 mm)
  - ☐ vial holder

- **From FOSS 5th Grade Kit, Mixtures and Solutions**
  - ☐ baking soda (1 teaspoon)

- **From FOSS 3rd Grade Kit, Matter and Energy**
  - ☐ light source (40 watt light bulb)
  - ☐ lamp

Part I
LOOKING BACK

Objective

Students will analyze an image and a primary source document to determine how the 17th century colonists solved some of the problems identified in the activity in Day 3.

Engage/Introduction

- Display the Historical Problems/Solutions Chart. Remind students of the various problems that they discussed yesterday.
- Tell students that today they will use the same analytical processes they used on Days 2 and 3 to determine how the 17th century colonists solved some of their problems.

Explore/Analysis

- Project the 17th Century Colonial Survival Solutions Power point (Teacher Resource 4.1)
- Read aloud the primary source, Treaty With Massasoit. Explain that Sachem means leader and Massasoit means great leader.

Teacher will ask:

- *What was the mood during the visit of Massasoit?* (Cite evidence from the text)
- *What rules did the colonists and Wampanoags agree to?* (Cite evidence from the text)
- *Who punishes a person who breaks the rules?* (Cite evidence from the text)
- *What problem(s) did this help solve?* (Cite evidence from the text)

- Show the next slide of the engraving from the Library of Congress depicting the creation of the treaty.
  - Students work in pairs to analyze the engraving using the visual analysis sheet (Student Handout 4.1).
  - Provide sufficient time for students to thoroughly investigate the image.
- Review the image with the class as a whole group. Emphasize the role the treaty played in helping to solve some of the problems identified yesterday.

Explain/Conclusion

Based on evidence from the analysis, add possible solutions, to the Class Problem/Solution Chart begun on Day 3.

- **Journal Entry**
  - Students complete a journal entry that answers the focus question: *How does a new colony solve problems?*

PART II
LOOKING FORWARD

Objectives

Students will investigate two methods currently being used or developed by NASA to provide oxygen to astronauts in the International Space Station (ISS) and future space colonists.

Task 1 Electrolysis Investigation

Engage/Introduction

- Ask the class to breathe in, hold their breath, and then breathe out. Then ask questions and elicits responses about the Respiratory System to evaluate how much the students know, how much information needs to be quickly reviewed, and what needs to be retaught.

  Teacher will ask:
  - *How do fish 'breathe' underwater?*
    Students are given time to think, pair-share a response. Teacher and class then review the role of gills in fish respiration.
    http://www.youtube.com/watch?v=XEIRlw5rCUk

- Show students a *picture/illustration/video* of a deep-sea diver underwater. Have students discuss how the diver is able to breath underwater. Write **S.C.U.B.A.** on the board and invite the class to guess what the U and B might stand for in this acronym. (***self-contained, underwater breathing apparatus***) Discussion should lead or be directed towards the use of air tanks under water. Videos will be helpful with students.

http://www.youtube.com/watch?v=RYevE1m-ni4 or
http://www.youtube.com/watch?v=wJKZFRWHoi0

- Ask the students where else the tanks might have a use (for people with breathing problems, in hospitals, mountain climbers, during emergencies on board airplanes). If the subject does not come up, use *a picture/ illustration/ video* of an astronaut to initiate a discussion on how to breathe beyond earth's atmosphere where there is no air. http://www.youtube.com/watch?v=tF-VpiuzJNc

- Introduce a short video from NASA about the installation of oxygen generators aboard the International Space Station. While watching the video the students will note on a worksheet the three sources of oxygen aboard the ISS: oxygen generators, oxygen cylinders, and percolate candles. http://www.youtube.com/watch?v=wJKZFRWHoi0 and http://www.youtube.com/watch?v=O_iuT6uN-Is

  In addition, go to this link and write '*Recycling*' in the search box
  http://www.nasa.gov/audience/foreducators/nasaeclips/search.html?terms=&category=1000

  (Not all videos are mandatory, but useful for content and language development)

Explore/Analysis
Investigation Question:
Will an electrolyte such as salt enable the breakdown of a liquid (water) into gases?

- Provide each group of students with a D-cell, D-cell holder, 2 copper wires, a light bulb holder, and a bulb. Students use the provided materials to make the bulb light.

- Provide a third copper wire. Make a circuit tester from the materials. Test the conductivity of the test materials from the FOSS electricity and magnetism module.

- Provide a small cup of water. Test the cup of water for conductivity.

- Introduce salt as an electrolyte. Stir in 1 or 2 spoonfuls of Epsom Salt into the cup of water. Test the salt water for conductivity.

- Observe closely what is happening in the cup.

- Draw an annotated diagram of the apparatus.

- Hypothesize the source of the bubbles on the copper wires.

- Introduce the pencils sharpened at both ends. Test the graphite for conductivity.

- Introduce the terms electrolysis and electrodes. Introduce the 9v battery package. Have the students identify the positive terminal and the negative terminal.

- Pierce the plastic packaging with a pin or paper clip at the positive terminal and insert one end of the pencil to form the anode.

- Pierce the plastic packaging with a pin or paper clip at the negative terminal and insert one end of the other pencil to form the cathode.

- Tape or rubber band the pencils to the battery package so that the other ends protrude.

- Place the anode and cathode into the salt water and observe the vigorous electrolysis.

- Remove the battery pack and electrodes after a short period of observation.

- Explain to the students that electrolysis is breaking apart the hydrogen and oxygen bonds.

  Providing a first hand experience in which scientific vocabulary is developed in context supports understanding for students prior to reading the informational text.

  Teacher will ask:
  - *Why does the bulb light? [you created a closed circuit]*
  - *Which materials conduct electricity and which don't? [non-metals do not conduct electricity]*
  - *Does pure water conduct electricity? [no]*
  - *Does salt-water conduct electricity? [yes]*
  - *Where are the bubbles originating? [at the pencil points]*
  - *Would it be possible to capture the bubbles of gas? If so, how would you do it? [optional; have students engineer a device that will collect the bubbles]*

Explain/Conclusion

- Read and discuss the two articles:
  - Making Oxygen from Water (Student Handout 4.2)
  - Oxygen From Plants (Student Handout 4.3)

  Teacher will ask:
  - *Is there a ready source of carbon dioxide on Mars or the Moon?* Cite your evidence from your Moon/Mars Graphic Organizer. (Day 2, Student Handout 2.3)
- **Journal Entry**:
  Have students complete an entry that answers the question:
  - *Which method of oxygen generation would you recommend for your colony?* State the reason for your choice.
    Note: If doing both tasks, complete readings and science notebook entry after completing both tasks.

TASK 2: Photosynthesis Investigation

Engage/Introduction

- Show students the Elodea plants. Ask questions and elicit responses about the process of photosynthesis to evaluate how much the students know, how much information

needs to be quickly reviewed and what needs to be retaught. Have students record the investigation question in their science notebooks.

Explore/Analysis
Investigation Question:
Will the photosynthesis of elodea produce measurable amounts of gas?

Photosynthesis Investigation Part 1: Oxygen Production (Light Source at 20 cm)

- Using aged tap water at room temperature, fill the vial to just below the lip.
- Remove a few leaves from the end of one sprig of Elodea. Cut off a section of the plant's stem on a bias and crush it gently.
- Place Elodea in the vial with its prepared stem facing up.
- Put vials in the vial holder so that you can easily see the prepared end of the stem in the vial.
- Expose the Elodea vial to the light source (keep the vial about 20 centimeters away from the bulb).
- After one minute has passed, begin counting the number of bubbles that float up from the stem.
- Using a timer that shows in seconds, record on Student Handout 4.4 ***Elodea Investigation Lab Record Sheet*** (section: Light Source at 20cm) the number of bubbles that are observed to rise in one-minute intervals for 5 minutes.
- Repeat the same measurements for another 5-minute period (Trial 2).
- Sum the two sets of data and divide by 10 to get the average.

Teacher will ask:
- *Why are there bubbles? [a gas is formed]*
- *What are the bubbles made of? [oxygen]*
- *How does the Chemical equation of Photosynthesis help you answer these questions? [oxygen is a product of the photosynthetic reaction]*
- *Where is the plant getting the carbon dioxide it needs for photosynthesis? [from the air and baking soda dissolved in water]*
- *What factors might lead to an increased production of oxygen? [increased light intensity and increased availability of CO_2]*

Photosynthesis Investigation Part 2: Increased Light Intensity Investigation (Light Source at 5cm)

Test Question 1:
Will gas production increase with increased light intensity?

- Using the same sample you tested earlier, expose the elodea vial to the light source (keep the vial about 5 centimeters away from the bulb).

- Use Student Handout 4.4 (section: Light Source at 5cm).

- Using a timer that shows in seconds, record the number of bubbles that are observed to rise from the stem in one-minute intervals for 5 minutes (Trial 1).

- Repeat the same measurements for another 5-minute period (Trial 2).

- Sum the two sets of data and divide by 10 to get the average.

Teacher will say and ask:
- Compare the two averages.
- Did the increased light intensity lead to an increase in gas production? Use evidence to explain your answer.

<u>Investigation Part 3: Increased Carbon Dioxide Investigation</u> (Light Source at 5cm and Baking Soda)

Test Question 2:
Will gas production increase with increased amounts of Carbon Dioxide in the form of Baking Soda?

- Using the same sample, (vial and Elodea), put 0.5 grams (1/4 teaspoon) baking soda in the vial.

- Put the sample 5 centimeters away from the lamp.

- After one minute has passed, begin counting the number of bubbles that float up from the stem.

- Using a timer that shows in seconds, record the number of bubbles that are observed to rise in one-minute intervals for 5 minutes (Trail 1).

- Repeat the same measurements for another 5-minute period (Trail 2).

- Sum the two sets of data and divide by 10 to get the average.
Teacher will say and ask:
  - *Compare the two averages.*
  - *Did the increased amounts of Carbon Dioxide (Baking Soda) lead to an increase in gas production? Use evidence to explain your answer.*

- *Providing a first hand experience in which scientific vocabulary is developed in context supports understanding for students prior to reading the informational text.*

Explain/Conclusion

- Read and discuss the two articles:
  - Student Handout 4.3a: Making Oxygen from Water
  - Student Handout 4.3b: Oxygen From Plants

  Teacher will say and ask:

  Is there a ready source of carbon dioxide at the Mars or the Moon? Cite your evidence from your Moon/Mars Graphic Organizer.

- **Journal Entry:**
  - Have students complete an entry that answers the question:
    Which method of oxygen generation would you recommend for your colony? State the reason for your choice.

    Note: If doing both tasks, complete readings and science notebook entry after completing both tasks.

    Journal entries provide an opportunity for students to develop organizational skills in writing after having experienced oral practice with other students and the teacher.

PART III
BRINGING IT ALL TOGETHER

- As a whole group, view the Classroom Historical Problem/Solution Chart and the Classroom Biosphere 2 Problem/Solution Chart.
- Add any additional solutions to the identified problems.
- **Journal Entry**:
  - Have students complete a journal entry that answers the focus question:
    How does a new colony solve problems?

    Journal entries provide an opportunity for students to develop organizational skills in writing after having experienced oral practice with other students and the teacher.

- **Space Colonization Application entry (Teacher Resource 1.2)**
  Teacher will say:
  - *All **Space Colony Teams** will review the application that will be submitted to Congress.*
  - *Work with your team to prepare the information to enter in the section: "**Physical and Social Survival Needs Assessment**".*
  - *In preparation for filling out this section, consider the various problems your space colony will need to solve in order to survive and thrive in a new environment.*

*OPTIONAL RESOURCES

Have students view short NASA video-clips on living on Mars and the Moon.

- Go to this link and use SEARCH window and type in ***other worlds***
  http://www.nasa.gov/audience/foreducators/nasaeclips/search.html?terms=&category=1000
- https://www.youtube.com/watch?v=9I7HFpkYB9M
- https://www.youtube.com/watch?v=jhJgR6QhNPU
- http://channel.nationalgeographic.com/channel/videos/moon-water/
- http://video.pbs.org/video/2365084421/
- http://channel.nationalgeographic.com/channel/videos/moon-colony/
- http://video.nationalgeographic.com/video/kids/science-space-kids/nasa-space-robot-kids/
- Go to this link and use SEARCH window and type in ***Plants***
  http://www.nasa.gov/audience/foreducators/nasaeclips/search.html?terms=&category=1000
- when at site use SEARCH window and type in ***Living Conditions***
  http://www.nasa.gov/audience/foreducators/nasaeclips/search.html?terms=&category=1000