

**2007
Winning Lesson Plan
from Bothell, Washington***Astronaut Training Manual:
The Colony Investigation*by Sheila Guard
Canyon Park Junior High
SchoolSubject: Earth & Space
Science

Grade Level: 8

Duration: Four Weeks

Overview and Purpose

The unit purpose is to demonstrate how humans use inquiry to better understand the natural world. Prior to this unit, my students learn about Earth as a system. When we reach the space science unit, we discuss human need to explore and expand our horizons. I connect space exploration to the students' prior learning about early American exploration studied previously in Social Studies. Students consider what we need to survive, and brainstorm how we might find this in space. They brainstorm problems associated with space travel and the potential for colonization. Teams of students research and design an experiment related to one potential problem associated with space colonization (too much/little heat, purifying water, etc). These results are shared with other teams in the class.

Educational Standards Addressed

This unit is intended to incorporate the three major components of the Washington State Essential Learnings for 8th grade. Students learn about the interactions between Earth and space while solving realistic problems related to space colonization. This is an issue currently on the forefront of scientific exploration. Throughout this process, students study principles tied to systems and practice skills of scientific inquiry and the technical writing.

Objectives

- Students consider reasons to explore space and identify potential locations for human inhabitation.
- Students will identify key elements needed to successfully create a colony in space.
- Student teams will design an investigation that tests one aspect of surviving in a space colony.
- Students will report results back to other students, and use this information to lead a discussion about what would realistically be needed for humans to colonize space in the future.
- Materials: Materials vary depending upon the agreed experiments set up by the groups. I conference with groups and help generate a list of what I can provide, and what they need to bring from home.

Procedures

Use the attached worksheets as a guide to complete these tasks. I set groups up “Jigsaw style” such that the first group brainstorms designs and potential problems. Students then break out into new groups with members from the different brainstorming teams to investigate a related colony topic.

Days 1 & 3:

“Brainstorming Potential Problems with Space Colonization”: Groups design potential space colonies-what it might look like, items needed, potential problems.

Day 2:

Video – “Journey to Mars”: Presents research scientists are already doing related to colonization.

Days 4–5:

Identify/research potential research topics: Shelter, atmosphere, food, water quality, waste, etc. Complete the problem solving activity to formulate possible investigative questions.

Day 4–6:

“Prelab” Group’s design investigations and conference with me to set up plan; arrange materials.

Day 7 & 8:

Set up lab procedures – methods, data charts, actual material setup.

Days 9–19:

(number of days and task on specific dates can/will vary depending upon group’s experiment):

INQUIRY TIME: Complete data collection on days set up during prelab conferences.

NOTE: I have students complete predetermined tasks from the Challenger Mission notebook during periods of time in class when they are not collecting data from their investigation.

Days 20 & 21:

Groups analyze experiment results and interpret their data. They then report back.

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Procedures (Cont'd)

Lesson Plan Calendar

Monday	Tuesday	Wednesday	Thursday	Friday
3/4 Brainstorm colonies in space	3/5 Video – “Journey to Mars”	3/6 PROPOSAL DRAFT DUE	3/7 Group conferences	3/9 Group conferences
3/12 Group conferences	3/13 Set up labs-provide materials	3/14 Set up labs-provide materials	3/15 Data Collection	3/16 NO SCHOOL
3/19 Data Collection	3/20 Puffy Face lab	3/21 Data Collection	3/22 Data Collection	3/23 Run to the Moon
3/26 Data Collection	3/27 Run to the Moon	3/28 Data Collection	3/29 Last day to Collect Data	3/30 Complete analysis/conclusion
4/2 Organize labs/share results	4/3 Organize labs/share results	4/4 Field Trip: Moon Mission	4/5 Field Trip: Moon Mission	4/6 DUE: Astronaut Training Manuals

Extensions Beyond the Classroom

Days 22 & 23:

Field trip – I take 5 classes to the Challenger Space Program, “Mission to the Moon” following completion of the Colony Investigations. During this interactive experience at the Museum of Flight, students work cooperatively together to locate an optimal site for a future Space Colony on the moon.

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Hand-outs – 1

Brainstorming Potential Problems with Space Colonization:

Select one problem your group will pursue further – General Topic:		
Describe the Problem:		
Why is it a problem?		
Devise potential solutions/methods to investigate this problem.		
Potential Solutions	Pro's	Con's
Solution 1 –	a) b)	a) b)
Solution 2 –	a) b)	a) b)
Solution 3 –	a) b)	a) b)
Which of these solutions would work the best? Why?		
How might you investigate this solution here on Earth?		
State a testable question that would help test to see if this solution works: What happens if...		

Names															
Proposal Due Date															
Science Class Period:	1	2	3	4	5	6	Research Group/Station #:	1	2	3	4	5	6	7	8

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Hand-outs – 2

PRE-LAB: Brainstorm/Plan your investigation

Project topic you are investigating:	
Testable Guiding Question:	
Methods/Procedure: How will you test this question?	Draw the set up:
Materials/Resources: What will you need to make this investigation work?	
Hypothesis/Prediction: What do you think will happen?	
<p>Data Collection: What data will you collect?</p> <p>How will you document this data?</p>	
<p><i>Set up your timeline: Include this information</i></p> <p>1) Dates to work on pre-lab</p> <p>2) When you will collect data (ex. 10 min each day over two weeks, or 3 straight days of 45 min each).</p> <p>3) The dates you plan to do: “Run to the Moon” and “Puffy Face” Lab (require 1-2 days each)</p>	

Names															
Proposal Due Date															
Science Class Period:	1	2	3	4	5	6	Research Group/Station #:	1	2	3	4	5	6	7	8

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Proposal and Plan – Conference Preparation

Project Topic:	
Guiding Question: PROBLEM	Last updated: ___/___/___
Define your groups' problem and the relevance to a space colony:	
Research Focus: INVESTIGATIVE QUESTION	Last updated ___/___/___
INVESTIGATIVE QUESTION: <i>This should investigate ONE variable related to the above problem.</i>	
Describe how this investigation will help solve the problem stated above.	
What materials will your group likely need from Mrs. Guard?	
What materials will provide from home? Please list what each student will bring.	
Student: _____	→ _____
Student: _____	→ _____
Student: _____	→ _____
Student: _____	→ _____

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Project Proposal and Plan Scoring Guide

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Proposal:	Meets Standard	Not at Standard
Significance/Worthiness:		
1. The problem is well defined	2	1
2. The proposal describes how the project has relevance to the space colony	2	1
3. The proposal includes a well-justified and logical resolution to the stated problem	2	1
Plan Manageability:		
1. Checkpoints are included to monitor progress	2	1
2. Resources are identified	2	1

Astronaut Training Manual (A.T.M.) Scoring Guide

To qualify as a member of the Canyon Park Research Space Colony, you need to complete three activities demonstrating parts of astronaut training. After millions of NASA dollars are used to train you (O.K. maybe \$2.95 or so), you will be prepared to lead this world forward in our exploration of space.

I. Colony Investigation	II. Life Support Systems	III. Research and Navigation
Your inquiry investigation	Puffy Face Experiment	Run to the Moon

Bonus Opportunity:

Complete up to 2 additional activities – Navigating a Spacecraft and/or Mars Mapping

Submitted On Time: **YES** **NO**

Number of Days Late: ____ x – 6 points = – ____ off grade

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Notes to improve Your Grade on Your Final Draft of the Colony Investigation

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Section	Examples of what students are writing	Example of how to write section more clearly in the final draft
Problem statement – Should show relevance of topic to space colony	How long does water last on different surfaces?	<i>A space colony will need to conserve water as much as possible to maximize availability for colonists. This can be done in part by selecting materials for water storage that minimize the amount of water that evaporates.</i>
Investigative Question	Which plants will grow fastest using a fertilizer?	Will <i>radish plants</i> grow <i>taller</i> using a 25%, 10%, or 5% Miracle Gro solution
Fair Test: Manipulated and Responding Variables	Manipulated Variable – The type of light exposed to the plant Responding Variable – How long it takes plants to grow	Include details about HOW variable is changed: Manipulated Variable – The filter color light goes through to reach the plant: <i>Clear, yellow, green, red.</i> Responding Variable – How well the radish plants grow in the different colors: <i>Height (mm), number of leaves, color/health</i>
Controlled variables	Examples – Amount of water Size of dome	Give the actual amounts/sizes – Amount of water: <i>Use 25 mL in each sample</i> Size of dome: <i>Half sphere shaped, 10cm in diameter</i>
Tests & Trials	Most identified tests well, but incorrectly identified the number of trials: Example- We will observe the plants 3 times over the next two weeks	The trials represents how many times you repeat each test, not the length of the observations Example – We will observe 5 radish plants growing in each of the tests (growing at 0°C, 25°C, and 50°C)
Methods	Step by step procedure: 1. Build a shelter out of plastic 2. Turn the light on over the shelter and so on.	Make sure the procedure is complete enough that someone else can use it to repeat the lab 1. Place a 10 cm diameter plastic bowl upside down on smooth table for the first shelter. 2. <i>Position the temperature bulb of a metal thermometer inside the shelter at the central point (see drawing on flow chart)</i> 3. <i>Position a light 50 cm directly above the central point of the dome. (FLOW CHART: Include measurements, quantities, pictures that clarify your steps)</i>
Hypothesis	Don't forget to include your hypothesis in your pre-lab If [RESTATE YOUR INVESTIGATIVE QUESTION], then [EXPLAIN WHAT YOU THINK IS GOING TO HAPPEN], because [WHY DO YOU THINK THIS WILL HAPPEN]	

Table of Contents

Pg #	Expectations	Score
	Cover Page includes Your LOGO Design for the Mission	4 3 2 0
	This Table of Contents – Showing correct order of manual	4 3 2 0
	Parent Evaluation and Signature Verifying: Presentation of manual and data “Flex Your Brain” format followed with evidence of editing	__/9 pts
	Colony Investigation:	
	PRELAB Problem/Testable Question: 2 pts –Clear problem/Testable → __3 pts- One variable → __4 pts- Allows for clear data collection Fair Test: __ 2 pts – Correctly identified one manipulated variable, and the responding variable __ 3 pts – Also described 3-5 controlled variables (kept the same) __ 4 pts – Design considers multiple trials (>3) for each test (the change to the manipulated variable) Materials and Methods: __2 pts-Material list/drawings → __3 pts-Thorough procedure → __4 pts-Flow chart shows steps Flow Chart: __2pts- Clear labels/units → __3 pts-Procedure clearly represented → __4 pts-Neat/effective color	__/16 pts
	Hypothesis: __2 pts-Included → __3 pts–“If..then.. because...” format → __4 pts-Supported with a clear explanation	4 3 2 0
	Data Collection: __2 pts – Included in a data chart → __3 pts – Collected qualitative & quantitative data __4 pts – Accurate and appropriate for the investigative question (graphed if useful)	4 3 2 0
	Post lab: Included an accurate conclusion that uses proper science terms and concepts to __ Description of how the experiment did/didn't support the investigative question/hypothesis __ Discussion of the patterns observed in your data __ A concluding sentence that discusses where you could go further with your research? __ Includes a 2 nd paragraph connecting research to the colony and describing a potential follow up lab	4 3 2 0
	“Puffy Face” Investigation: Completed the following sections- Investigative Question, hypothesis, data observations, post lab conclusion questions	4 3 2 0
	“Run to the Moon” Investigation: Completed the following sections Investigative Question, hypothesis, data observations, post lab conclusion questions	4 3 2 0
	Extra lab (optional): Complete up to 2 additional activities –Navigating a Spacecraft and/or Mars Mapping	8 6 4 2
	LAB PARTICIPATION: Consistently used class time well to collect data __2 pts-Inconsistent → __3 pts- Active → __4 pts-Active leader in labs	4 3 2 0
	GRAPHICS REPRESENT DATA: See blue sheet – Clear title, labels, colored, proper units __2 pts-Included → 3 pts-Follow illustration criteria → __4 pts-Appropriately represent data	4 3 2 0
	TYPED: __3 pts: Clear, easy to follow → __4 pts- processed tables, charts, and/or graphics	4 3 2 0
TOTAL SCORE = _____/65 points		

59-65 → A- Standards exceeded

52-58 → B-Standards met

45-51 → C- Some standards met

39-44 → D- Standards not met

< 39 → F- Insufficient detail to grade on standards

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Astronaut Training Manual Parent Evaluation

Astronaut in Training (Student's Name): _____

Parent/evaluator's Name (Please print): _____

Parents: Please review your child's manual, and assess the work quality. You are not grading whether the activity's content is "correct", but the quality of the presentation. If your child's work does not meet a given criteria, I urge you to have them improve that component of the assignment. Note any changes by initialing next to the improved score on this sheet.

Look for these three criteria and check the boxes that most appropriately describe the quality of your child's training manual.

	Criteria 1* Labs are typed and neatly presented	Criteria 2* Technical writing follows "Flex Your Brain" format (see blue sheet in back of comp book)	Criteria 3* Data in each lab is organized into charts, tables, or graphs
Well done [3]	All labs are typed, neat, and easy to follow. Drawings are labeled and colored	Format is clearly followed •Includes: Pre-lab, lab, post lab •Post lab: Complete sentences •Clearly proofread & edited	•Appropriate for data •Titled/labeled •Correct measurement units •Neat
Okay [2]	•Handwritten, but easy to follow •Drawings included, but not colored or labeled	Includes: Pre-lab, lab, post lab •Post lab: Incomplete sentences •Needs some additional editing	•Missing one of the above items in some illustrations
Needs work [1]	Labs are not typed and not easy to follow	Lab sections missing or explanations are unclear	Data missing from multiple labs or missing 2+ the above items

*Please initial if improvements are made in any of the three categories.

Comments

To assist in your evaluation, please ask your child to show you specific examples in their training manual. If you still have questions please contact your child's science teacher.

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Sample Investigation Pre-lab

Name: _____

Group Members: _____

Colony Investigation Topic: Purifying Water for Drinking

Purpose: What is your guiding question? (This question will be too general to be testable)

Example: "How can the colony purify water?"

Investigative Question: Clearly identifies one variable and the specific tests, plus it refers to the method.

Example:

OK [2] → 1 Variable

"Can salt be removed from water?"

BETTER [3] → 1 Variable with method

"Will salt be removed from water if it is run through a coffee filter?"

BEST [4] → 1 Variable with method & specific tests

"Which will remove the most salt, running water through 1, 2, or 3 coffee filters?"

Fair Test

Details that show what exactly you will be testing.

Manipulated Variable (What you are changing):

- The number of coffee filters the salt water is run through

Responding Variable (What will happen as a result of the change):

- Amount of salt deposited on the coffee filters

Test: How will you change/manipulate the manipulated variable?

- I will pour a salt solution (10 grams salt:100 mL water) through 1, 2 and then 3 coffee filters. They will be stacked so the salt water solution can be poured through and collected on the other side.

Trials: How many times will you repeat the experiment for EACH TEST?

- I will repeat each test 5 times (for a total of 15 trials)

Controlled Variables (Everything that is kept constant from one test to another during the experiment):

1. The amount of salt in each saltwater solution: 10 g
2. The amount of water in each salt water solution: 100 mL
3. The size and shape of each filter
4. The temperature of the saltwater solution
5. The amount of time the water is given to evaporate from the filters

Hypothesis

If the number of coffee filters is increase, then more salt will be removed, because each additional filter will remove salt that the others did not.

Materials

List AND draw exactly what you will need to use

- 250 mL beaker 150 g salt
- scale 1500 mL water
- 30 – 10 cm round coffee filters

Methods

- Include EACH of the following
- A two-sentence summary of what you will do.
- Timeline: How long will it take you to collect your data (# of days and amount of time each day)?
- A step-by-step procedure, clear enough that someone else could do your investigation
- A flow chart/diagrams, to clarify your procedure

Data

Create a data chart that will allow you to clearly record your qualitative and quantitative observations

Data charts need a title, clear labels, room for multiple tests, clearly identified measurement units.

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Post Lab

Puffy Face Experiment

Discussion (What does the data tell you?):

- Describe changes that occurred in any of these measurements.

Conclusions (How does this change/affect your thinking?):

- What do you think caused these changes?
- How is this similar/different to what an astronaut might experience in space?

Future Investigations (Where could we go from here?):

- What do you think the long term affects of this condition might do to a human body?
- How might NASA solve this problem?

Data: Determining the affects of gravitational shifts on body fluids and resulting conditions.						
	Measurements (in mm)			Pulse Rate: Measure other wrist	Facial changes: Color, shape, fluid position	Subject's sensations in face, hands, legs
	Head: Circumference at eyebrow	Mid- Calf	Wrist			
Initial measure Prior to testing						
Standing						
5 minutes legs up						
10 minutes legs up						
15 minutes legs up						
5 min sitting up*						

*Stand up slowly when completely finished

Consistent Measurements: To be consistent, place a small (2cm) piece of tape at the point you will take measurements on the test subjects forehead, mid-calf, and wrist.

To Find Test Subject's Pulse: Use your first two fingers to find the distal radial pulse on your teammate's wrist. Count the number of pulsations you feel in fifteen seconds, and multiply by 4 (normal rate 60-80 beats/min).

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Post Lab

Name: _____

Date: _____

Period: _____

Investigation Title: _____

Write a conclusion you can make based upon your data collection. Attach a neat copy of your data to this form. (Data Score: Clear title, labeled columns/rows, thorough trials, proper units.)

For your concluding paragraph be sure to (To Meet Standard):

- Answer to your investigative question (Hint: Refer back to the accuracy of your hypothesis)
- Include supporting data from your data table
- Explain how these data support your answer

To Exceed Standard:

Write another paragraph explaining a logical follow up investigation that could be done to better understand your topic.

Write Your Investigative Question:

Conclusions:

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