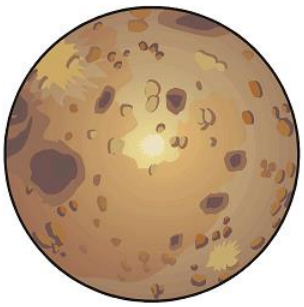
Colony on the Moon

Student Material

We are quickly using up our resources here on Earth.
What will happen when we completely run out?



Can any other place in our solar system sustain human life?

One way to explore usable "space" is to
set up a permanent colony somewhere in it.

NASA has spoken about colonizing another planet,
but little has been discussed about colonizing a **moon**.

Imagine you have been hired by NASA to propose the most efficient and effective way
to colonize a moon in our solar system.

A future lunar colony will have to be a **self-contained habitat** with all life-support systems necessary for survival of **people, animals, and plants.**

Your team will need to research the characteristics of **two moons**
(size, climate, surface features, and orbital radius), plus
the natural resources that can be used.

Then your group will choose the better moon to colonize.
Once your research is complete,
you will build a model and submit it to a NASA representative.

Let's show **"Earth"** what life on the moon can look like!

© 2004–2023, IDE Corp. and EdQuiddity Inc
Permission to duplicate for registered users of MyQPortal only

Colony on the Moon *Presentation Rubric*

Student Material

	Novice	Apprentice	*Practitioner*	Expert
Sources	1 resource for research, from 1 source	3 resources for research, from sources	4 resources for research, from a variety of print and digital sources.	all of *Practitioner* plus: emails an expert in the field
Moon Selection Research	characteristics of each moon: climate, environment, geography, and temperature	☐ 2 natural resources on each moon to use in colony ☐ characteristics of each moon: climate, environment, geography, and temperature	☐ 2 natural resources on each moon to use in colony ☐ describes the role of gravity within the moon(s) ☐ analyzes and interprets characteristics of each moon to determine scale properties of objects: size (crust and atmosphere), surface features, and orbital radius ☐ 3–4 statistical/fact-based reasons for choosing moon	all of *Practitioner* plus: 2 photographs/charts/graphs comparing the characteristics of the two moons
Life-Support Systems Table	<5 life-support systems in a colony	☐ 5–6 systems in a colony ☐ requirements of each system ☐ what system will contain on moon	☐ 7–8 systems in a colony, including the flow of energy and cycling of water ☐ requirements of each system ☐ analysis of how each is met on Earth ☐ description of how each system will operate on moon and what it will contain	all of *Practitioner* plus: limitations posed by the moon with each system and how to overcome those limitations
Presentation	☐ 1–2 members speak ☐ shows model of colony to class ☐ short (1- to 2-sentence) explanation	☐ all but 1 group member speaks ☐ use of model ☐ general explanation of colony setup	☐ all group members speak ☐ use of model in explanation of colony (based on research facts) ☐ resources used from moon and those brought from Earth ☐ 1–2 problems encountered and how the group overcame them	all of *Practitioner* plus: summary of aspects and conditions of chosen moon that support life

© 2004–2023, IDE Corp. and EdQuiddity Inc
Permission to duplicate for registered users of MyQPortal only

Colony on the Moon *Colony Model Rubric*

Student Material

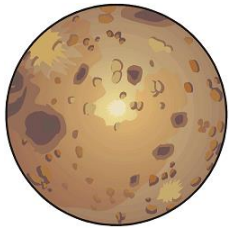
	Novice	Apprentice	*Practitioner*	Expert
Model Content	☐ 2–4 systems shown, including the follow of energy and/or cycling of water ☐ 2–3 natural and imported resources	☐ 5–6 systems labeled, including the follow of energy and cycling of water ☐ systems logically placed ☐ 4–6 natural and imported resources	☐ 7–8 systems labeled, including the flow of energy and cycling of water ☐ systems logically placed ☐ 7–10 natural and imported resources ☐ draft of model as evidence of pre-planning	all of *Practitioner* plus: draws evidence sources to support development of model
Map and Legend	map of colony	☐ map of colony ☐ legend ☐ uses proportions to compare the size and distance of objects within the map	☐ accurate map of colony ☐ legend showing accurate symbols to depict systems ☐ compares the size and distance of objects within in the map and real life using proportions	all of *Practitioner* plus: shows location of colony on moon (latitude and longitude)
Construction	☐ constructed in >12” by 24” area ☐ only simple materials used (paper, markers)	☐ constructed in >12” by 24” area ☐ use of recyclable materials	☐ constructed in 12” by 24”area ☐ creative use of a variety of recyclable materials ☐ model has 3D characteristic or moving parts ☐ incorporates technology	all of *Practitioner* plus: evaluates a peer’s design to determine how well they meet the criteria and constraints of the problem

EDQUIDDITY
EDUCATION FOR YOUR WHATNESS

© 2004–2023, IDE Corp. and EdQuiddity Inc
Permission to duplicate for registered users of MyQPortal only

Colony on the Moon *Scaffold for Learning*

Teacher Material



Benchmark Video and Discussions
- Unit launch to create a felt need
- Earth's place
- Solar system patterns

Instructional Activities: Learning

Instructional Texts/Websites
- Earth-based instruments (I, P)
- Lunar phases (I, P)
- Create a presentation (I, P)
- Visuals for a presentation (I, P)
- Research (I)
- Information collection (I, P)
- Mathematical calculations (I, P)
- Synthesizing information (IV)
- Scales/proportions (I, P)
- Surface features (I, P)
- Reading informational text (IV)

Instructional Videos
- Earth-based instruments (I, P)
- Lunar phases (I, P)
- Create a presentation (I, P)
- Visuals for a presentation (I, P)
- Research (I)
- Information collection (I, P)
- Mathematical calculations (I, P)
- Synthesizing information (IV)
- Scales/proportions (I, P)
- Surface features (I, P)
- Reading informational text (IV)

How-to Sheets
- Calculating proportions
- Developing models
- Create a presentation
- Visuals for a presentation
- Research
- Scales/proportions

Interactive Websites
- EdPuzzle (I)
- NASA (I, P)
- Freerice (I)
- National Geographic

Learning Centers
- Lunar phases (I, P)
- Eclipses (I, P)
- Seasons (I, P)
- Gravity (I, P)
- Mathematical calculation (I)
- Reading informational text (I, P)

Small-Group Mini-Lessons
- Earth-based instruments
- Lunar phases
- Create a presentation
- Visuals for a presentation
- Research
- Information collection
- Mathematical calculations
- Synthesizing information
- Scales/proportions
- Surface features
- Reading informational text

Instructional Activities: Additional

Practice
- **Vocabulary (I, HW)**
- **Model content (I)**
- **Life-support table (I)**
- **Understand lunar phases/gravity (I, HW)**
- **Research moons (I, HW)**
- **Note-taking on moons (IV)**
- **Synthesizing research (I)**

Application
- **Determine the best moon for survival (I, P)**
- **Assemble support for moon choice (I, P)**
- **Observations/investigation (I)**
- **Design a model (I, P, SG)**
- **Presentation (P, SG)**

Assessment
- **Self-assess lunar phases (I)**
- **Self-assess math calculations (I)**
- **Use rubric to peer edit task (P, SG)**
- **Use rubric to self-assess task (I)**

Reflection (I)
In *Efficacy Notebook*, reflect on the following: What surprised you about your moon research? How comfortable would you be if asked to live on the moon? What would you need to have with you if lived on the moon? What did you like about this task?

Key: Individual **(I)**, Pairs **(P)**, Small Groups **(SG)**, Activities suitable for homework **(HW)**, Insights Video **(IV)**

EDQUIDDITY
EDUCATION FOR YOUR WHATNESS

© 2004–2023, IDE Corp. and EdQuiddity Inc
Permission to duplicate for registered users of MyQPortal only

Colony on the Moon *Content Facilitation Grid*

Teacher Material

Student	Identify the planets in the solar system by name and relative location from the sun.	Use models and graphs that accurately depict scale to compare the size and distance between objects in the solar system.	Describe the use of instruments to observe and explore the moon and planets.	Describe the forces holding Earth in orbit around the sun, and the moon in orbit around Earth.	Relate a celestial object's mass to its gravitational force on other objects.	Identify the role gravity plays in the structure of the solar system.	Compare the size and distance of objects within systems in the universe using proportions.	Identify the role gravity plays in the structure of the solar system.	

EDQUIDDITY
EDUCATION FOR YOUR WHATNESS

© 2004–2023, IDE Corp. and EdQuiddity Inc
Permission to duplicate for registered users of MyQPortal only

Colony on the Moon *Facilitation Questions*

Teacher Material

COMPREHENSION: *Ask questions that ensure students understand content and skills needed to solve the problem.*	• What moons exist in our solar system? • What conditions are necessary to support human life?
APPLICATION: *Ask questions that ensure the ability of students to apply learning to new situations.*	• Which moon is best suited for a future colony? Why? • How does a life-support system function?
CONNECTION: *Ask questions that ensure the ability of students to apply learning to their lives.*	• Would you be willing to move to a colony on a moon? Why or why not? • What current events connect to your study of moon colonization?
SYNTHESIS: *Ask questions that encourage students to create new information from existing data.*	• How do various life-support systems work together to create our living environment? • How can a model be used to effectively portray a vision?
METACOGNITION: *Ask questions that prompt students to think about their own thinking process.*	• What were some of the thought processes you used in accomplishing this task? • What problems did you encounter? How did you solve them? • What parts of this task excited you most? What does that tell you about yourself?

© 2004–2023, IDE Corp. and EdQuiddity Inc
Permission to duplicate for registered users of MyQPortal only

Colony on the Moon *Teacher Notes*

Teacher Material

Unit Overview	
Students explore the engineering challenges with sustaining human life on a moon. They will research properties of space systems, analyze and compare two moon habitats, and decide upon the better site to support human life. Students will use this knowledge to create plans for a colony on a moon and work to build a model to present to NASA.	
Enduring Understandings	**Essential Questions**
• The solar system is comprised of various objects that orbit the sun and are classified based on their characteristics. • All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems.. • Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation, crystallization, and precipitation, as well as downhill flows on land. • Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources.	• How do people use the process of science to investigate questions about the natural world? • What is Earth's place in the universe? • What makes up our solar system and how can the motion of Earth explain seasons and eclipses? • How have living organisms changed the Earth, and how have Earth's changing conditions impacted living organisms? • What makes up our solar system, and how can the motion of Earth explain seasons and eclipses?
Next Generation Science Standards Addressed	
Space Systems — Middle School • MS-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. [Clarification Statement: Examples of models can be physical, graphical, or conceptual.] • MS-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. [Clarification Statement: Emphasis for the model is on gravity as the force that holds together the solar system and Milky Way galaxy and controls orbital motions • statistical information, drawings and photographs, and models.] [Assessment Boundary: Assessment does not include recalling facts about properties of the planets and other solar system bodies.]	
Earths Systems — Middle School • MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. [Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.] [Assessment Boundary: Assessment does not include the identification and naming of minerals.] • MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. [Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.] [Assessment Boundary: A quantitative	

© 2004–2023, IDE Corp. and EdQuiddity Inc
Permission to duplicate for registered users of MyQPortal only

understanding of the latent heats of vaporization and fusion is not assessed.]

- MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).]

21st Century Skills Addressed

Core Content and Interdisciplinary Themes

- Subject-Area Mastery
- Environmental Literacy

Learning and Innovation

- Critical Thinking and Problem Solving
- Creativity and Innovation
- Communication and Collaboration

Information and Media Literacy

- Information Literacy
- ICT Literacy

Life and Career

- Initiative and Self-Direction
- Productivity and Accountability
- Leadership and Responsibility

EDQUIDDITY
EDUCATION FOR YOUR WHATNESS

© 2004–2023, IDE Corp. and EdQuiddity Inc
Permission to duplicate for registered users of MyQPortal only