CURRICULUM GUIDE FOR

Sun, Moon and Earth

(Based on the *Discovery Works: Sun, Moon and Earth* and *Project Earth: Astronomy*)

Wallingford Public Schools
5th Grade
Science

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UNIT SUMMARY

This unit focuses on the causes of day and night, the causes of the seasons and the changes (phases) in the Moon's appearance. The unit begins with investigations of the reason for day and night. Students will model the rotation (spin) of the Earth about its axis to demonstrate the 24-hour cycle of one rotation and observe day and night from Earth. Students will then model the Earth's revolution or orbit around the sun on an inclined axis (23.5 ^{o}) to recognize the reason for the seasons. Students will observe and describe changes (phases) in the appearance of the Moon over a lunar cycle (approximately one month). Students will recognize that the positions of the Earth, Moon and Sun are predictable and that each "celestial (relating to the sky) body" moves in a predictable pattern. By having a deeper understanding of these patterns, we have made technological advances such as telescopes, periscopes, microscopes and even eye glasses to have a better "view" of the world around us and improve our quality of life.

STAGE 1- STANDARDS/GOALS

What should students understand, know, and be able to do? Stage one identifies the desired results of the unit including the related state science content standards and expected performances, enduring understandings, essential questions, knowledge and skills.

Enduring Understandings *Insights earned from exploring generalizations via the essential questions (Students will understand THAT…) K-12 enduring understandings are those understandings that should be developed over time, they are not expected to be mastered over one unit or one year.*	**Essential Questions** *Inquiry used to explore generalizations*
<u>*Overarching Enduring Understandings:*</u> • Science is the method of observation and investigation used to understand our world. (K-12) • Inquiry is the integration of process skills, the application of scientific content, and critical thinking to solve problems. (K-12) <u>*Unit Specific Enduring Understandings:*</u> ▪ The predictable position of the earth in the solar system affects the cycles of day and night ▪ The predictable position of the earth in the solar system affects the cycle of the seasons. ▪ The predictable movement of the moon accounts for the apparent changes in its appearance when viewed from earth.	• How is inquiry used to investigate the answers to questions we pose? • How does the position of the earth in the solar system affect the cycles of day and night? • How does the position and tilt of the earth's axis in the solar system affect seasonal cycles? • How does the moon's orbit around the earth change our perception of the moons surface?

Knowledge and Skills

What students are expected to know and be able to do

The knowledge and skills in this section have been extracted from Wallingford's K-5 Science Scope and Sequence.

Knowledge

K1. Analyze relationships between the sun and earth, the earth and moon and the sun, earth and moon.
K2. Distinguish the difference between revolution and rotation.
K3. Illustrate the four seasons
K4. Explain the changes in appearance of our moon over time
K5. Describe the apparent movement of the sun.
K6. Conclude that the earth's movement is the reason for the apparent movement of the sun.
K7. Conclude that the earth's axis is responsible for our seasons.
K8. Conclude that the rotation of the earth is responsible for the cycle of day and night.

Skills

S1. Generate investigable and non-investigable questions.
S2. Observe objects and describe commonalities and differences among them.
S3. Classify in a variety of ways based on properties.
S4. Predict what might happen.
S5. Design a fair test to answer an investigable question.
S6. Revise plan based on observation/ results.
S7. Conduct simple investigations.
S8. Collect and record data using appropriate tools, such as:
    - Metric ruler
    - Timer
    - Non-standard measuring devices
    - Etc.
S9. Organize appropriate and accurate measurements and observations, using:
    - Graphic organizers
    - Charts and graphs
    - Illustrations or diagrams
    - Journaling
S10. Draw conclusions based on data, observations, or findings.
S11. Communicate results or information in an appropriate manner, using:
    - Presentations
    - Visuals
    - Simple reports

Content Standard(s) *Generalizations about what students should know and be able to do.*	
CSDE Content Standards (CSDE Science Framework 2004)	**CSDE Primary Expected Performances** (CSDE Science Framework 2004)
Earth in the Solar System – How does the position of Earth in the solar system affect conditions on our planet? **5.3 - Most objects in the solar system are in a regular and predictable motion.** • The positions of the Earth and moon relative to the sun explain the cycles of day and night, and the monthly moon phases.	B22 Explain the cause of day and night based on the rotation of Earth on its axis. B23 Describe the monthly changes in the appearance of the moon, based on the moon's orbit around the Earth.
Science and Technology in Society – How do science and technology affect the quality of our lives? **5.4 - Humans have the capacity to build and use tools to advance the quality of their lives.** Advances in technology allow individuals to acquire new information about the world.	B25 Describe the uses of different instruments, such as eye glasses, magnifiers, periscopes and telescopes, to enhance our vision.
Scientific Inquiry	B INQ.1 Make observations and ask questions about objects, organisms and the environment. B INQ.2 Seek relevant information in books, magazines and electronic media. B INQ.3 Design and conduct simple investigations. B INQ.4 Employ simple equipment and measuring tools to gather data and extend the senses.
Scientific Literacy	B INQ.5 Use data to construct reasonable explanations. B INQ.6 Analyze, critique and communicate investigations using words, graphs and drawings. B INQ.7 Read and write a variety of science-related fiction and nonfiction texts.

Scientific Numeracy	B INQ.8 Search the Web and locate relevant science information. B INQ.9 Use measurement tools and standard units (e.g., cm, m, g, kg) to describe objects and materials. B INQ.10 Use mathematics to analyze, interpret and present data.

Common Misconceptions Children Have

By identifying misconceptions early, teachers can design appropriate lessons to address and change student misconceptions.

- Students may not grasp the differences in size between Earth, the Sun and the Moon or understand the great distances between them.
- They may see the Sun as completely different from other stars.
- Students might think that the Sun and stars really move to produce the motions we seem to see them make in the sky.
- They may think the Moon gives off light in the same as the sun. They may believe that the Moon's far side is its dark side.
- Students may think that seasons have to do with Earth's distance from the Sun.
- Students may not be able to connect the motion of the Moon to the disappearance of the Sun in a solar eclipse.
- The earth is spinning on its axis at approx. 1,000 miles per hours. Because the earth is so large compared to the size of an average child, we do not feel the spin.

STAGE 2 – DETERMINE ACCEPTABLE EVIDENCE

How will we know if students have achieved the desired results and met the content standards? How will we know that students really understand? Stage two identifies the acceptable evidence that students have acquired the understandings, knowledge, and skills identified in stage one.

Performance Task(s) *Authentic application in new context to evaluate student achievement of desired results designed according to GRASPS. (Goal, Role, Audience, Setting Performance, Standards)*	**Other Evidence** *Other methods to evaluate student achievement of desired results.*
See Next Two Pages for a Sample Performance Task and a Sample Rubric	See Suggested Learning Activities on Pages 10-16 for additional assessment ideas.

Performance Based Assessment
Sun, Moon and Earth

Goal: The goal of this task is to provide answers to our friendly alien, Gorp, visitor's questions about life on Earth. See next page for The Private Journal of Gorp.

Role: You are an Earth expert, who is currently working with NASA on a special project involving communicating with extra-terrestrial life forms.

Audience: Your audience is NASA astronauts and extra-terrestrial life forms.

Product Performance and Purpose:
You will need to read the excerpts from Gorps private diary (see next page). Then you will prepare a written response to the questions that Gorp has asked.

Standards and Criteria for Success: Your report to NASA and the extra-terrestrial life forms should include…

1. Reasons for the changing seasons on earth
2. Reasons for day and night on earth
3. Additional information that you believe would be helpful to our alien visitor.
4. Diagrams, models, graphs and/or illustrations.

	4	3	2	1
Reason for the Seasons	Correctly and thoroughly identifies the reason for the seasons	Identifies the reason for the seasons	Identifies part of the reason for the seasons	Did not identify the reason for the seasons
Reason for day and night	Correctly and thoroughly identifies the reason for day and night	Identifies the reason for day and night	Identifies part of the reason for day and night	Did not identify the reason for day and night
Model, graph, illustration	Model definitely shows what you learned	Yes, but not your absolute best work	Shows effort, but you could do better	Not your best work
Neatness, creativity	All parts of the project are neat, and show creativity	Yes, but not your absolute best work	Shows effort, but you could do better	Not your best work
Spelling and grammar	No errors	2-3 errors	4-6 errors	More than 7 errors
Due date met	Due date met	1 day late	2 days late	3 days late
BONUS – additional information				

The Private Journal of Gorp…….
Keep Out !

Day 10 – September 15th
These earth creatures seem to hibernate at the time when the giant ball in the sky gets turned off. What is this phenomenon?

Day 75 - January 10th
I, Gorp am noticing many strange occurrences. There is liquid which tumbles from the sky and forms piles of cold, white material. When held in my hand it melts, but kept outside it keeps its form. I can see less of their bodies because they are wearing more body coverings on their heads, and feet and fingers. What happened to the warm days and those body coverings which covered fewer parts of the body?

Day 150 – April 1st
Strange plant life is sprouting from the ground. How odd! Earthlings are showing more skin, and are not hibernating as much.

Day 225 – July 13th
The giant ball in the sky has been visible more often. Earthlings have to cool themselves by jumping into large puddles they put behind their dwellings. The strange plants which sprouted from the ground now have lots of color, and some of them have brightly colored round spheres hanging off of them…. Then, they put them in their mouth and say "yum".

Day 362 – September 2nd
I, Gorp have been on this planet for what these earthlings have called a year. My supreme commander needs my report, but I still have many questions about this planet.

What is going on here? Why are there such changes in temperature on this planet? Why does the ground change? Where does the giant ball in the sky go to? Is it visiting another planet? Does this happen year after year? How do these earthlings know when their planet will change again? I wish someone could help me to answer these questions before my report is due to my commander. HELP!!

STAGE 3 – LESSON ACTIVITIES

What will need to be taught and coached, and how should it best be taught, in light of the performance goals in stage one? How will we make learning both engaging and effective, given the goals (stage 1) and needed evidence (stage 2)? Stage 3 helps teachers plan learning experiences that align with stage one and enables students to be successful in stage two. Lesson activities are suggested, however, teachers are encouraged to customize these activities, maintaining alignment with stages one and two.

The suggested lesson activities are not sequenced in any particular order. Teachers may select which lesson activities will best meet the needs of their students and the unit objectives. Each lesson activity is coded with the corresponding knowledge (K) and/or skill (S) objectives that are found in stage one.

**** Although there is no specific sequence for these lessons, it is our suggestion that the lessons should follow the progression – Day and Night, Moon Phases and Seasons.**

Science notebooks should be utilized to record and assess student's use of inquiry skills and understanding of concepts.

The following lessons from the TEACHER MANUALS found in the kit ARE aligned with the objectives of this unit:

Discovery Works : Sun, Moon, and Earth
How does earth move each day? Shadow stick sundial pg. B34
How does the earth move throughout the year? Sun paths pg. B32
How does the moon move? Moon Phases pg. 50

Project Earth Science: Astronomy:
Activity 10 pg. 83
Activity 11 pg. 91

***** Materials that do not align with these activities have been removed from the science kit. *****

Day and Night:

- The predictable position of the earth in the solar system affects the cycles of day and night
  - How does the position of the earth in the solar system affect the cycles of day

and night?

Lesson A – Daylight and Darkness journal (K8, S4, S10, S9) –This is an on-going lesson which will last the entire unit.
The students will make daily, in class observations in their science notebooks. The students will be tracking the:

- **hours of daylight**
- **hours of darkness**

using the Record Journal newspaper (weather page) as a reference tool. The students will have the opportunity to make predictions and observations based on the data that they have collected. Students will choose the most appropriate system for gathering, recording and sharing their data.
To differentiate this lesson, use the following web site and have some students also start track the phases of the moon. Earth and Moon Viewer at www.fourmilab.ch/earthview/vplant.html).
The approximate latitude and longitude of Wallingford is 41.49 and 72.85.
**** You may consider using the Inspiration program software program, Excel spreadsheet, or Word as a way to integrate technology.**
**** Lesson A can also be tied into the math objectives for data collection and graphing for grade five.**

Lesson B – Day and Night- Using a Sundial (K1,K8,K6,K5,S2,S4,S8,S9,S10)
Additional reading in Discovery Works pg. B34-b35 would be helpful to the teacher.
The teacher will introduce the following materials to the students; 8x11 piece of card stock, a wooden dowel, a compass, science notebook and a pencil.
The teacher will conduct an explore session on a sunny day facilitating students through the raising of questions for further investigation related to this section's enduring understandings.
Students will choose a question for further investigation and conduct their investigation.
When the investigation is completed, students will share out their findings with the class.
Students should synthesize their own learning (see Appendix 1 for sample writing prompt) in their science notebook.
The teacher will synthesize the learning by using the enduring understandings, knowledge and skills related to this investigation.

Lesson C – Earth and Sun- Building a model to show day and night (K1, K8,S2, S4, S7, S8, S9, S10, S11)
The teacher and students will brainstorm and determine which Styrofoam ball will represent the sun and the earth, and should be able to defend their reasoning based on prior knowledge. The teacher will provide markers to the students, and will ask the students to color the "sun" (large ball) Styrofoam ball yellow and color the "earth "(medium ball) Styrofoam ball blue. Each ball should be completely colored.
At this point, the teacher will tell the students that the earth rotates on its axis once every twenty four hours. Using the sun and earth models, the students will be given time to explore

why/how we experience day and night. At the end of this inquiry, teacher and students will synthesize information. It is the goal of this lesson that the students will understand that the rotation of the earth causes day and night. When the hemisphere that is facing the sun is experiencing day, the opposite hemisphere must be experiencing night. (Teacher needs to see that the students are rotating the earth on an axis, not revolving the earth around the sun) * See teacher notes for additional content information.

Lesson D- Assessment of Day and Night
Ideas may include:

- **Science notebook reflection prompt (See Appendix 1)**
- **Concept map, graphic organizer**
- **Vocabulary reinforcement (See Appendix 2)**
- **Teacher conference with student demonstration using model (See Appendix 3)**

Moon Phases

- The predictable movement of the moon accounts for the apparent changes in its appearance when viewed from earth.
    - How does the moon's orbit around the earth change our perception of the moons surface?

Lesson A - Class Moon Chart (K1, K4,K6, S2, S3, S4, S8, S9, S10,) This is an on-going activity which can last for the school year.
Students will create a classroom chart that will show the appearance of the moon on a daily basis using the website (www.fourmilab.ch/earthview/vplanet.html.), student observations or the Record Journal newspaper. Teachers can start this at any time; however, it is most dramatic when started during the new or full moon. Students will also be able to add their own observations in their science notebooks.

Lesson B – Making predictions (K1, K4, K6, S2, S3, S4, S8, S9, S10)
The teacher will provide 'Phases of the Moon' sheet (see Appendix 4) to each student. Students will work in pairs. The teacher will instruct the students to write the predicted date that this moon phase will appear in the bottom right hand corner of each moon block. The students at this point will meet with their science partner and will discuss their predictions. Students will justify their predictions in their science notebooks. Each day, the students will look at the class chart, and note any differences between their predications and the actual appearance of the moon in their science notebook. Sample questions and/or comments to facilitate discussion can be found below:

- **Why is that happening?**

- **Show me how that relates to what we're studying…**
- **How do you know that?**
- **What do you see, notice, about…?**
- **Where have you seen this pattern before…?**
- **What would you say about…?**
- **How can we find out about…?**
- **What does this remind you of?**
- **Tell me more about…**
- **How are you going to use this information…?**
- **What will happen if…?**
- **What is different about that?**
- **Show me…**
- **I'm noticing that…, how did that happen?**

Lesson C – Ping Pong Phases Part I (K1, K4, K2, S2, S4, S8, S9, S10)
Note: Both lessons C and D can be found in Project Earth Science: Astronomy Pg. 91-102.

Students and teacher will work together for the first part of this experiment. Teacher should mark the floor with masking tape to show the path that they will follow. There should be a total of 8 marks on the floor which correspond to the data sheet (found in the Project Earth Science: Astronomy book page 94) which will be used in this lesson. The teacher will place a bright light in the center of a darkened room. Make the room as dark as possible. Using their own small moon Styrofoam ball, the entire class should form a circle around the light. This circle should be as tight as possible but still allow each student to turn around with one arm extended. All students should face the light (sun) and hold their ball directly in front of his body or slightly above his head. Observe what portion of the side of the moon facing you is illuminated by the sun. Now turn 45 degrees to the left and make the same observation. Continue to make a 45 degree turn until you are once again facing the sun. Students and teacher will synthesize the information by discussing the following questions and by reflecting in their notebook:
1) How much of the illuminated part of the moon could you see when you were facing the sun?
2) How much of the illuminated part of the moon could you see after each turn?
3) Whether you could see it or not, how much of the ball's surface area was always illuminated?

Lesson D – Ping Pong Phases, Part II (K1, K4, K2, S2, S4, S8, S9, S10)
Note: Both lessons C and D can be found in Project Earth Science: Astronomy Pg. 91-102.
Each student will 'paint' exactly half of the small moon Styrofoam ball black with a marker. The simplest way to do this is to cut a hole in the diameter of the ball in a piece of cardboard. Putting the ball in that hole before coloring it will keep one side protected from the marker. This simulates the moon with one side illuminated by the sun and the other side facing away from the sun, the dark side of the moon. Next, stick a pencil into the bottom center of the Styrofoam ball. Each group of two student (paired off already) will stand in an open area of the room approx. 2 feet apart and holding the ball at eye level so that the stationary student can see the black side

only. The student holding the moon should walk around the stationary student in a circle. Making sure not to turn the ball and to always face in the same direction; for example facing the board. The student will have to walk backwards and sideways at times to do this. At each of the eight portion of the white part of the ball that you can see. Switch places with the student helping you and repeat the activity. Label your drawings on the data sheet with a name for each phase of the moon.

Lesson E – Lunar Phase Matching Game (K1, K4, S2, S8, S9, S10, S11)
***See Appendix 5 –Lunar Phase Matching Game**
Teacher will provide students with a copy of Lunar Phase Matching Game (2 pages). Each student will cut out the photo column of the page and put it aside. Next, they will paste the remainder of the Lunar Phase Matching paper into their science notebooks. Students will then cut each individual photo of the moon phases, and will begin to manipulate the photos. Working in pairs, students will begin to match the photos with the phase name and description. Using their data collection sheet from Lessons C and D, the students will verify the accuracy of their matches against their collected data. Students will them paste the corresponding photo to the phase name and description.

Lesson F – Moon Phase review and assessment (K1, K4, S2, S10)
Students and teacher will meet to synthesize the data that has been gathered from Lessons B, C and D. Teacher will post chart paper throughout the room with the following headings:

- **New Moon**
- **Waxing Crescent**
- **First Quarter**
- **Waxing Gibbous**
- **Full Moon**
- **Waning Gibbous**
- **Third (or last) Quarter**
- **Waning Crescent**

Teacher will share the following thinking tool with the students:

- **Waning= losing light on the left**
- **Waxing= gaining light on the right**
- **Gibbous= ¾**
- **Crescent= sliver.**

Teacher poses the following question to the group, prior to sending them off to add information to the charts. "Students, before we draw the phases of the moon today, what can you tell me about the following phases of the moon". After students have had a chance to visit all 8 charts, group will review information and teacher will clarify for accuracy. Teacher then hands out Phases of the Moon (See Appendix 5) for each student. Students will need a pair of scissors, glue and construction paper. Each student will be asked to begin with the new moon, and to arrange the phases in order with names and descriptions.

Seasons

- The predictable position of the earth in the solar system affects the cycle of the seasons
  - How does the position and tilt of the earth's axis in the solar system affect seasonal cycles?

Lesson A – Reason for the Seasons (K1, K3, K5, K7, K6, S2, S4, S8, S9, S10)
Note: Complete teacher instruction are located in Project Earth: Astronomy pg. 83-89, 129-131

The teacher will model this activity while the students make observations, and jot wonderings. Using two globes, arrange a lamp and globes so that the lamp is in the center and the two globes are approx. 2 ft from either side of the lamp. Darken the room. Students will make and record observations about the intensity of the light on different parts of the globe that are facing the light. Take one globe and walk it through an orbit around the sun, making sure that you maintain the tilt of the axis and keep it oriented in the same direction. At each position, you may want to spin the globe so that the difference between day and night can be observed. Students make and record observations about the brightness of light on the United States as the globe goes through its orbit. Students and teacher synthesize information using the following questions to spark discussions:

1) **How did the brightness of light on the United States compare in the first demonstration when there was a globe on each side of the light?**
2) **How can you account for the difference in the brightness of the light?**
3) **How did the brightness of light on the United States change when the globe was walked around the sun?**
4) **At what point in the orbit do you think each of the seasons would occur?**
5) **When it is summer in the United States, where might it be winter? As a closure activity, in their science notebooks, students will respond to the following prompt "What I learned about the seasons so far….."**

Lesson B – Seasonal changes (K1, K3, K5, K7, K6, S2, S4, S8, S9, S10)
Student will work at their seats for this activity. Using the "earth" Styrofoam ball, the teacher will guide the students to locate and mark north and south of their model. Next, the teacher will guide students to locate and mark the equator. Last, the teacher will guide students to locate and mark our approximate location on the earth, using a stick pin or some other removable object.

Teacher will lead students into a discussion and synthesis on the rotation of the earth (day and night). Remind the students of yesterday's activity, and the look of the globe (it is not straight up and down, it is tilted). Teacher will model with a skewer, that we can simulate the tilt of the earth by piercing our earth model (at an angle, it does not need to be exactly 23 degrees) with a skewer so that earth appears to be on an axis. Allow students to "mess around" with the earth and sun model, making an "I notice" and "I wonder" chart in their notebook while experimenting with rotation and revolution. The questions that have been raised during this "messing about" serve as a springboard into the Literature Inquiry Investigation (see page 17).

The Literature Inquiry Investigation is part of this unit and can be found after the teacher background notes. <u>The Literature Inquiry Investigation does not need to be done as part of the seasonal changes lessons alone, it can be used with any part of this unit to explore a variety of topics.</u>

<u>Lesson C</u> – The trees, they are a Changin' (K1, K3, K5, K7, K6, S2, S4, S8, S9, S10)
Teachers and students discuss the apparent changes in our environment during seasonal shifts. Explore specific examples of flora or fauna during the year (animals hibernate, trees lose or gain foliage) and how the position of the sun changes in the sky. Ask the students to think about and make generalizations on the appearance of the seasons. In their science notebooks, students will illustrate the changing of the seasons using the playground as location that will change throughout the year.
The teacher will collect and assess science notebooks using the rubric which can be found in Appendix 6. Any misconceptions that are discovered after looking at the notebooks, should be clarified or re-taught.

<u>Lesson D</u> – Assessment – The Trees, They are a Changin'
The teacher will hand out construction paper, and ask each student to fold the paper so that there are 4 boxes on the paper. The teacher will ask that the student label each section with one of the four seasons. The students will then draw a scene in the box which represents what would be seen during each season. The student should include 1 stationary object, such as a tree or themselves and the position of the sun.
See Appendix 6

Sun, Moon and Earth – Grade 5
A LITERATURE Inquiry

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This guide is a tool for helping you plan an inquiry activity. The prime factor is that your students get the opportunity to practice choosing their own question and planning and carrying out an investigation to find out what they can learn from investigating that question.

Approx. Time: 1-2 weeks

Related State Content Standard(s):	Related State Expected Performance(s):
5.3- Most objects in the solar system are in a regular and predictable motion.	B 22. Explain the cause of day and night based on the rotation of earth on its axis. B 23. Describe the monthly changes in the appearance of the moon, based on the moon's orbit around the earth.
Related Enduring Understanding(s):	**Related Essential Question(s):**
• The predictable position of the earth in our solar system is responsible for the cycle of day, night and seasons.	• How does the predictable position of the earth affect the cycle of day and night? • How does the predictable position of the earth affect the cycle of the seasons?
What simple **content objectives**/goals do you want to accomplish with this investigation? (see district curriculum documents)	What simple **process skills** do you want to improve with this investigation?
Students will: • Compare day and night • Clarify their understanding of the phases of the moon • Understand the causes of the seasons	• Questioning • Reflecting • Inferring • Interpreting • Communicating

What phase of this investigation will you provide the most modeling/templates/mini-lessons/scaffolding for better skill development?
Teacher will do a think aloud using the Fact, Question and Reaction model in order for the students to begin to raise questions (Phase 1 of the Inquiry Model).
Materials/Resources:
• Chart paper • Sticky notes • Markers • Pencils and pens • A wide variety of non-fiction books related to the topic of Sun, Moon and Earth. ** Note – Teachers should contact their Library Media specialist to acquire the necessary books, at a variety of levels, for use in their classroom during this unit. Literature books have been purchased to support the science kits. Examples of available books: The Moon Book by Gail Gibbons, The Reason for Seasons by Gail Gibbons, *Kids Discovery Moon*
What kinds of investigations do you anticipate students designing?
Sample student investigation questions: • What causes day and night? • What cause the seasons? • Why does the moon look different during a month?

PHASE 1 – Observing and Questioning

INQUIRY STARTERS

- What is the launching activity or **inquiry starter** for the investigation?
- What will be your **inquiry starter prompt**? How will you "invite" your audience to work with the materials?
- What **materials** will you use for the inquiry starters?
- How will you **elicit and collect or display student's questions**? Will they share questions orally? In writing?
- **Choosing investigation questions**: How will you help your students determine which questions they can choose from to investigate? How will you or the students form investigation groups?

Time	Task	Hints
5 – 10 min.	Setting the context – Begin session by doing a book talk with the students, highlighting the different types, levels of books, and topics found in the book - that students will be looking at. Provide time for students to do a book pass.	Uses books from the library for your book talk and book talk.
45 min.	Teacher models Fact, Question, and Reaction technique. Teacher should use a text that they are comfortable with while doing a think aloud. After the think aloud, explain to students that, during this unit, you will be focusing your investigations on three categories- 1. day/night 2. moon phases 3. seasons. Teacher divides class into smaller groups to explore literature.	• **Assessment note:** This is an opportunity for the teacher to formatively assess the ability of your students to discriminate between fact and opinion, the ability to formulate a question, and personally respond to new information.
45 min.	• Create a Fact, Question and Reaction chart on the board. Chart the student's observations (Facts). These will naturally lead to questions. If students do not initially chart their reactions, teacher should make observations and help students with this. • At this time teacher should introduce students to the additional materials that will be available for students' investigations. Teacher should guide students to websites that have been previewed and contain relevant, appropriate information. This will generate additional questions. • Teacher may choose the most appropriate questions for investigation based on the content objectives of this lesson. (see page 1)	• **Guided Lesson/Thinking Tool:** Try to help students rephrase their questions into investigable questions that can be investigated in the "here and now" with the materials that we have available. • See page 2 of this inquiry investigation for some of the sample questions that students may generate

Student Samples - Fact, Question, Reaction

Facts…	Questions…	Reaction…
• The earth turns around once every 24 hours • The earth is tipped on its axis	• What causes day and night? • How tipped is the earth?	• Wow, I didn't know the earth was tipped!

5 -10 min.	Teacher can create groups for planning and investigating, (groups of 2-3 are recommended). • Things to consider: How will you help your students determine which questions they can choose from to investigate? How will you or students form investigation groups?	• The teacher may want to form groups based on student interest in a particular question. • Assigning group roles such as materials manager, recorder, communicator, etc. may be helpful.

PHASE 2 – Planning and Investigating

INVESTIGATION

- What **additional materials** will you introduce? How will you introduce additional materials participants can use to study the phenomena?
- How will you manage/organize materials, set up and clean up?
- How will you support the groups in **planning** their investigation? Will you provide criteria or planning sheets?
- How will you facilitate during the investigation?

Time	Task	Hints
5 min.	Teacher will review the materials (books) available for the groups to use to investigate their questions.	
15 min.	Class can brainstorm the elements of an effective plan while the teacher records on chart paper. Items discussed may include:	• This can be done with minimal teacher input; in order for students to develop their own plans (mistakes are expected).

30 min.	○ Question ○ Directions – numbered/sequenced steps (key words, glossary, search techniques, etc.) ○ Revise plans when changes are made ○ List of materials (book titles) ○ Jobs – if assigned ○ Labeled diagrams or drawings ○ Prediction / hypothesis ○ Type of results you will collect and how they might be organized This can remain as a guide for students to refer to as they plan, or can be utilized to formulate a rubric. Teacher directs each group to develop a plan to use to investigate their question. This should be recorded by each group to share with the class in words or pictures.	• **Assessment Note:** This is an opportunity to formatively assess student planning. • Teachers may choose to use the "Investigation Plan Template" (See Appendix 1 on page 25). This template can be taped into students' journals for future reference. • Teacher may choose to model a plan using a question that students are not investigating.
15 min.	Students will then share their plans with the class (pair share, museum walk, chart paper, jigsaw, etc.), possibly modeling specific steps, using the materials.	• Teacher should be adding key elements of an effective plan to the original list recorded on chart paper.
15 min.	Students should revisit their plans at this time, making the necessary revisions.	• Teacher should reinforce the fact that most/all of the important plan elements were included in students' shared plans.

45 – 60 min.	Using their investigation plans and materials, students can conduct their investigations. Students will record their observations and findings during the literature investigation in their student journals. Teacher will facilitate with reminders to record information. Removing students from their materials for a few minutes will help them concentrate on recording observations and noting revisions they made to their plan. If students finish their investigation early they can continue to investigate a related question or start preparing for their presentation/sharing with the larger group. Plan on ample time for clean-up procedures.	• Materials can be distributed to each group by the teacher, or a designated student may gather them for his/her group. Plastic café trays may be helpful to manage the materials. • Teacher should circulate, question and guide groups. • Remind students that a good plan may still need to be revised once you begin your investigation. • **Guided Lesson/Thinking Tools**: Teacher may need to provide a mini-lesson on data collection and organization of this data. Some groups may need a template/chart/ graphic organizer to help with data collection.

Open Ended Questions and Comments to Help Guide Students during the Investigation

What do you know about…?
What will you need?
What will you add?
I wonder what will happen when…?
Why is that happening?
Show me how that…
How do you know that?
What do you see, notice, hear about…?
What does this do?
Where have you seen…?
What's happening with this?
What would you say about…?
How can we find out about…?
What other way can you try?
What else can you do about…?
What can you use this for?
Tell me about it.
What's your plan for that?
What does this remind you of?
Tell me more about…
How are you going to use…?
How will you use this today?
What does it need?
What else can you do about…?
What will happen if…?
How can we change that?
What happened when you did that?
What is different about that?
What will you do to change that?
Show me…
I'm noticing that…, how did that happen?

PHASE 3 – Interpreting Results and Communicating

SHARING RESULTS AND PROCESSING FOR MEANING

- How will investigation groups present what they have learned from their investigations? (visual, oral presentation, combination, etc.) How will you decide the order of the presentations? (by similar questions, content goals, random, etc.)
- How will the facilitator synthesize the knowledge and findings of the participants for the group?

Time	Task	Hints
45 – 60 min.	Prepare to share results. Things to consider: How will students visually share their results? (overheads, chart paper, poster, etc.) Teacher will allow an allotted time for each group to share their results (approx 3 minutes).	• **Guided Lesson/Thinking Tool:** Discuss with students what would be in an "effective presentation" (question, hypothesis/prediction, overview of procedure, results, and conclusion). • Teachers may find it helpful to take notes as students present; documenting which groups had evidence of each big idea. • Teachers may choose to use the template, called "Preparing to Share Results," to prepare for sharing (See Appendix 2 on page 26) • Consider charting "findings/ conclusions" after each group presentation. This will be helpful later during the synthesis.

Sample Student Visual for Presentation:

Question: What causes day and night?
Plan: First, we will choose different books
Next, we will use the index and table of contents to find keywords
Then we will skim and scan the books looking for information
Last, we will create a picture to show what we learned.
Results (data): If the earth is facing the sun it is day. If the earth is away from the sun it is night.

Conclusion: The position of the earth during its rotation causes the cycle of day and night

15 min.	Synthesis – What have we learned about …….? Use specific examples from the class to support new learning/findings. Provide a copy (or have students copy into their journal) of the big ideas/summary of investigation findings.	• Use the big ideas to question students to guide them toward the content goals of the inquiry investigation.

Sample – Big Ideas/Summary of Investigation Findings:
The position of the earth during its rotation causes the cycle of day and night • **The earth rotates once every 24 hours** ***NOTE – these should be aligned with the content goals and objectives of the unit found on page 1**

15 min. 15 – 30 min.	Follow up activity after synthesis. Students will be prompted to write in their science journals about what they learned during this inquiry. Students will then Pair Share their journal entries with a student who was not in their investigation group.	• What did they learn from revising their plans? • What did they notice about their plans as they investigated? • Was sequence important? • Did they develop/consider new questions during their investigation? • Did their partners notice the same things?
10 min.	Whole class discussion regarding student journal entries and Pair Share discussions.	• You might ask, "How was this different than how you have done science before?" • **Assessment Note**: Teacher will collect the student science notebooks for summative assessment.

Investigation Plan Template

Appendix 1

Team member names:_____
_____

Our **question** is:_____
_____

Our **hypothesis/prediction** is:_____
_____

Materials we will use:_____
_____
_____

PLAN
First, we will_____
_____
_____
_____
Then we will_____
_____
_____
_____
Next we will_____
_____
_____
_____
Finally we will_____
_____
_____
_____

What **changes/revisions** did you make to your original plan?
_____
_____
_____

Preparing To Share Results

Appendix 2

Question: _____

Hypothesis/Prediction: _____

_____

Summary of what you did (plan) _____

_____

_____

_____

_____

We found out that (data or results)_____

_____

Conclusion (WHY?) _____

_____

_____

Space for illustration/diagram of investigation plan and/or results.

LITERATURE RESOURCES

These literature resources have been purchased to supplement the kit and are housed in each elementary school library.

Guided Reading Sets (6 copies in each school)
Green Book, Jill Walsh
The Moon Book, Gail Gibbons
Comets, Meteors, and Asteroids, Seymour Simon
Galaxies, Seymour Simon
The Universe, Seymour Simon
The Reasons for Seasons, Gail Gibbons
Charlie and the Great Glass Elevator, Ronald Dahl
Meteor, Patricia Polacco
Kids Discover Magazine: *The Moon* (12 copies plus Teacher's Guide)
To the Moon and Beyond, Linda Lott

Read Aloud (1 copy per school)
Exploring the Solar System: The Sun, Giles Sparrow
The Sun and the Moon, Patrick Moore
My Place in Space, Robin Hirst
Stargazers, Gail Gibbons
Zoo in the Sky, Jacqueline Mitton

Related Materials that May Be Found in Your Library
Videos:

- All About the Moon
- All About the Sun
- All About the Earth

Additional Teacher Resources That Are Suggested:
These additional readings are aligned with the unit objectives.
Discovery Works – Sun, Moon and Earth
Pg. B34- B35 – see modified inquiry in "Day and Night" section
Pg. B38-B41, B46-B49, B52–B56, B64-B71, B76-B78.

Materials List

Sun, Moon and Earth – Grade 5

Revised January, 2006

Expendable Materials
12 pieces 11x14 cardboard for sundial inquiry
1 box modeling clay
1 roll masking tape
2 packs of multi color markers (8 pk.)
Packed separately - Styrofoam balls
12 – 6 inch sun
24 -3 inch earths
24 – 1 inch moons

Reusable Materials
1 teacher's manual – Discovery Works: *Sun, Moon and Earth*, Silver Burdett Ginn, 1996
Teacher manual – *Project Earth Science: Astronomy*
25 student books- Discovery Works
Resource manual with Blackline masters
1 curriculum guide
1 copy - excerpt MS Inquiry National Standards pg. 48-59
6 table tennis balls (ping pong balls)
6 sharpie markers
6 inflatable globes
1 globe pump
1 small world globe with stick through it
1 6 inch globe on stand
Desk lamp with extra bulb
1 clamp lamp
10 foot extension cord
12 flashlights with batteries
6 extra flashlight batteries
24 sharpened pencils
12 dowels (approx. 12 inches long)

Teacher Background Notes

These science content background notes were created for teacher use only. We anticipate that these notes provide you, the teacher, with some useful background as you facilitate inquiry activities for your students. These notes are not meant to be an overview of the unit, but as background information for you that go beyond the content of this particular unit. These notes should not be replicated for your students; however, you may share some of the content when appropriate for the developmental level of your students.

These notes have been prepared by Evelyn Gallagher, Earth Science Teacher.

What is the cause of day and night? (How does the position of the Earth relative to the Sun explain day and night?)

1.) The Earth spins (rotates) on an inclined axis. [The spinning is caused by the angular momentum of the matter that first came together to form the earth - all matter in the solar system rotates. This is a very abstract concept and is like asking why does an object have mass?]

2.) The Earth is spinning on its axis at approximately 1,000 miles per hour! Why can't we feel the movement? Basically, the size of the Earth compared to humans (and the forces of gravity which hold us to the Earth) prevent us from "feeling" the spin or rotation and our atmosphere is also rotating with us so we don't have a spinning sensations like when you twirl around.

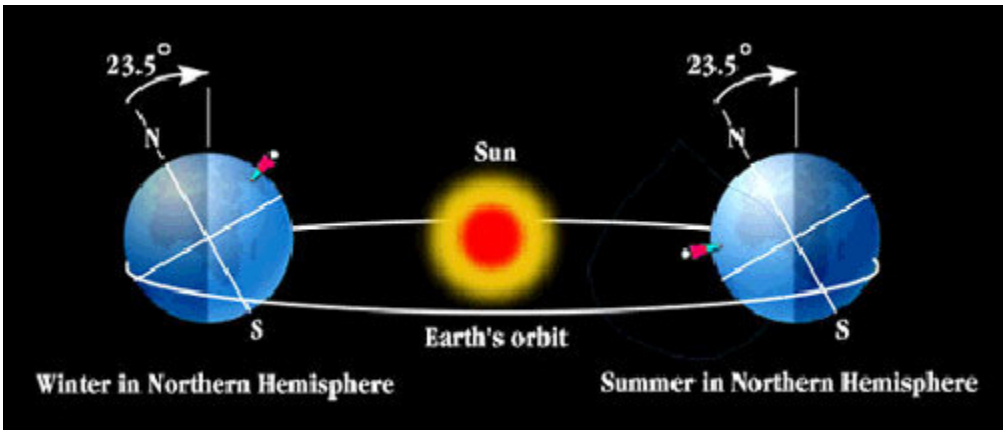
3.) It takes 24 hours for this planet to spin or rotate once.

4.) When Earth is ***facing*** the Sun directly it is day light. When it is facing ***away*** from the Sun it is night time.

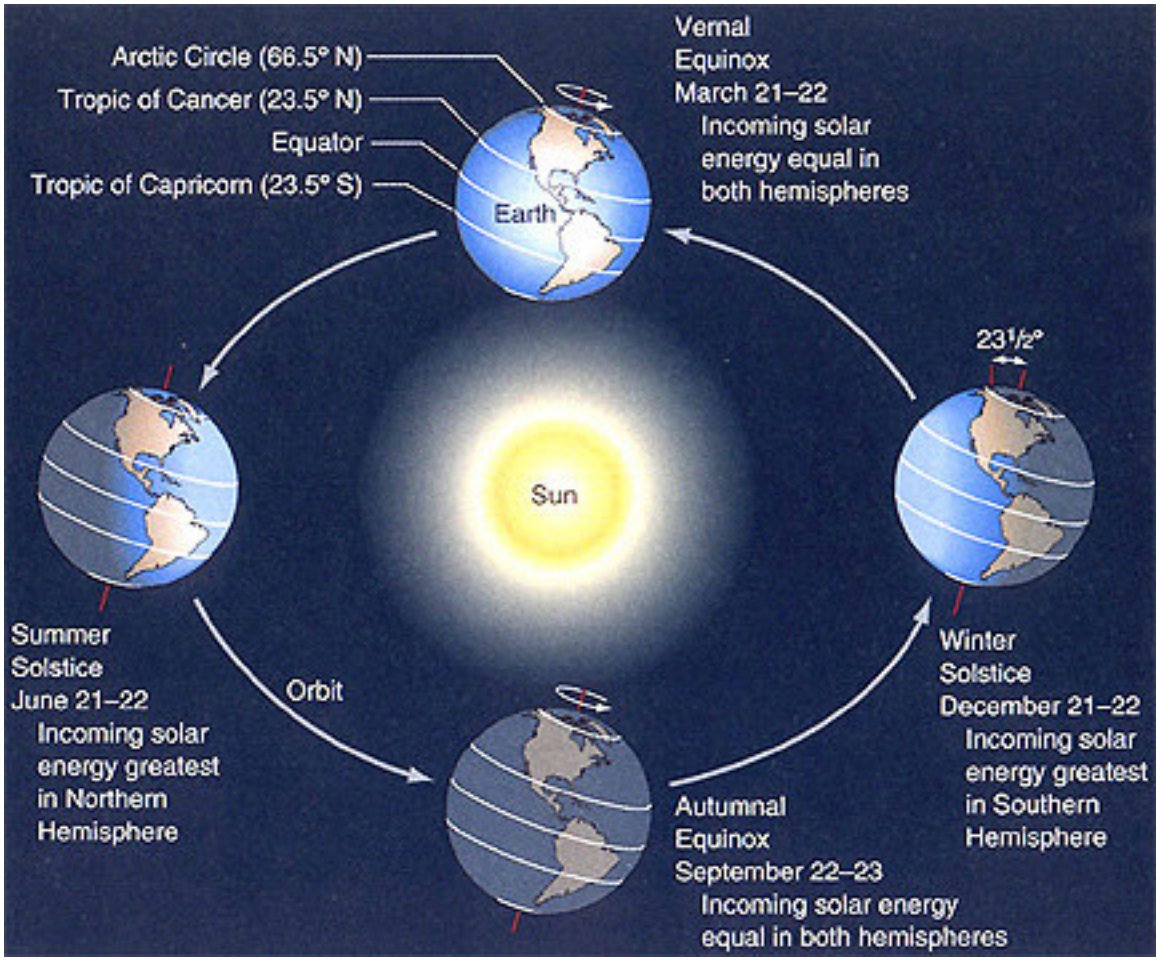
What is the reason for seasons?

Most students (and the majority of adults) think that it is cold in winter because the Earth is farther from the Sun. In reality, it is not the distance from the sun that affects temperature on earth, it is the tilt of the earth that affects how cold it is in the winter.

1. The Earth is offset by 23.5 ^{o} from its orbital plane.
2. The Earth revolves (orbits) the Sun at 23.5 ^{o} throughout the entire 365 +days (or a little over one year) that it takes for one complete revolution. It takes an extra quarter of a day per year so every fourth year is a leap year (with an entire day added).



3. The figure above shows a "person" on the right standing in the Northern Hemisphere (for example Wallingford, CT.) in summer. The Sun's ray are hitting the person ***directly*** because of the Earth's tilt on its ***axis is toward*** the Sun, From his perspective, the Sun appears directly overhead, therefore the maximum amount of radiant heat is hitting the person.
4. The figure on the left, showing the person in the Northern Hemisphere (for example Wallingford, CT) in winter, is **NOT** receiving direct sunlight because of the Earth's tilt on its axis ***away from*** the Sun. The Sun appears at an angle in the sky not directly overhead from his perspective.



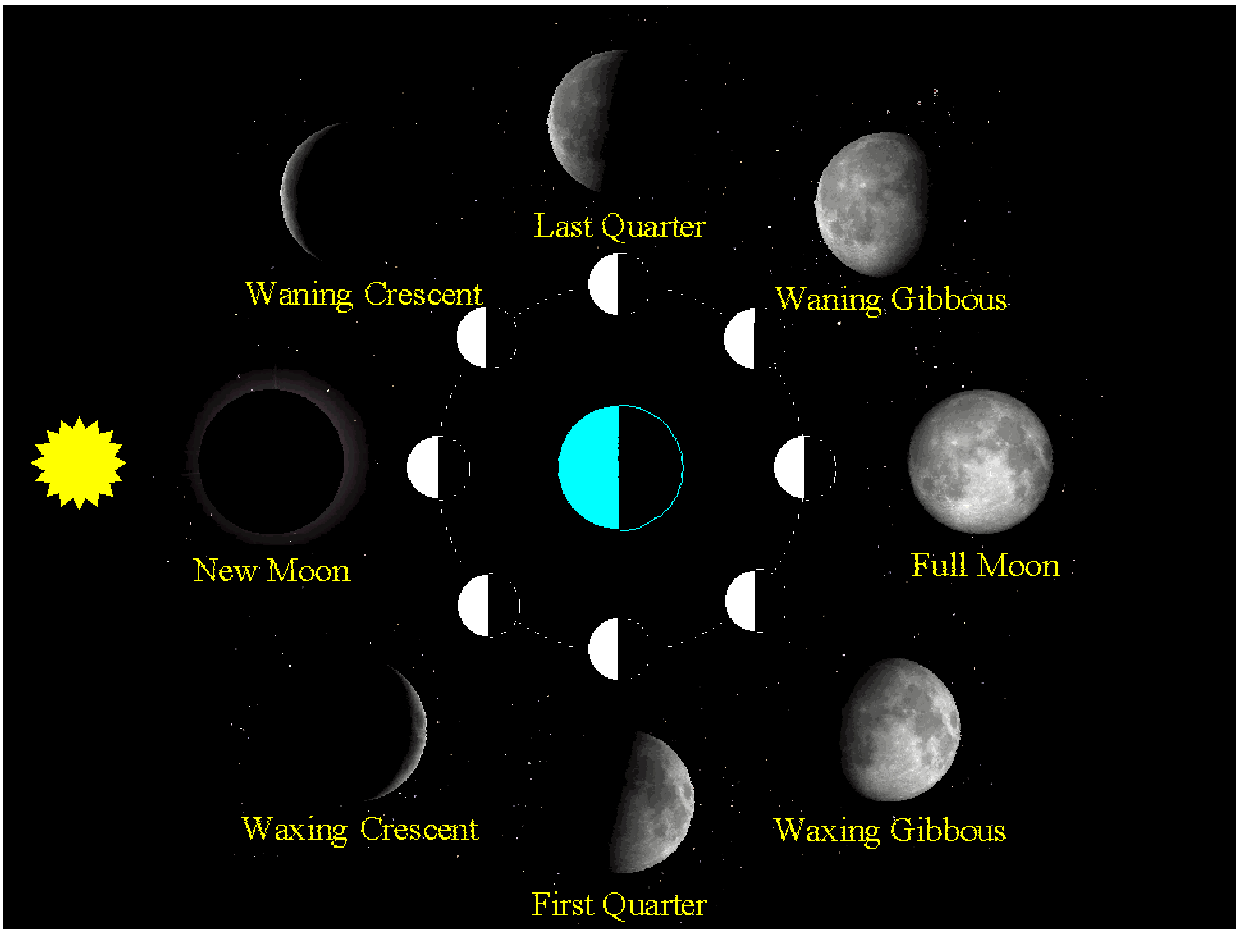
http://rst.gsfc.nasa.gov/Sect14/agburt2_02_11.jpg

5. In the figure above, the "four seasons" are shown with the direction of the Earth's axis. The diagram illustrates that when it is Summer in the Northern Hemisphere, the Northern Hemisphere is **tilted toward** the Sun at the same time, the Southern Hemisphere experiences winter. There are more hours of daylight in the Summer months in the Northern Hemisphere compared to winter. During Spring and Autumnal Equinoxes, the Northern Hemisphere and Southern Hemisphere receive the same amount of sunlight, directed at the equator. "Equinox" means equal day (12 hours) and equal night (12 hours). During our winter, the Northern Hemisphere is **tilted away** from the Sun. At the same time the Southern Hemisphere experiences Summer.

6. Summer begins on June 21st, Fall begins on September 21st, Winter begins on December 21st and Spring begins on March 21st.

Why does the appearance of the Moon change throughout the month?

1. The Moon orbits (revolves) around the Earth in about 27 to 29 days.
2. The Moon also rotates at the same rate or speed that it revolves, therefore from our perspective on Earth; we always see the same side. (This is because the gravitational forces of the Earth are much stronger than the Moon's and the Earth "pulls" in the Moon toward its own rotation.
3. The Moon reflects the Sun's rays and appears to be "lit" up but has no visible energy source of its own.



http://www-astronomy.mps.ohio-state.edu/~pogge/Ast161/Unit2/moonphase.gif

4. There is less mass on the Moon (it is about 1/4th the size of Earth) so your weight would be 1/6th of Earth weight.
5. There is no atmosphere (air) so there is no weather on the moon.
6. "Waxing crescent" moon appears bright on the to the right side; 1st quarter is ½ lit on the right side; waxing gibbous is three quarters of the moon on the right side lit up; full moon the entire moon is lit; "waning" gibbous the moon appears three quarters lit on the left side; 3rd quarter the moon id ½ lit on the left side, waning crescent the moon appears as a sliver on the left side and a new moon is not visible. Waxing moon or "growing" moon can be remembered by thinking of pouring wax into the right side of a container. Waning moon is receding to the left.

How do science and technology affect the quality of our live?

Investigations of the sky date back thousands of years and are essential to the development of civilization. As humans progress, so do technology and the tools needed for examining the sky, Sun, Earth and Moon. By understanding how celestial bodies move in a pattern using technological advances such as telescopes, magnifiers, periscopes and even eye glasses, we have improved our quality of life. For example, these advances give us higher order processing skills to improve navigation systems such as radar, GPS, On-Star in our vehicles.

Misconceptions Students May Have:

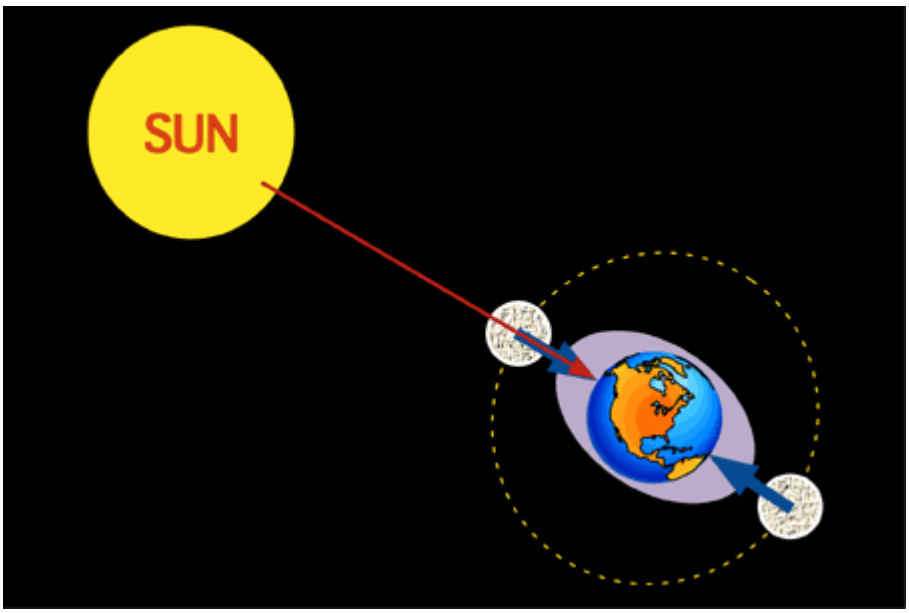
Why isn't the length of the day the same all year round?

If the Earth is closer to the Sun in winter, why isn't it warmer and summertime?

If the Moon is on the opposite side of the Earth away the Sun, why doesn't the Earth block the rays?

Additional topics that may come up or may be investigated for higher level students.

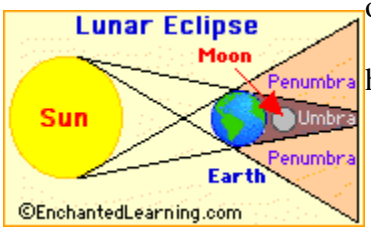
Tides - Tides are periodic rises and falls of large bodies of water. Tides are caused by the gravitational interaction between the Earth, Moon and Sun. The gravitational attraction of the moon to Earth causes the oceans to bulge out in the direction of the moon. Another bulge occurs on the opposite side, since the Earth is also being pulled toward the moon (and away from the water on the far side). Since the earth is rotating while this is happening, two high tides and two low tides (semi-diurnal)occur each day at about every six hours.



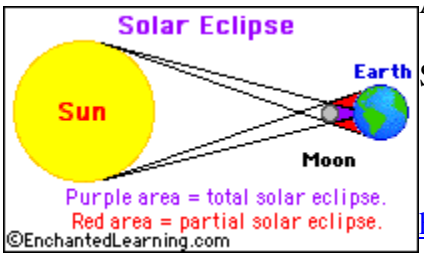
http://www.physicalgeography.net/fundamentals/8r.html

Craters- Impact craters are the remains of collisions between an asteroid, comet, or meteorite and the Moon. They appear as "potmarks" on the surface of the Moon. The Earth also has been bombarded by asteroids, comets and meteorites but our atmosphere helps to burn most of them up before they hit the surface. The Moon doesn't have an atmosphere to protect it or erode away the evidence of the collisions the way the Earth does. There are some areas on Earth that show impact craters and it is believed by some scientists that a giant meteorite struck in the Yucatan Peninsula of Central America causing catastrophic climatic changes that may be responsible for the extinction of dinosaurs!

Eclipses – A lunar eclipse occurs when the Earth's shadow blocks the Sun's rays from hitting the Moon.



http://www.enchantedlearning.com/subjects/astronomy/moon/Lunareclipse.shtml



A solar eclipse occurs when the Moon's shadow blocks the Sun's rays from the Earth.

http://www.enchantedlearning.com/subjects/astronomy/sun/solareclipses.shtml

Constellation – A constellation is a group of stars that when seen together appear to make a pattern. Examples are the Big Dipper, Little Dipper, Orion and the zodiac signs.

To view the Earth, Moon and Sun on a daily basis from outer space go to: Main page: http://www.fourmilab.ch/earthview/vplanet.html
You can view either a map of the Earth showing the day and night regions at this moment, or view the Earth from the Sun, the Moon, the night side of the Earth, above any location on the planet specified by latitude, longitude and altitude. By clicking on the blue underlined words under **viewing the Earth.**
You can view the Moon from the Earth, by clicking on "Earth," Under "**Viewing the Moon."**

You can also view the Sun on a daily bases by going to **http://www.sec.noaa.gov/SWN/index.html** This site from National Oceanic and Atmospheric Administration (NOAA) shows any sunspots and solar flares.

You can also visit http://www.spaceweather.com/ This site shows the side of the Sun facing the Earth but also explains what is happening around the opposite side of the Sun. The Sun also rotates (about every 27 days) so we see the entire surface of the Sun. If there is a lot of solar activites (called solar weather) like sun flares and explosions, it can affect the Earth's weather.

Appendix 1

Day and Night
Science Notebook Entry Prompt

Summarize the science ideas that you have learned during your investigation.

In addition, you may include any pictures, or diagrams, that explain what you have learned during your investigation.

Science Notebook Entry Rubric
Science Content

3 – A well written entry which includes all of the following: topic related science vocabulary, examples from the investigation, diagrams with labels, connections to other students' investigations.

2 – A written entry which includes most of the following: topic related science vocabulary, examples from the investigation, diagrams with labels, and connections to other students' investigations.

1 – An entry which include some of the following: topic related science vocabulary, examples from the investigation, diagrams with labels, and connections to other students' investigations.

0 – An entry which includes none of the above characteristics.

Appendix 2

Using a Predict and Clarify Strategy to Teach Content Vocabulary.

Purpose: The strategy encourages students to use their prior knowledge about word parts and information from outside sources (books, text) to predict and clarify the meaning of content words. This activity is particularly helpful for struggling readers because it builds on prior knowledge, and improves comprehension of new materials.

Materials:
Note cards
Chart paper
Dictionaries
Text or trade books

Steps:

1. Teacher creates a chart that includes the columns**: Words**, **Predictions** and **What I've learned.**
2. Teacher lists four or five words that students will need to know to understand the concepts in the unit. Examples may be *rotation, revolution, and axis*.
3. Teacher models a think aloud, and writes a prediction of the words meaning.
4. Teacher uses textbook, trade book or dictionary to find definition. Teacher records ideas of words leaning under What I've Learned column.
5. Teacher can organize students in pairs or individually. Using a Predict and Clarify sheet (see appendix??) students will copy the words from the chart onto their own papers.
6. Students will write their predictions on the Predict and Clarify sheet.
7. Students will use textbooks, trade books or dictionaries to find the words meaning.
8. If text books, trade books or dictionaries are not available, or if the teacher would like a richer activity, you can ask your students to do the following the uncover the meaning of the word;
    a. Skim the pages of books for the word.
    b. Read the sentence that contains the word.
    c. Discuss the meaning of the word with a partner or group.
    d. Predict the word's meaning based on the sentence and your group's discussion.
    e. Partners or groups share their predications with classmates.
9. Students complete the What I've Learned column on their Predict and Clarify sheet.
10. Teacher and class discuss the meaning of words, and clarify any unknown word. Students will make adjustments to their individual Predict and Clarify sheets if needed.
11. Students keep the Predict and Clarify sheets for use during the unit of study.

* *Adapted from Easy Mini-Lessons for Building Vocabulary by Laura Robb*

Appendix 2

Predict and Clarify

Name_____

Word	Prediction	What I've Leaned

Sentences:
Use each word in a sentence that shows you understand the word's meaning.

1.

2.

3.

Appendix 3

Sample Assessment of Day and Night

Teacher Conference with Student Demonstration Using Model

- This is intended to be used during a conference with a student. Students should bring their Styrofoam model of the earth to you. A light source to represent the sun should be present as well. Teacher will ask various questions of the student to assess their learning. Modify questions as appropriate for needs of various learners.

- It is recommended to use a simple 1-3 grading system for this assessment.

- Suggested vocabulary that you may want to hear in a good response is: rotation, axis, and hemisphere.

Questions for Day and Night

1. Show me with your model what the earth would like in relation to the sun (lit lamp) if it was nighttime in Wallingford.

2. How would you change your model to show me if it was daytime?

3. Show me where it is nighttime some where on your model.

Sample Rubric

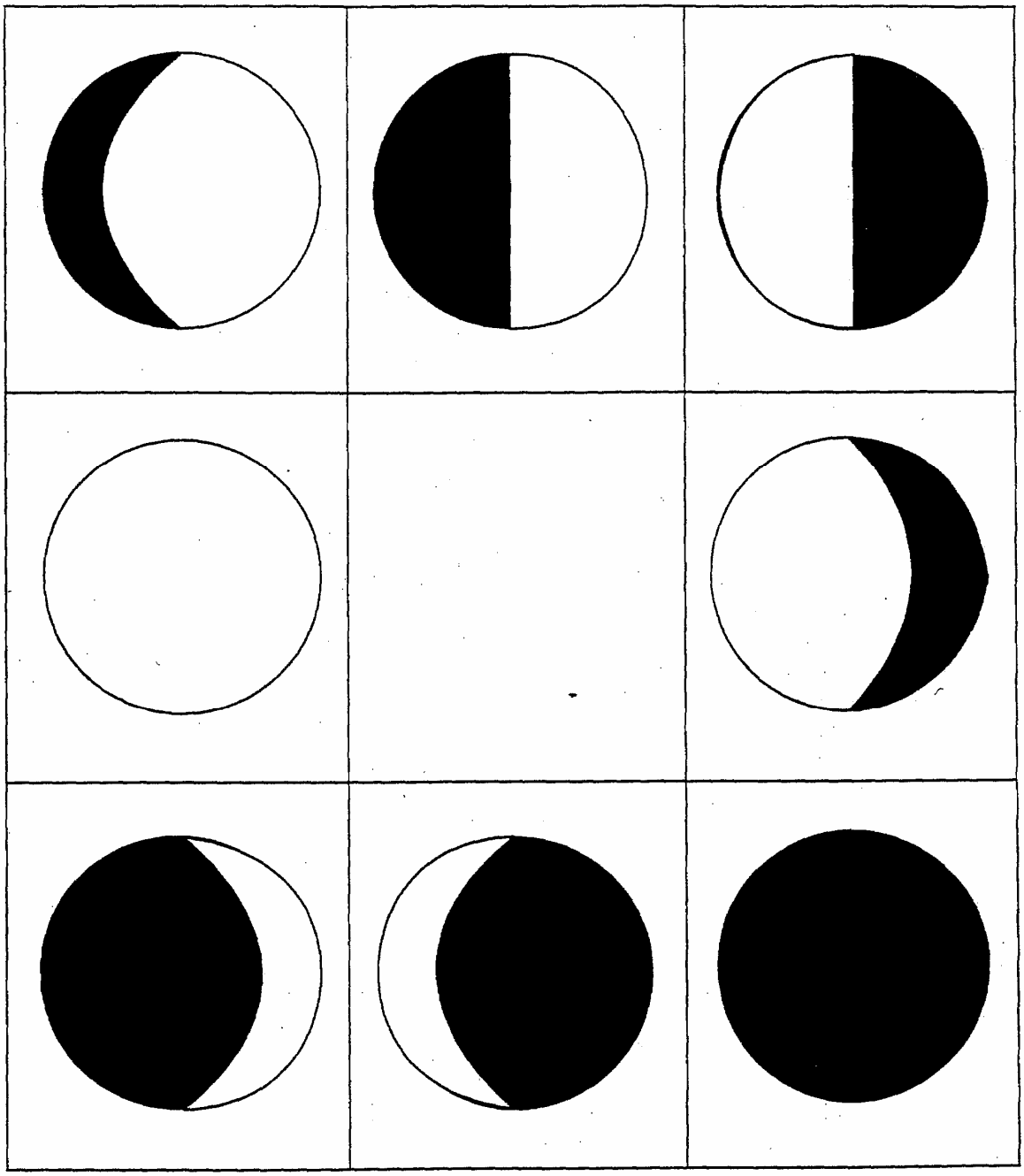
3-Good understanding of day and night, uses adequate vocabulary

2-Understands why day and night occur, may struggle with explanation

1- Could not tell why day or night occurs

Appendix 4

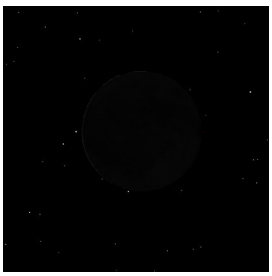
Phases of the Moon



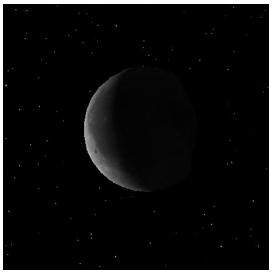
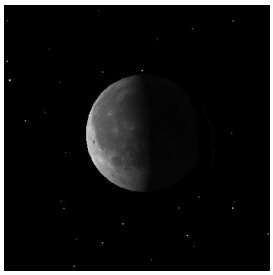
Appendix 5

Lunar Phase Matching Game

Directions: Cut out the boxes and paste a picture, the name, and description together on a new sheet, in the correct order.

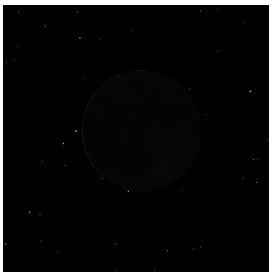
	New Moon	
This moon cannot be seen. The moon is in alignment with the sun and therefore rises with and sets with the sun.		A narrow strip of the moon's lighted hemisphere is visible from Earth. Shaped like a crescent. The light is on the right. This moon is east of the sun. It is seen above the sunset glow in the west at sunset. (between 4:00 PM & 8:00 PM - average - 6:00 PM)
Waxing Crescent	First Quarter	Waxing Gibbous
	Half of the lighted hemisphere is visible from Earth. Shaped like a semicircle. The light is on the right. This moon rises about noon and sets at midnight. It is seen looking south at sunset.	Three quarters of the lighted hemisphere is visible from Earth. Shaped like a football. Light is on the right. Look to the east in the afternoon hours for rising this moon

Appendix 5

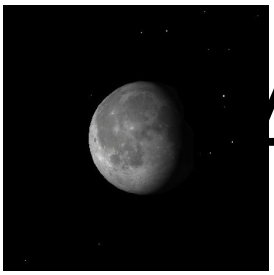
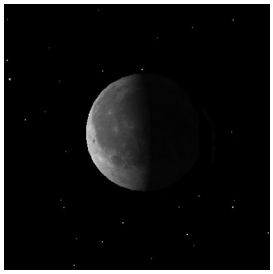
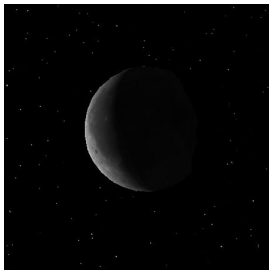
Three quarters of the moon's lighted hemisphere is visible from earth. Shaped like a football and the light is on the left. This moon rises in the east in the hours after sunset approaching midnight.	Full Moon	The moon's entire hemisphere, like a full circle, is visible from Earth. This moon rises at sunset, is up all night, and sets at sunrise. Look to the east at sunset for the rising of this moon.
	Half of the moon's lighted shape is visible from Earth. The light is on the left. This moon rises in the east at about midnight and sets in the west at about noon.	
Waning Crescent	Third Quarter	Waning Gibbous
		This moon is seen in the east in the pre-dawn skies. Look to the east before the sun rises to see this crescent moon. The light is on the left.

Appendix 5

Lunar Phase Matching Game – ANSWER KEY

	New Moon	This moon cannot be seen. The moon is in alignment with the sun and therefore rises with and sets with the sun.
	Waxing Crescent	A narrow strip of the moon's lighted hemisphere is visible from Earth. Shaped like a crescent. The light is on the right. This moon is east of the sun. It is seen above the sunset glow in the west at sunset. (between 4:00 PM & 8:00 PM - average - 6:00 PM)
	First Quarter	Half of the lighted hemisphere is visible from Earth. Shaped like a semicircle. The light is on the right. This moon rises about noon and sets at midnight. It is seen looking south at sunset.
	Waxing Gibbous	Three quarters of the lighted hemisphere is visible from Earth. Shaped like a football. Light is on the right. Look to the east in the afternoon hours for rising this moon

ANSWER KEY **Appendix 5**

	Full Moon	The moon's entire hemisphere, like a full circle, is visible from Earth. This moon rises at sunset, is up all night, and sets at sunrise. Look to the east at sunset for the rising of this moon.
	Waning Gibbous	Three quarters of the moon's lighted hemisphere is visible from Earth. Shaped like a football and the light is on the left. This moon rises in the east in the hours after sunset approaching midnight.
	Third Quarter	Half of the moon's lighted shape is visible from Earth. The light is on the left. This moon rises in the east at about midnight and sets in the west at about noon.
	Waning Crescent	This moon is seen in the east in the pre-dawn skies. Look to the east before the sun rises to see this crescent moon. The light is on the left.

Appendix 6

Assessment of "The Trees, they are a Changing"

There should be four pictures all having the student and a playground object all in the same spot in every picture. It is expected that the student will be placing the sun in the picture for each of the seasons. The placement of the sun is what will be assessed for this assignment. Students may also ad foliage or details to the environment for added color.

Items to be looking for:
Winter drawing- sun should be on the horizon
Spring Drawing- sun should be on left side of picture
Summer drawing- sun should be straight above
Fall drawing- sun should on right side of picture

A simple 1-3 scoring guide is recommended for this assessment.

3- Sun is in correct position for every season

2- Sun is in correct position for 2 seasons

1- Sun is in incorrect positions for 3 or more seasons

Any misconceptions should be addressed in class.

Appendix 7

I N S T I T U T E · F O R · I N Q U I R Y
A DESCRIPTION OF INQUIRY

Appendix A

At the *Exploratorium Institute for Inquiry* our work in science education is deeply rooted in the belief that human beings are natural inquirers and that inquiry is at the heart of all learning. The work that we do with educators is designed to give them an opportunity to personally experience the process of learning science through inquiry. Our hope is that this experience will stimulate their thinking about how to create classrooms that are supportive environments for children's inquiry.

Inquiry is an approach to learning that involves a process of exploring the natural or material world, that leads to asking questions and making discoveries in the search for new understandings. Inquiry, as it relates to science education, should mirror as closely as possible the enterprise of doing real science.

The inquiry process is driven by one's own curiosity, wonder, interest or passion to understand an observation or solve a problem.

The process begins when the learner notices something that intrigues, surprises, or stimulates a question—something that is new, or something that may not make sense in relationship to the learner's previous experience or current understanding.

The next step is to take action—through continued observing, raising questions, making predictions, testing hypotheses and creating theories and conceptual models.

The learner must find her or his own pathway through this process. It is rarely a linear progression, but rather more of a back and forth, or cyclical, series of events.

As the process unfolds, more observations and questions emerge, giving occasion for deeper interaction and relationship with the phenomena—and greater potential for further development of understanding.

Along the way, the inquirer collects and records data, makes representations of results and explanations, and draws upon other resources such as books, videos and the expertise or insights of others.

Making meaning from the experience requires reflection, conversations and comparison of findings with others, interpretation of data and observations, and the application of new conceptions to other contexts. All of this serves to help the learner construct new mental frameworks of the world.

Teaching science using the inquiry process requires a fundamental reexamination of the relationship between the teacher and the learner whereby the teacher becomes a facilitator or guide for the learner's own process of discovery and creating understanding of the world.

Map of IFI Inquiry Structure

(3 Phases of Inquiry Diagram)

Appendix B