Lesson Study Sample: Moon Phases (Sample Lesson A)

v. 7-26-05

Steps of the lesson: learning activities and key questions (and time allocation)	Student activities/ expected student reactions or responses	Teacher's response to student reactions / things to remember	Points of evaluation	Observation notes
Pre-assessment (5 minutes) Pass out pre-test on moon phases. Collect the pre-test. **Instructional Sequence** ***Part One:* Moon Phases from an Outside Perspective (27 min)** **Full Moon:** Have students **INDIVIDUALLY** draw a 2-D picture of the sun-earth-moon system during a full moon. Put an "X" on the earth where you would have to be in order to see the moon high in the sky. (3 min) Break class into groups of three. Assign one student each to hold the moon, the sun and the earth. Pass out globes, tennis balls ('suns') and ping pong balls ('moons'). Have students show the relative positions of the sun, moon and earth	*Students should do this work by themselves on the pre-/post thinking handout without consulting the teacher or other students.* *Anticipated Student Response:* Student has the moon with the lit side	Glance over pre-test to check general level of student conceptual understanding. As you roam the room, check student drawings to assess their current understanding, but DO NOT intervene. Also remind them NOT to move onto the next phases. ***BEFORE YOU CONTINUE, READ THE IMPORTANT NOTE AT THE END OF THIS COLUMN.** Remind students that the spheres used in this lesson do not match the relative size of distances in the real sun, earth, and moon system. Roam the room checking	Are students focused on the task? Evidence? What evidence do you have that students are appropriately challenged by the questions? Are students making a diligent effort to answer the question? Are student misconceptions apparent in their drawings? If not, note them. Do the students persevere or immediately look to other groups or the teacher for the answer, or give up?	

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during a full moon. (6 min) After students struggle with this, collect ping pong balls and pass out half black/white ping pong balls. Allow the students to try again to model the full moon. (4 min) **3rd Quarter Moon:** Have students **INDIVIDUALLY** draw a 2-D picture of the sun-earth-moon system during a 3rd quarter moon. Put an "X" on the earth where you would have to be in order to see the moon high in the sky (3 min). Have students switch positions (e.g. the student holding the 'moon' is now holding the 'sun'). Have groups demonstrate the relative positions of the sun, moon and earth during a 3rd quarter moon. (4 min) **New Moon:** Have students **INDIVIDUALLY** draw a 2-D picture of the sun-earth-moon system during a new moon. Put an "X" on the earth where you would have to be in order to see the moon high in the sky (3 min).	facing the earth *in a position other than full moon position* (e.g. at 90° with the sun and earth). (Possible response: Student rotates the moon so that the lit side faces the sun) *Anticipated Student Response:* Students model a 1st quarter moon (savages!).	progress and intervene with questions as necessary. *Why is the moon lit up in the first place?* *How much of the sphere of the moon is illuminated?* *Is that always true?* *If you were standing on the sun and looking at the moon, what would the moon look like?* *What do you need to do to your moon so that it looks full from the sun?* *Now what would you see if you were standing on the Earth? Is it a full moon? Where would you have to move the moon in order for it to be full?* *Find the full moon in your Moon Log. Which quarter came after the full moon? What does that quarter look like? Is the same portion shaded in your Moon Log for the third*	What evidence do you have that the black and white ping pong balls helped students develop an understanding of light reflection on a sphere? Students have grappled with the full moon. Is it easier now for them to individually draw this subsequent phase? Is everybody in the group creating a drawing? ***Note:*** *By switching positions, students will eventually have the opportunity to view the model from all three perspectives.* Are students who struggled early in the lesson showing more persistence toward the	

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Have students switch positions again. Have groups demonstrate the relative positions of the sun, moon and earth during a new moon. (4 min) ***Part Two:* Moon Phases from an Earth Perspective (20 min)** Collect tennis and ping pong balls. Pass out polystyrene balls on a stick. Hold up one of the spheres on a straw and the lamp with the bare bulb. Introduce them as a model moon and model sun. Tell students that their heads will be models of the earth and one of their eyes will represent an observer on earth. Set up the naked bulb in the middle of the room. When the 'moons' are ready, place the 'sun' (the naked lit bulb) in the center of the room. Ask students to distribute themselves around the sun, maintaining as much elbow room from one another as possible. Darken the room and let students make unguided observations. (5 min)	Note: Watch for similar anticipated student responses noted in Part One.	*quarter as that in the model your group is holding? What position should the moon be in in order to have the same portion shaded as the 3rd quarter moon in your log?* Roam the room checking progress and intervene with questions as necessary.	end of the lesson? Can you see evidence of students applying newly formed knowledge to successfully address a new scenario? Does the change in perspective confuse students or complement what they learned in Part One? Do they see the connection between Parts One and Two? Are there any "aha's" for students? Is everyone in the group actively engaged? If so, what made this engagement occur? If not, what occurred when students lost interest?	

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Review Discoveries With the lights still off, call for attention and ask students to report their observations. After the initial inquiry, focus a series of observations by asking the questions below. Allow students to make the observations, holding the moon spheres at arm's length, after each question. (15 min) *How would you move the moon to simulate the revolution of the moon around the earth?* *Where do you position the moon model to observe the new moon?* *The full moon?* *Where do you position the moon model to show the first-quarter phase?* *Third-quarter phase?* *How can you simulate all the phases of the moon in their correct order using the ball and the bulb?* *How can you simulate the rising and setting of the moon with your head and the ball?*	Student groups should go through each of the questions systematically. Ask groups to demonstrate and explain their answers to each question.	This is a teacher-led activity. Take the students through each question, checking their understanding, and prompting incomplete explanations with questions.	How do students demonstrate that they understand the earth and moon rotate in a counter-clockwise direction? Do students show that the visible portion of the half-illuminated moon ball accounts for the phases? How do students position the models to demonstrate the four primary phases? Are they positioning the model correctly? Are all students participating in the activity and discussion? Make observations which show what occurred to promote or discourage participation.	

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Introduce the terms, gibbous, crescent, waxing and waning at the appropriate points in the moon phase. **Assessment (30 min)** ***Summary Questions*** Call for attention and set a task. Pass out handout with the summary questions below. *"Your job is to be able to answer all of the questions on the handout from both an earth perspective (using your head as the earth) and an outsider's perspective (using the fist as the earth). EVERYONE in your group should be able to answer ALL of the questions, as I am going to call on random members of your group and ask them a random question from the handout."* 1. *How would you move the moon to simulate the revolution of the moon around earth?* 2. *Where do you position the moon model to observe the new moon?* 3. *The full moon?*	Students should work within their groups with as little input from the teacher or other groups as possible.	*Answer:* Hold moon in one position and turn your head from side to side, all the way right to all the way left (counterclockwise), simulating the rotation of the earth, which is responsible for moonrise and moonset. The teacher moves through the room checking student progress, prompting and questioning when necessary. Avoid giving students answers. Let them grapple with the content and depend on group members.	Are groups actively engaged in problem solving or are they looking to the teacher, other groups, or other group members for answers? Make observations on what promotes or discourages student problem solving. Are students "testing" each others' conceptual understanding to make sure each member of the group understands the content?	

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4. *Where do you position the moon model to show the first-quarter phase?* 5. *Third-quarter phase?* 6. *How can you simulate all the phases of the moon in their correct order using the ball and the bulb?* 7. *Does the moon change abruptly from one shape to the next, or is the change gradual?* 8. *How can you simulate the rising and setting of the moon with your head and the ball? With the globe and the ball?* ***Challenge Questions-*** 1. *Use the rotation of the earth and the revolution of the moon to demonstrate what time of day (or night) the moon rises at each of its prime phases.* 2. *Figure out how far the moon travels around earth during one full day (in degrees and/or miles).* 3. *You are living in Italy and you see a full moon*	When students have mastered the summary questions, pass out the "Challenge Question Handout" and have them work with their groups to answer the questions.	Give students a ✔ on the assessment chart if they demonstrate understanding of the summary questions. When groups have mastered the summary questions, the teacher will give those groups one to three of the challenge questions.	Are students able to use the models developed in this lesson to answer one or more of these challenge questions correctly? Do students appear less frustrated and more confident in their ability to answer these challenge questions compared to early in the lesson?	

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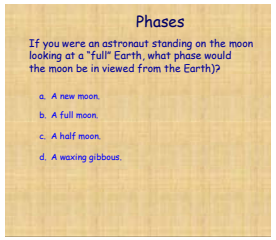
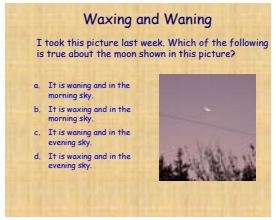
one evening. What phase will a friend living in the United States see that same evening? 4. *If you were on the moon and could see North America, what continent would you see next, Europe or Asia?* ***PowerPoint Slides***  		**Important Note:** The use of the painted ping pong ball is to reinforce in the minds of students that the moon has half the sphere illuminated at all times. Like all models or analogies, this model does break down. On the moon the illuminated portion changes through the progression of the phases. On the ping pong ball, the same half of the sphere is always "illuminated". This may reinforce in the minds of the students that there is a "dark" side of the moon. Use of the polystyrene spheres later will illustrate for students the notion that the illuminated portion of the moon changes during the progression of the moon phases. During their work with the ping pong ball, watch and listen carefully to assess student understanding. If students seem to have the "dark side of the moon" misconception, ask "If you were in one location on the moon during a complete moon phase cycle, how much of that time would you be able to see the sun?" During the work with the polystyrene ball (Cycle 3), you could ask students to actually draw an "X" on their "moon" and ask them to describe at all phases whether they can.	Are all students engaged in wrestling with the content?	

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This is a photo of a shop sign taken in Eugene, OR. What's the matter with this picture?  **Post-Test**				

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