

# Kinesthetic Lunar Rotation/Revolution

## Does the Moon rotate?

**Preparations:** Constellations may be placed on the outside of a larger circle encircling all participants as in the other Kinesthetic Astronomy activities. The Sun may be removed from the Kinesthetic Astronomy setup and the activity done in the same space.

There are many questions that can be asked regarding the Moon's rotation and revolution. Try to solicit student questions first, then ask any of these questions to help move the activity forward: "Do we always see the same side of the Moon? Have you tried looking at different times of day/night? Does it look any different at sunrise/sunset? Depending on their answer, how can you tell? Does the Moon revolve (orbit) the Earth? Which way does the Moon orbit? (Toward the east or west?) How can you tell?" Depending on whether you've covered the rotation and revolution of the Moon before this activity, you're likely to get a wide variety of responses. The aim of this activity is to put the students in the model and allow them to experience for themselves what happens over the course of one lunar revolution/orbit (Moonth = month). It is very important that you get them to commit to an answer to the following: "Does the Moon rotate?"

This activity is designed to give participants a first hand look at the movement of the Moon. This activity should be done in a large open area.

- 1) Gather students into a large group. Set up the inquiry by asking all students to formulate questions about the Moon and its motion. In the absence of student questions, pose some of those listed above. Close with, "Does the Moon rotate?" Make sure all students commit. Note responses.
- 2) Ask: "Have you seen 'the man in the Moon?'" "Do we always see the same side of the Moon?"
- 3) Tell students: "The Moon's orbit can be explored in 2 ways—WITH and WITHOUT rotation." "We're going to figure out for ourselves if the Moon rotates as it revolves."
- 4) First, get 2 students to help demonstrate. Pick one to be the Earth and the other, the Moon. Tell the 2 students: "Stand about 5 feet apart. Continue to face each other. Moon: revolve around Earth counterclockwise" (as viewed from above). The Moon should walk around the Earth. As it revolves, tell the Moon: "Keep facing the Earth while you revolve." When they are finished with one revolution, proceed to step 5. *\*Refer to the lower right of the "Moon Phase Diagram" following this activity.*
  - a. *\*Alternatively, you can skip this step all together and proceed to step 5 if you want to encourage more inquiry.*
  - b. If you have a large number of students, it may be necessary to get all students to revolve (orbit) at the same time. (It is usually best to orbit WITH rotation first.) If groups are small or work well together, it may be possible to allow free exploration and more inquiry so that some students revolve without rotating while others rotate as they revolve. (*It is*

*important NOT to tell the students which activity represents the real Earth—Moon system and which does not. They MUST, however, be told that one model represents revolution WITH rotation while the other does not.)*

- 5) Have participants pair up and stand FACING each other about 5 feet apart with about 7 feet between pairs.
- 6) Tell students: “Decide who will be the Earth and who will be the Moon.” (It doesn’t matter as they will switch positions when they complete the first run of the activity.)
- 7) Ask each Earth: “Can you see the face of the Moon?” [Yes.] Ask each Moon: “How would you represent a lunar revolution (orbit)?” [A likely answer: The Moon has to walk around the Earth and complete a circle.] “Is the orbit of the Moon circular? Will your path be? How long does it take for the Moon to revolve (orbit) once?”
- 8) Tell students: “We are going to model what the Moon looks like both WITH rotation and WITHOUT rotation.
  - a. Revolution **WITH** rotation: Tell the students pretending to be the Moon: “Always remain facing Earth. Slowly revolve (orbit)  $\frac{1}{4}$  of the way around the Earth counterclockwise (as viewed from above) so that you are always facing the Earth.” When they are  $\frac{1}{4}$  of the way around, ask, “What part of the Moon do you see?” [Face, or front] Repeat this question when they have gone  $\frac{1}{2}$  way around and again at the  $\frac{3}{4}$  mark and end. Ask the Earth: “Did you ever get to see the back side of the Moon?” [No.] **Tell students to switch places and repeat.** After everyone has been the Moon, ask: “Is the backside the same as the dark side? Why or why not?” [Students should have seen the face of the Moon each time. The dark side of the Moon changes with its phases. It is always  $\frac{1}{2}$  lit, but the  $\frac{1}{2}$  that is lit changes with its position in orbit.]
  - b. Revolution **WITHOUT** rotation: Tell the students pretending to be the Moon: “Keep your eyes fixed on a far away object or something on a wall of the room as you revolve (orbit).” [*This should be demonstrated first by just walking in a circle (not around the Earth) while staying focused on a distant object to show students what you mean. This keeps your body from turning at all. \*See the upper left corner of the “Moon Phase Diagram” following this activity.*] When they do it, they need to walk around the Earth. When they are  $\frac{1}{4}$  of the way around, ask, “What part of the Moon do you see?” [Side.] “Are you still facing the same direction?” [Yes] Did you rotate? [No.] Repeat these questions when they have gone  $\frac{1}{2}$  way around and again at the  $\frac{3}{4}$  mark and end. Ask: “Did you ever get to see the back side of the Moon? Why or why not?” **Tell students to switch places and repeat.** [Students should have seen all sides of the Moon.] After they have completed this trial, ask them again: “Does the Moon rotate. How can you tell? Did the Earth see the same side of the Moon all the time? Which model most closely mirrors what we observe outside?”

- 9) It is likely that at this point, there will be disagreement of whether or not the Moon rotates as it revolves as it is a difficult concept to grasp initially. You may need to once again select 2 students and move to the middle of the group so that all can see. At this point, repeat revolution **WITH** rotation. Tell students that if the direction of their toes changes from pointing at the far off spot, their body has rotated. Also point out that the person acting as the Moon will eventually see the whole room. At the same time, the Earth is always seeing the same side of the Moon (as mentioned in #2 above). The rotation is so slow that this is often the point at which they realize what is happening. This needs to be repeated as much as necessary to get them to realize that their bodies are rotating slowly (they are also seeing different star patterns). When the person playing the Moon revolves **WITHOUT** rotation, they never see the whole room, just the spot at which they are looking.

**TEACHER TIP:** Draw particular attention to the fact that in order for the Earth to continually see the face of the Moon, the Moon must rotate or you would see all sides of it just as in 8 (b).