TIMING THE TIDES

Tide tables, commonly seen in newspapers and on television in coastal areas, show that comparable local high and low ocean tides occur almost one hour later from one day to the next. The motion of the Moon as it revolves about the Earth largely accounts for this time lag.

The following activity investigates the timing of the tides by demonstrating the effect of the Moon's orbital motion on the time that elapses between comparable local tides.

OBJECTIVES:

After completing this investigation, you should be able to:

- Describe how the times of high and low tide change from one day to the next.
- Describe why the times of high and low tide change from one day to the next.

INVESTIGATIONS:

1. Examine the *Tide Time Diagram.* The diagram (not drawn to scale) shows Earth at the center as seen from far above Earth's North Pole. The counterclockwise rotation of Earth and the direction of light arriving from the distant sun are shown. Earth time is marked in one hour intervals along the circumference of the planet. Since Earth rotates 360º in 24 hours, each hour a fixed point on Earth rotates (5º) (10º) (15º).
2. The large circular ring in the diagram shows the daily positions of the Moon relative to Earth during one lunar month lasting from one new Moon phase to the next new Moon. (The 29.5-day lunar month has been rounded to 30 days for the purposes of this activity.) Every day, the moon's position advances about (10º) (12º) (15º) along the circle representing the 30-day month.
3. The lower *Tidal Bulge/Moon Diagram*, viewed from the same perspective as the upper drawing, is of the Moon and Earth with the depth of the ocean greatly exaggerated. It shows the theoretical locations of the ocean's two dominant tidal bulges. One always faces the Moon (where lunar gravitation is strongest) and the other always faces directly away (where lunar gravitation is weakest).

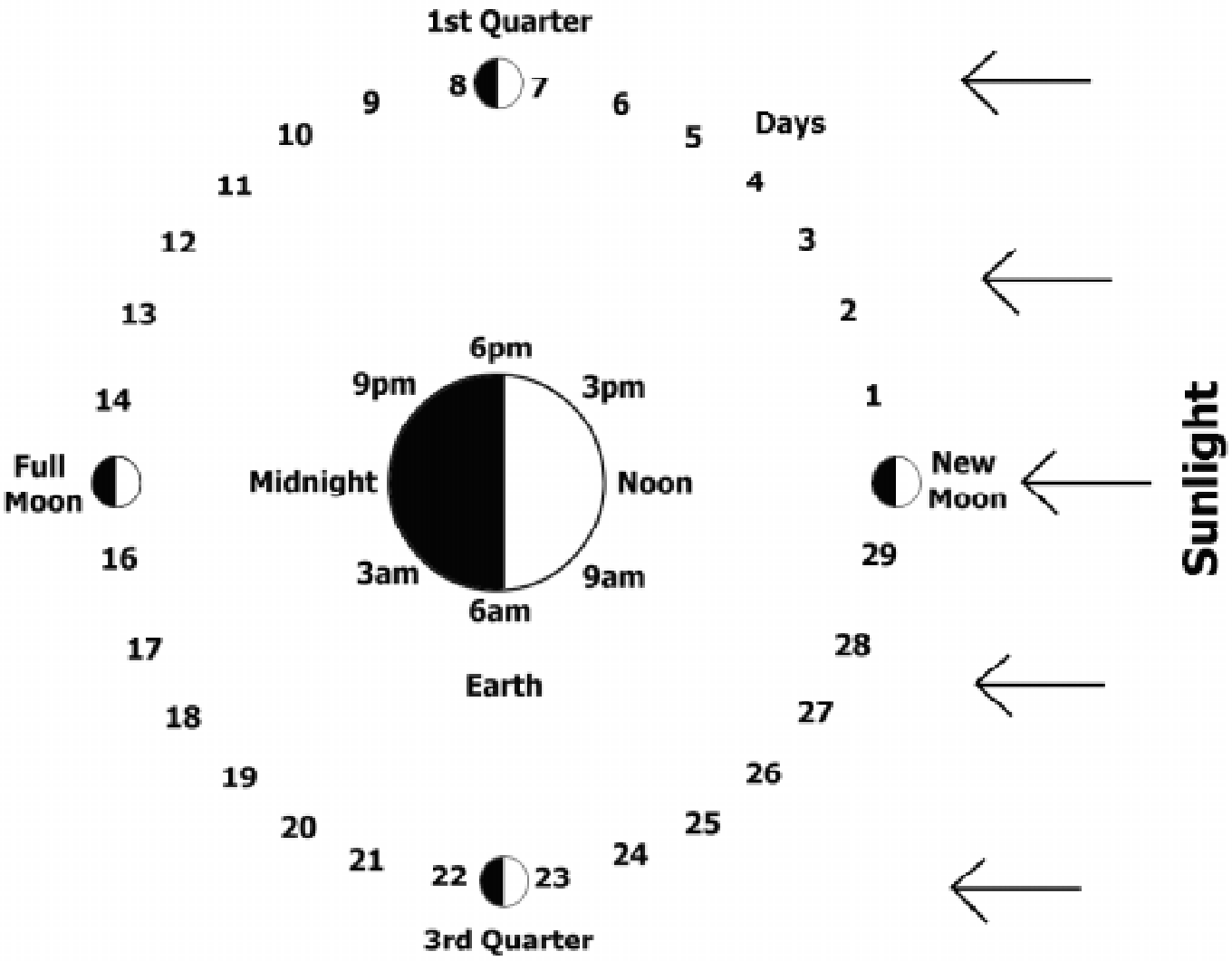
   Make a tracing or photocopy of the lower diagram on a clear plastic sheet. Place this directly over the upper diagram so that the center points of the diagrams coincide. Use a sharp pencil to hold the two together at their centers. Twist the overlay so the Moon progresses from one daily position to the next. The moon is advancing in the (same) (opposite) direction as Earth's rotation.
4. Place the Moon at its Day 1 position. A point on Earth rotating through the center of the bulge facing the Moon would experience a high tide at this time. The time, found by reading the time on Earth clock indicated by the "Solar Time" arrow pointing at the high tide bulge, would be about (12:50) (1:30) (2:50) p.m.
5. Advance the Moon to its day 2 position. On this day, a point on Earth rotating through the same bulge would experience a high tide at about (12:50) (1:40) (2:30) p.m.
6. Comparing the time of the Day 2 high tide to the Day 1 high tide, the time of the high tide is about (1) (2) (3) hour(s) later than the day before.

7. Just as it takes more than one hour for the minute hand of a clock to make two successive passes of the advancing hour hand, it takes (less than 24) (24) (more than 24) hours for a point on Earth to pass through and catch up with the same advancing tidal bulge. That is why comparable local high and low tides occur later from one day to the next.
8. The time lag investigated in this activity is typically less than an hour, but how much less? To make an estimate, determine from the diagrams the times of comparable high tide on Day 10 and Day 20. From this information, find how many minutes later the tide occurred on Day 20 than on Day 10, and divide by 10. According to these calculations, the daily time lag rounds off to about (40) (50) (55) minutes.

SOURCE

The Maury Project, American Meteorological Society

Tide Time Diagram



Tidal Bulge / Moon Diagram