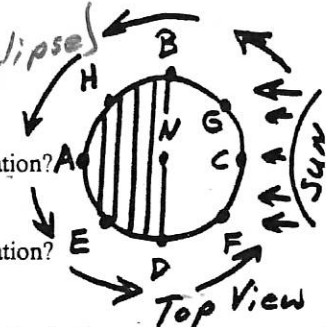
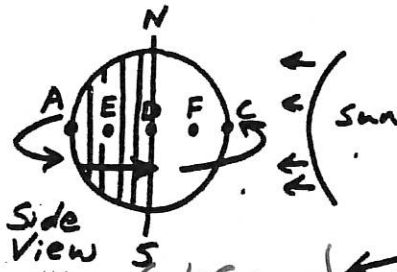
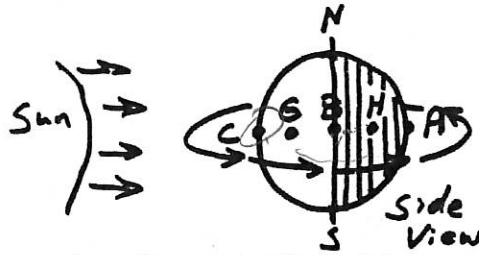


System of the Earth, Moon, and Sun

Part 1: Time of Day, Moon Phases, Eclipses, and Tides



1. a) How much of the Earth is always dark?  $\frac{1}{2}$
- b) Is there ever an exception to this? If so, explain. Yes (Solar Eclipse)
2. Which side is dark? (the side facing the sun, or the side opposite the sun)
3. -a) In the pictures above, which point is entering darkness? B
- b) What's that time of day called? Sunset
- c) Approximately what hour would it be according to a clock at this location? 6PM
4. -a) In the pictures above, at which point is the sun directly overhead? C
- b) What's that time of day called? Noon
- c) Approximately what hour would it be according to a clock at this location? 12PM
5. a) In the pictures above, which point is entering daylight? D
- b) What's that time of day called? Sunrise
- c) Approximately what hour would it be according to a clock at this location? 6AM
6. a) In the pictures above, which point is located opposite the sun, in complete darkness? A
- b) What's that time of day called? Midnight
- c) Approximately what hour would it be according to a clock at this location? 12AM

7. Estimate the time of day at each of the following points:

E = 3AM F = 9AM G = 3PM H = 9PM

8. a. Which way does the Earth Rotate? Provide an answer that works from any vantage point.

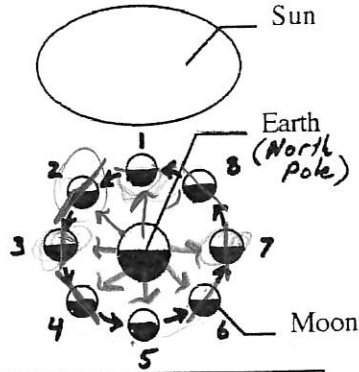
Eastward

- b. How can you prove that your answer is correct?

Sun appears to move westward

### Simulate The Moon Phases

Be like the diagram on the right. Your head is the Earth. Your tennis ball is the moon. Stretch out your arm and hold the tennis ball away from your head. Imagine that the sun is in the front of the room -- this means you will need to make sure the sunny side of the moon is facing the front of the room. Hold the moon in position 1, then move it to positions 2, 3,...



Not To Scale!  
Out Of Proportio

### Draw the moon Phases

For each position on the diagram above, draw what you saw.

1.  Name: <i>New Moon</i>	2.  Name: <i>Waxing Crescent</i>	3.  Name: <i>Waxing Quarter</i>	4.  Name: <i>Waxing Gibbous</i>
5.  Name: <i>Full Moon</i>	6.  Name: <i>Waning Gibbous</i>	7.  Name: <i>Waning Quarter</i>	8.  Name: <i>Waning Crescent</i>

### Name The Moon Phases

Use the terms below to come up with names for the moon phases you drew in the boxes above.

Waxing: Becoming more full. (When the right side of the moon is lit, it is waxing.)

Waning: Becoming less full. (When the left side of the moon is lit, it is waning.)

Crescent Moon: A thin, curved moon.

Gibbous Moon: A moon which is almost full, but it's not quite round.

Quarter Moon: A moon which is half light and half dark.

Full Moon: A complete, fully lit moon.

New Moon: A completely dark, invisible moon.

9-16. A moon's name has two parts. Part 1: tells whether it is growing or shrinking. Part 2: describes the shape. For example, an almost full moon which is growing is a waxing gibbous. Full moons and new moons are neither waxing nor gibbous. Label the each of the boxes above with the full, correct name.

17. A solar eclipse occurs when the moon's shadow covers us. A lunar eclipse occurs when the Earth's shadow falls on the moon.

a) During which moon phase can we have a solar eclipse? *New Moon*

b) During which moon phase can there be a lunar eclipse?

*Full moon*

**Useful Vocabulary:**

**Revolution:** movement of something around something else in an elliptical or circular path.

**Rotation:** spinning of something on its axis.

**Synodic Month:** 29.5 earth days (very roughly, 4 weeks); the time it takes to go from one new moon to the next.  $7\frac{1}{2}$  days  $\approx$  1 week  $\approx$   $\frac{1}{4}$  moon cycle.

**Sidereal Month:** 27  $\frac{1}{3}$  days; the time it takes for the moon to make a complete revolution.

**Lunar Eclipse:** the earth's shadow falls on the moon.

**Solar Eclipse:** the moon's shadow falls on the earth.

**Partial Eclipse:** a person standing in the shadow can see some, but not all, of the sun.

**Total Eclipse:** a person standing in the shadow cannot see any of the sun.

**Zenith:** the point at which something is highest in the sky. For example, the sun is at its zenith at around noon.

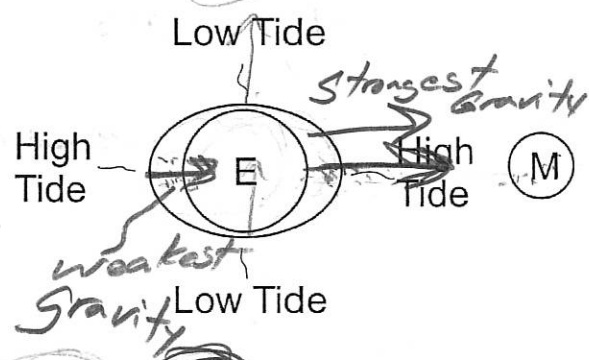
**Tides:** the rise and fall of water's surface due to the gravitational pull of the moon and sun.

**Spring Tide:** An especially strong tide that is produced when the sun and moon are working together.

**Neap Tide:** An especially weak tide that is produced when the sun and moon are working against each other.

The moon and sun cause tides by the same process that a black hole would spagettify someone being pulled into the black hole. Explain.

The Earth and oceans are stretched out by the difference in the Moon's gravity on Earth's near and far sides.



Which celestial body exerts more gravitational force on our oceans? The Moon or the Sun? Why?

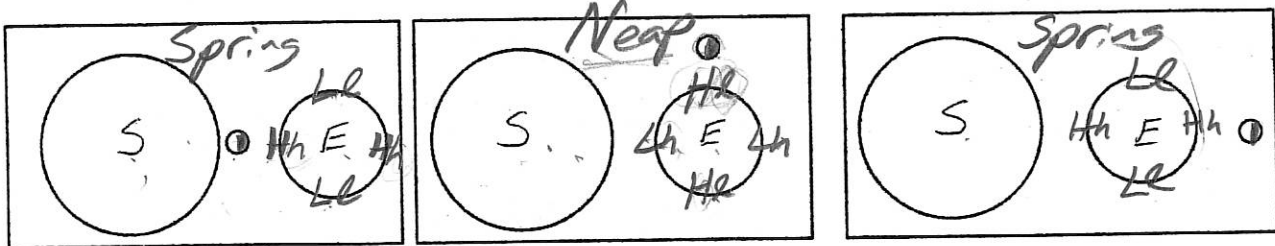
Sun has more mass

Why does the moon cause more extreme tidal effects than the sun?

Moon cause a larger difference between gravity on Earth's near and far sides.

18.

In each of the diagrams, write H where the moon makes high tides, and L where the moon makes low tides. Write h where the sun makes high tides, and l where the sun makes low tides.



19.

Spring tides are especially high tides where the sun and moon work together. Label the diagrams that have spring tides.

20.

Neap tides are especially high tides where the sun and moon work together. Label the diagrams that have neap tides.

21. Complete the diagram below by using arrows to show the rotation of the Earth and the revolution of the moon. Also shade the dark parts of the individual moon phases and the Earth. Then complete the table. For times, choose 3, 6, 9, or 12, AM or PM. For times of high tide, you do not need to designate AM or PM (since there are two of them about 12 hours apart).

Moon's Appearance	Name of Phase	Letter on Diagram	Time of Moonrise	Time of Moonset	Approx. Time of High Tide (AM and PM)	Spring Tide, Neap Tide, or Neither	Number of weeks until next full moon	Solar or Lunar Eclipse possible?
	Wan. Qtr	B	12AM	12PM	6	Neap	3	X
	Wax. Cresc.	D	9AM	9PM	3	X	1 1/2	X
	Wan. Gib	F	9PM	9AM	3	X	3 1/2	X
	Wax. Qtr	C	12PM	12AM	6	Neap	1	X
	Wax. Gib	D	3PM	3AM	9	X	1/2	X
	New	A	6AM	6PM	12	Spring	2	Solar
	Waning Crescent	H	3AM	3PM	9	X	2 1/2	X
	Full	E	6PM	6AM	12	Spring	0	Lunar

