A Month of Tides

Do tides change over time?

Tides are caused by gravitational interactions between the Earth, Sun, and Moon. The Sun and Moon exert a gravitational pull on the Earth, which causes the ocean to "bulge" depending on the orientation of the Sun and Moon. Since the Moon revolves around the Earth, this orientation changes over the course of the month, causing more-extreme or less-extreme bulges. Can we spot that pattern in the data?
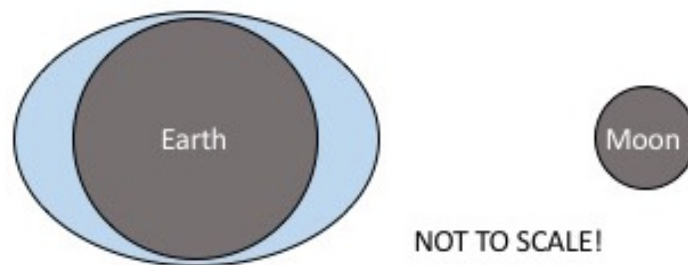

Figure 1. Conceptual figure of (exaggerated) tidal bulges created by the Moon.

Graphing the changing tides over the course of a month

The attached dataset shows tidal data for San Francisco, California, for the month of January 2015 *(data source: NOAA tide predictions, San Francisco California, 2015)*. It also lists the dates for the New Moon, First Quarter, Full Moon, and Third Quarter.

On your graph, plot the highest high tides and lowest low tides (one line each) on the Y-axis, versus time on the X-axis. Also, label on your graph the day of each given Moon phase. **Think carefully about the scale and range of your Y-axis before plotting your dataset!**
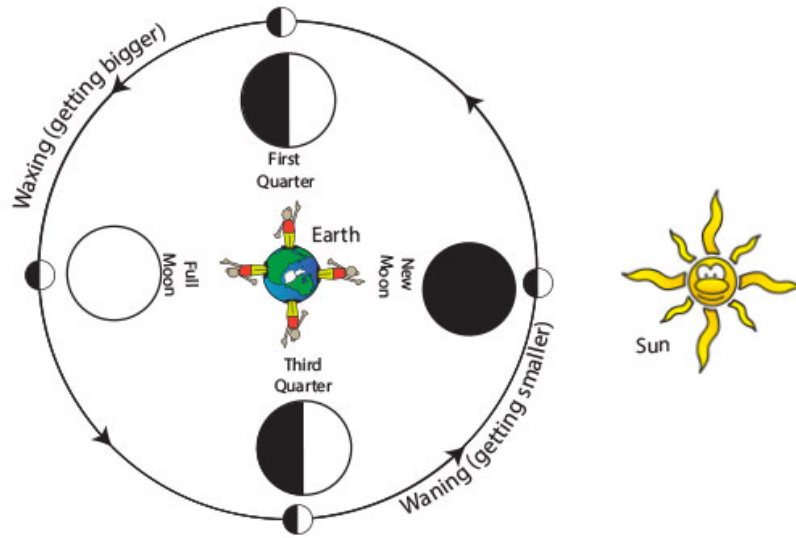
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Figure 2. The phases of the Moon, in relation to the Sun. How do you think this might be related to tides? (Image source: NASA.)

Guiding questions (record your answers in your notebook!)

- What is the range of highest high tides? What is the range of lowest low tides?
- When do the highest high tides tend to be highest? When do the lowest low tides tend to be lowest? What phases of the Moon correspond to higher high tides, or lower low tides?
- When is the difference between the high tide and low tide the smallest? What phases of the moon correspond to the smallest difference between high and low tide?
- …Can you think of an explanation that links your answers to the previous two questions?

San Francisco tides, January 2015

Date	Highest High Tide (cm, relative)	Lowest Low Tide (cm, relative)	Moon phase
Jan 1, 2015	198	−9	
Jan 2, 2015	198	−18	
Jan 3. 2015	198	−21	
Jan 4, 2015	195	−21	
Jan 5, 2015	189	−18	Full Moon
Jan 6, 2015	183	−12	
Jan 7, 2015	174	−6	
Jan 8, 2015	165	3	
Jan 9, 2015	155	15	
Jan 10, 2015	155	27	
Jan 11, 2015	158	40	
Jan 12, 2015	162	55	
Jan 13, 2015	165	52	Third Quarter
Jan 14, 2015	171	37	
Jan 15, 2015	177	18	
Jan 16, 2015	186	3	
Jan 17, 2015	195	−12	
Jan 18, 2015	204	−27	
Jan 19, 2015	210	−34	
Jan 20, 2015	210	−40	New Moon
Jan 21, 2015	207	−37	
Jan 22, 2015	198	−27	
Jan 23, 2015	186	−12	
Jan 24, 2015	183	6	
Jan 25, 2015	186	27	
Jan 26, 2015	186	37	
Jan 27, 2015	186	27	First Quarter
Jan 28, 2015	189	15	
Jan 29, 2015	189	6	
Jan 30, 2015	189	−3	
Jan 31, 2015	189	−6	

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