The Pilgrim Tides		
Earth Science	March, 2011	Mr. Traeger

Name: _____   Period: _____   Date: _____

Background and Purpose

Most of us have heard the story of the Pilgrims' exodus from England to the New World in the year 1620. The Pilgrims anchored the *Mayflower* at the site of Provincetown (Cape Cod), Massachusetts for almost a month before settling at Plymouth Harbor. Imagine that you are the ship's captain of the *Mayflower II* and you need to know the tidal fluctuations at Provincetown in order to keep the ship from running aground while at anchor. You will use the tide chart given to you to estimate/graph the tidal fluctuations for March, 2011 arrival at Provincetown. In doing so, you will become familiar with the differences in tidal ranges during each phase of the moon.

Materials

- Tide chart
- Ruler
- Graph Paper on Back
- Pencil

Procedure

1. Using a sheet of graph paper, divide the paper lengthwise into 4 separate sections.

2. Plot time of day on the *x*-axis and water level in feet on the *y*-axis for the dates corresponding to the third quarter, new moon, first quarter, and full moon. Be careful to scale your graph correctly and to account for negative tides, which are below mean sea level. The origin for the time axis should be 12:00 A.M. for each graph.

3. Once you have plotted your points, connect the points with a smooth curve. Make sure to label you graphs with a title and units on each axis.

4. Answer the questions that follow concerning your 4 graphs.

Pre Graphing Questions (Refer to pages 541-543 in your text to do these)

1. Draw the orientation of the Earth, Sun, and Moon for **Spring** tides. Also make sure to draw the tidal bulge of the ocean. See page 542.

2. Draw the orientation of the Earth, Sun, and Moon for **Neap** tides. Also make sure to draw the tidal bulge of the ocean. See page 542.

3. How many high tides and how many low tides are there (usually) per day? Why is this? Drawing a diagram of how the Earth rotates underneath the tidal bulge would be helpful.

The Pilgrim Tides

Provincetown Cape Cod Bay

Provincetown Cape Cod Bay, Massachusetts
Data acquired from http://www.boatma.com/

March Tide Chart

2011

| DAY	DATE	HIGH				LOW				☀ rise	set	🌙 moon
		AM	hgt	PM	hgt	AM	hgt	PM	hgt	rise	set	moon
Tuesday	01	9:01	9.2	9:38	8.4	2:40	1.1	3:25	0.4	6:16	5:30	
Wednesday	02	9:51	9.3	10:22	8.7	3:32	0.8	4:10	0.3	6:14	5:31	
Thursday	03	10:34	9.4	11:00	8.9	4:18	0.6	4:48	0.2	6:13	5:32	
Friday	04	11:13	9.5	11:35	9.1	4:59	0.4	5:24	0.2	6:11	5:34	🔵
Saturday	05	11:50	9.4			5:38	0.2	5:58	0.2	6:10	5:35	
Sunday	06	12:09	9.2	12:26	9.3	6:16	0.1	6:33	0.3	6:08	5:36	
Monday	07	12:42	9.3	1:03	9.1	6:53	0.2	7:09	0.5	6:06	5:37	
Tuesday	08	1:17	9.3	1:41	8.9	7:32	0.3	7:46	0.7	6:05	5:38	
Wednesday	09	1:54	9.2	2:20	8.6	8:12	0.4	8:25	0.9	6:03	5:39	
Thursday	10	2:33	9.1	3:03	8.2	8:55	0.6	9:08	1.2	6:01	5:41	
Friday	11	3:16	8.9	3:51	7.9	9:42	0.8	9:55	1.4	6:00	5:42	
Saturday	12	4:04	8.8	4:43	7.8	10:34	1.0	10:48	1.6	5:58	5:43	
Sunday	13	5:59	8.8	6:41	7.7	12:31 PM	1.0			6:56	6:44	
Monday	14	6:58	9.0	7:41	8.0	12:46	1.5	1:30	0.8	6:54	6:45	
Tuesday	15	7:58	9.3	8:40	8.4	1:47	1.2	2:29	0.4	6:53	6:46	
Wednesday	16	8:59	9.7	9:36	9.1	2:47	0.7	3:26	-0.1	6:51	6:48	
Thursday	17	9:56	10.2	10:29	9.8	3:44	0.1	4:19	-0.7	6:49	6:49	
Friday	18	10:51	10.7	11:20	10.5	4:40	-0.7	5:10	-1.1	6:48	6:50	
Saturday	19	11:44	11.0			5:33	-1.3	5:59	-1.5	6:46	6:51	🟡
Sunday	20	12:09	11.1	12:36	11.1	6:25	-1.8	6:47	-1.6	6:44	6:52	
Monday	21	12:57	11.4	1:27	10.9	7:16	-2.0	7:36	-1.4	6:42	6:53	
Tuesday	22	1:46	11.5	2:19	10.6	8:07	-1.9	8:25	-1.1	6:41	6:54	
Wednesday	23	2:36	11.2	3:12	10.1	8:59	-1.6	9:16	-0.5	6:39	6:56	
Thursday	24	3:29	10.8	4:07	9.4	9:54	-1.0	10:10	0.1	6:37	6:57	
Friday	25	4:24	10.3	5:06	8.9	10:51	-0.3	11:07	0.7	6:36	6:58	
Saturday	26	5:24	9.7	6:10	8.4	11:52	0.3			6:34	6:59	
Sunday	27	6:28	9.2	7:16	8.2	12:08	1.2	12:56	0.7	6:32	7:00	
Monday	28	7:34	8.9	8:20	8.2	1:13	1.4	2:01	0.9	6:30	7:01	
Tuesday	29	8:38	8.8	9:18	8.3	2:17	1.5	3:02	1.0	6:29	7:02	
Wednesday	30	9:35	8.9	10:07	8.6	3:17	1.3	3:53	0.9	6:27	7:04	
Thursday	31	10:25	9.0	10:49	8.8	4:09	1.0	4:37	0.8	6:25	7:05	

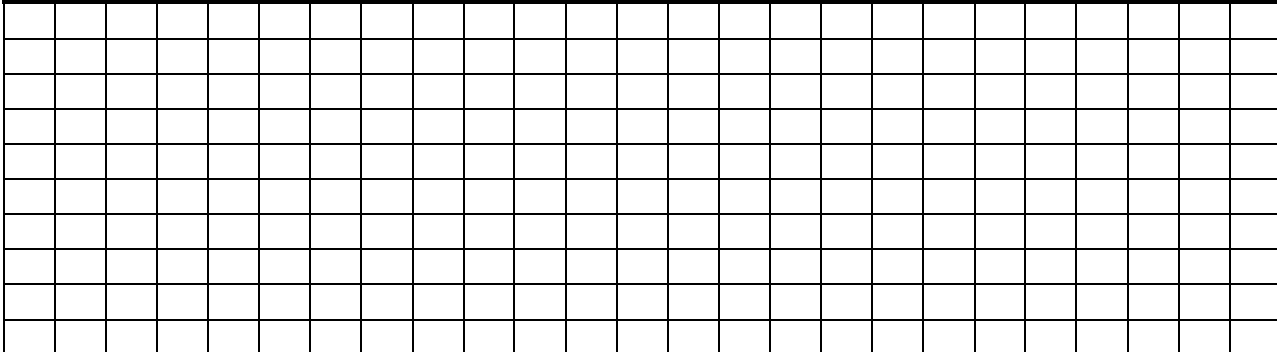| Earth Science	March, 2011	Mr. Traeger

<u>Making Tide Graphs</u>
Use the following graph sheet to plot your tides. Make sure to make 4 separate graphs, one for each phase of the moon. Plot time of day (hours) on *x* axis and height variation (feet) on *y* axis.
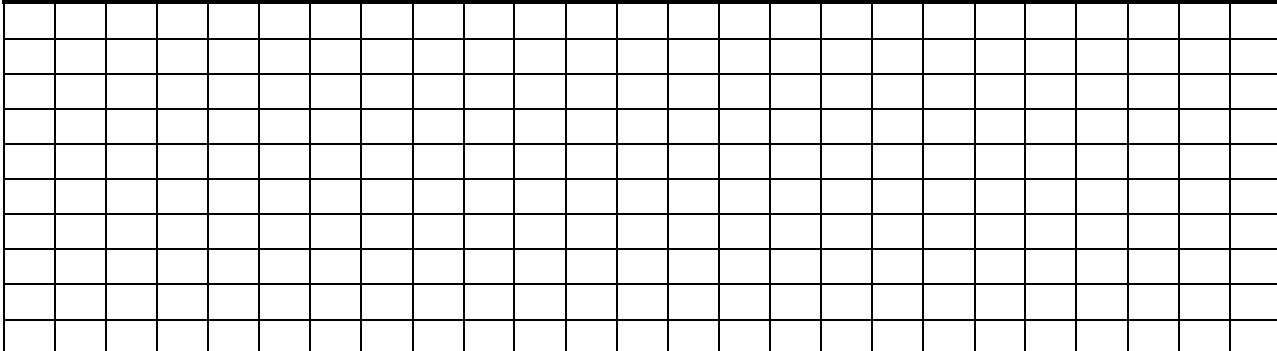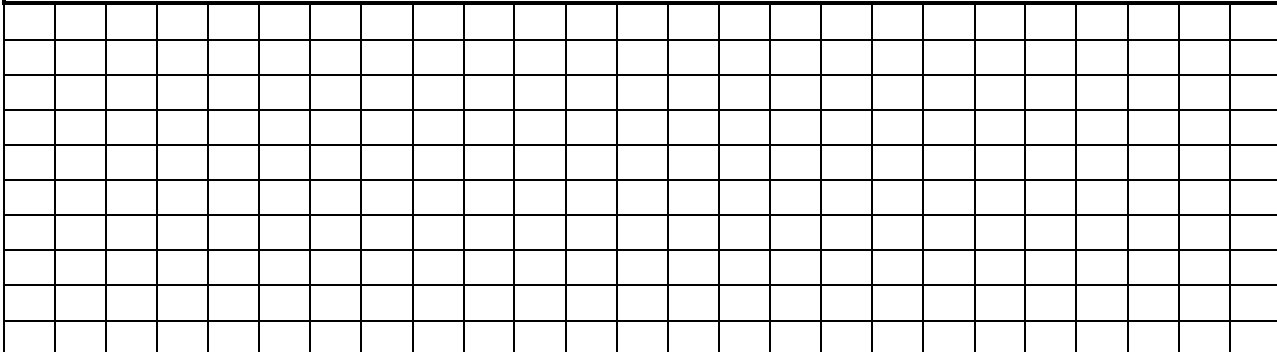
New Moon (Plot March 4, 2011)
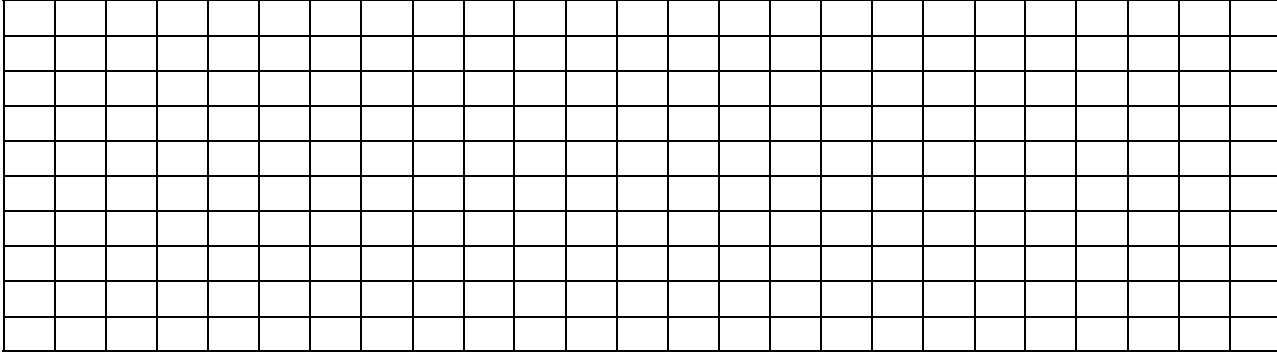
First Quarter (Plot March 12, 2011)

Full Moon (Plot March 21, 2011)

Third Quarter (Plot March 28, 2011)

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Post Graphing Questions (Refer to pages 541-543 in your text to do these)

1. Subtract the height value for the lowest low tide from the height value for the highest high tide for each date below. This is called tidal range. Show your mathematical work.

3/4/11 (New Moon)	3/12/11 (1st Quarter)	3/21/11 (Full Moon)	3/28/11 (3rd Quarter)
Highest high tide: Lowest low tide: Difference (Range):	Highest high tide: Lowest low tide: Difference (Range):	Highest high tide: Lowest low tide: Difference (Range):	Highest high tide: Lowest low tide: Difference (Range):

2. Which two dates above would be considered as Spring Tides? Which two dates above would be considered as Neap Tides? Use the tidal range to figure this out.

| Dates of Spring Tides	Dates of Neap Tides

3. Look at the times of the AM high tides for the whole tide chart. By how many minutes does the time advance for each successive day? Why is this?

4. Which has the greatest influence on tides, the sun or the moon? Why?

5. Which side of the Earth is more attracted to the moon? The side facing the moon or the side away from the moon? How does this explain the difference between AM high tides (night side of Earth facing towards full Moon) and PM high tides (day side of Earth facing away from full Moon) on March 21st?

6. Apogee is on March 6th and the moon is a distance of 406,582 km. Perigee is on March 19th and the moon is a distance of 356,577 km. How does this explain the difference of tidal range between the March 4th new moon and the March 19th Super full moon? Draw an orbital diagram to explain this.

7. Look at the following two tide graphs from different locations. Then look at the map on page 708-709 in your book. Explain why the tidal range (size of the tides) is different for each geographic location.

Boston, MA (Atlantic Ocean)   Cedar Key, FL (Gulf of Mexico)
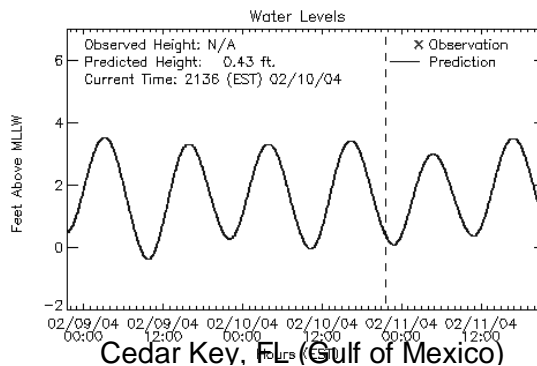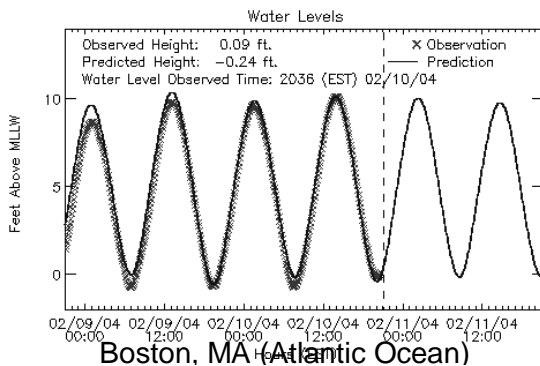
8. Why is it that oceans have larger tides and large lakes have smaller tides? Explain.

9. Predict what might happen on the Earth if we did not have the Moon to influence our tides. Would we still have ocean tides? If so, what other celestial body would cause them?