Name: _____

Grade:_____

**Gravity and Orbits**

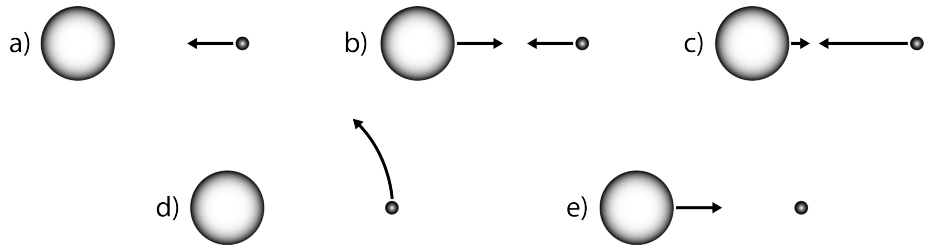
**Pre-lab**

Emily Moore 7/11/12 5:44 PM

**Comment [1]: Pre-assessment:** My students had challenges with using vectors for the first time so students struggled particularly with questions 1 and 5. These are also the questions where I saw the most growth between the pre and post-labs.

1. Choose the picture you think shows the gravity forces on the Earth and the Sun.

*(a longer arrow to represents a big force, and a shorter arrow represent a smaller force)*




2. How would these gravity forces change if the Sun got much bigger?

Increase Stay the same Decrease

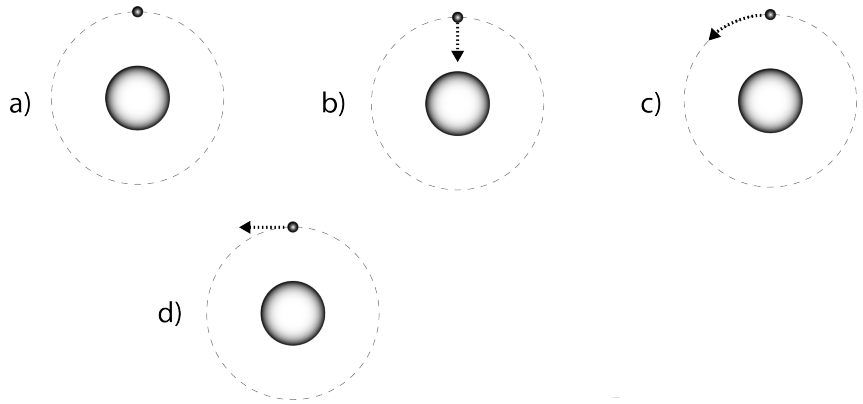
3. How would these gravity forces change if the Earth was much closer to the Sun?

Increase Stay the same Decrease

4. How would these gravity forces change if the Earth got much smaller?

Increase Stay the same Decrease

5. Choose the picture of how the Earth would move if you "turned off" the gravity forces.



**Name:** _____
**Grade:**_____

## Gravity and Orbits

**Learning Objectives-** Students will be able to:

- Draw motion of planets, moons and satellites.
- Draw diagrams to show how gravity is the force that controls the motion of our solar system.
- Identify the variables that affect the strength of the gravity.
- Predict how motion would change if gravity was stronger or weaker.

### Part 1: Understanding Motion

1) Open the ***Gravity and Orbits*** simulation. Take 5 minutes to **explore** the simulation. Talk about what you find with your partner.

2) Compare the motion of the **Earth around the Sun** with the **Moon around the Earth**.

| **Earth Around the Sun**<br>Your Picture<br><br>Your Description | **Moon Around the Earth**<br>Your Picture<br><br>Your Description |
|---|---|
| What are some things that are the **same** about these motions (from the pictures above)?<br><br>What are some things that are **different** about these motions (from the pictures above)? | |



Teacher Tip 7/24/12 10:23 AM
**Comment [2]:**
**Class Discussion:**
Students read the learning goals out loud. Students will have more context for, and be more invested in, the goals if they read them as a class AFTER the 5 minutes of play time.
*- Which goals do we already know a little bit about?*
*Which goals seem like they are going to be challenging to master today?*

**Class Discussion:** Review vocabulary that might be difficult for students (*rotation, revolution/orbit, increase, decrease).*
**(insert video link here)**

Emily Moore 7/12/12 2:41 PM
**Comment [3]:**
**Play Time Prompts:**
*- Try out whatever you want to in the next 5 minutes.*
*- Remember, just because you can destroy the Earth in the sim doesn't mean that you can destroy the sim in the process!*
*- I see several students are comparing the scale and cartoon views. I wonder which will be most helpful for us to use for our activity today.*
**Sim Attributes to Highlight:**
- Showing the path and grid options is useful to compare the motions in both situations.
**(insert video link here)**

Teacher Tip 7/24/12 10:26 AM
**Comment [4]:**
**Possible Sim Difficulty:**
Students may have difficulty comparing two complex setups in the sim.
**To address this:**
Advise students to open two Gravity & Orbits sims (or have pairs of students - each with their own computers - work together on this, or project two sims on the board). Set up one Earth/Sun system on one sim and one Moon/Earth system on the second sim. Prompt students to compare the motions side by side.

**Class Discussion:**
Ask students to make observations, share with a partner, and then share with the group. Observations may include: direction, size of orbit, time it takes the Earth and the Moon to make one revolution. **(insert link to video)**

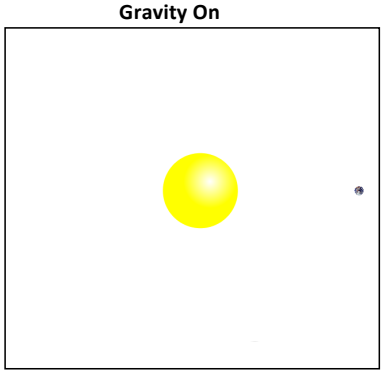
**Part 2: Understanding Gravity**

3) For the Sun and Earth system:

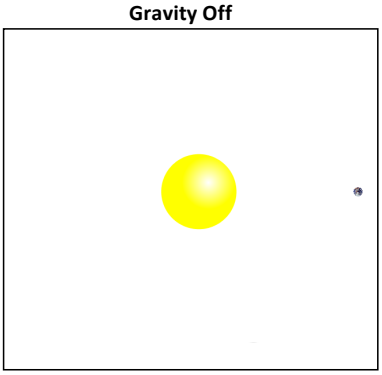
Teacher Tip 7/11/12 5:54 PM
**Comment [5]:**
**Prompt:**
*- Why do you think that these motions are different when gravity is turned off after the Earth is already in motion, as opposed to before the Earth is set in motion?*

a. **Draw** the path of the Earth with **Gravity On** and **Gravity Off**

**Gravity On**



**Gravity Off**



b. What would happen to our solar system if we did not have gravity?

c. Why would this change happen?

4) **Explore** the simulation to see how you can change the force of gravity and observe what happens

a. Why do you think the Earth moves, but the Sun does not move?

5) In **Question 2** you drew 2 pictures, go back and add arrows to **show the force of gravity**. Label the arrows "Gravity Force".

6) a. Find **all the ways** to change the length of the blue gravity force arrows.

b. Fill in an **Action** below and **check** if the gravity force increases or decreases

| Action | Gravity Force |
|---|---|
| Put star and planet closer together | ☐Increases ☐Decreases |
| | ☐Increases ☐Decreases |
| | ☐Increases ☐Decreases |
| | ☐Increases ☐Decreases |
| | ☐Increases ☐Decreases |

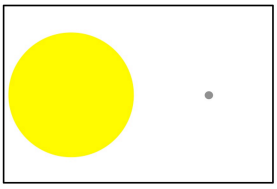
Teacher Tip 7/24/12 10:26 AM

**Comment [6]: Check for Understanding:** Circulate and quickly read over students' shoulders to ensure that they are correctly identifying the variables that affect the strength of the gravity.

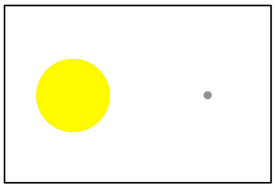
**Possible Student Difficulty:** Student incorrectly attributed a decrease/increase in gravity force for a particular action.
**To address this:** Prompt student to try the action again and make sure they correctly recorded their observations by saying: *Show me how you found that.* **(Insert video of "show me what you did" if available)**

7) **Compare** these two cases:

**Case 1**



**Case 2**



a. What changed between Case 1 and Case 2?

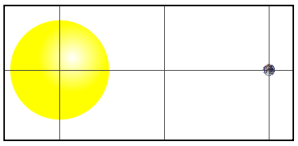
b. **Draw** the force of gravity using arrows on the Earth in each case. (*Remember, a long arrow is a big force, and a short arrow is a smaller force)*

Teacher Tip 7/24/12 10:27 AM

**Comment [7]: Check for Understanding:** Ensure that students have correctly identified that increasing the mass of the star will increase the gravity force, and therefore increase the length of the force vectors.

8) **Compare** these two cases:

**Case 1**



**Case 2**

a. What was changed between Case 1 and Case 2?

b. **Draw** the force of gravity on the Earth in each case.

c. **Explain** the difference in forces between Case 1 and Case 2.

Teacher Tip 7/24/12 10:27 AM

**Comment [8]: Check for Understanding:** Ensure that students have correctly identified that increasing the distance between the star and the planet decreases the strength of the gravity force, and therefore decreases the length of the vectors.

**Part 3: Gravity and Motion**

9) Fill in the table to help describe what you find out.

| **How can you….** | Explain what you changed | Draw the motion paths | What other changes do you notice? |
|---|---|---|---|
| ...make the Moon orbit in a bigger circle? | | | |
| ...make the longest Earth year? | | | |
| ...make the shortest Earth year? | | | |

Reflection:

Teacher Tip 7/11/12 3:23 PM

**Comment [9]: Extension Opportunity:** Facilitate this section by setting up the various tasks as challenges.
-*"Wow! Jose just made an Earth year that lasted 890 days! Can you share the things that you did to accomplish that? Did anyone else do something similar? What are other ways that we can accomplish the same task?"* **(see if there is a video of this)**

Teacher Tip 7/11/12 3:25 PM

**Comment [10]: Class Discussion:** Ask students to share out things that they did to accomplish the various tasks. If in doubt as to whether a students' response is accurate, ask the student to recreate the situation for the class to prove it! **(see if there is a video of this)**

Teacher Tip 7/11/12 3:42 PM

**Comment [11]: Possible Sim Difficulty:** Student thinks changing sim speed changes length of year.
**To address this:** Share out the longest year in days that different students have achieved. Encourage students to discuss in pairs or as a class share out how they are manipulating different variables to accomplish this. **(video link of this)**

Teacher Tip 7/11/12 3:30 PM

**Comment [12]: Class Discussion:** Ask students to return to the learning goals from the beginning of the lesson and reflect on their perceived mastery.
*- Which goals were the most challenging?*
*- Which were the most surprising or interesting things to learn?*
*-Which would they like to explore further?*
*- How did you feel about the topics when you first read the learning goals? How do you feel about those topics now, after going through the sim?*
*- Do you think your responses the post-lab will be different from the pre-lab?*

Name: _____
Grade:_____

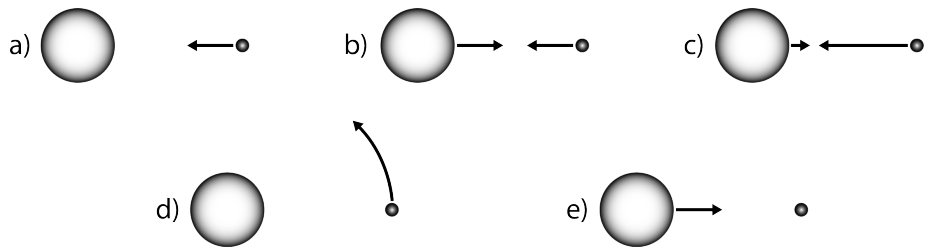
**Gravity and Orbits**

**Post-lab**

Emily Moore 7/12/12 2:42 PM
**Comment [13]: Post-assessment.** Review responses with students. Project on the smartboard/projector and call on students to answer questions and give feedback. Discuss answer choices that might confuse students, such as answer choice c and b.
**(insert video link of going over post-assessment if available)**

1 Choose the picture you think shows the gravity forces on the Earth and the Sun.

*(a longer arrow to represents a big force, and a shorter arrow represent a smaller force)*




2. How would these gravity forces change if the Sun got much bigger?

Increase Stay the same Decrease

3. How would these gravity forces change if the Earth was much closer to the Sun?

Increase Stay the same Decrease

4. How would these gravity forces change if the Earth got much smaller?

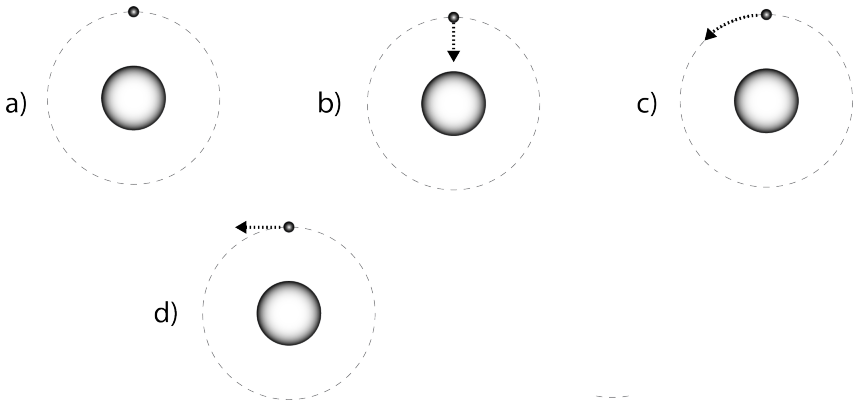
Increase Stay the same Decrease

5. How would these gravity forces change if the Earth and Sun were moved far apart?

Increase Stay the same Decrease

6. Choose the picture of how the Earth would move if you "turned off" the gravity forces.

Teacher Tip 7/11/12 6:13 PM
**Comment [14]:** Discuss, why will the planet go in this direction for option d? Why might some students be tempted to choose b?




7. How ***useful for your learning*** was this activity, compared to other science class activities? (circle)

More useful About the same Less useful

How ***enjoyable*** was this science class activity, compared to other science class activities? (circle)

More enjoyable About the same Less enjoyable

Why did you or did you not find it useful or enjoyable?