

A Scale Model of Earth's Atmosphere

Background:

GRACE is the name of a pair of satellites that will measure the gravity field of Earth. GRACE stands for Gravity Recovery and Climate Experiment. GRACE will help study problems in geophysics, oceanography and atmospheric science.

Objective:

To compare the layers of the Earth's atmosphere to the distances of certain objects.

Standards:

Science: unifying concepts and processes; science as inquiry; earth and space science; science and personal and social perspectives

Math: measurement; computation & estimation

Vocabulary:

tropopause	troposphere	stratopause
stratosphere	mesopause	mesosphere
thermosphere	exosphere	

Materials:

Meter stick	Adding machine tape	Map pencils
Scissors	Ruler	

Extensions:

- On the internet, find either a natural or manmade activity that occurs in each layer
- On a map of the United States, use a compass and draw a circle with a radius of 500 kilometers centered on your hometown. This represents the height above the Earth's surface that the GRACE satellites travel.

References / Resources:

<http://www.shodor.org/metweb/session1/layers.html>

<http://www.pbs.org/wgbh/nova/balloon/science/atmosphere.html>

Procedure: Copy the instructions and have the students complete the following:

1. Cut a piece of adding machine tape 3.5 meters long.
 2. Write the names of all of your group members on back of the tape.
 3. Measure and draw a line 10 cm from one end of the tape. Label this line *THE EARTH'S SURFACE*. Color the area from the line to the end of the tape purple. This will represent the area under the surface of the Earth.
 4. Measure and draw a line 5.3 cm above the Earth's surface and label that line *THE TROPOPAUSE*.
 5. Color the area from the Earth's surface to the tropopause blue and label it *THE TROPOSPHERE*.
 6. Measure and draw a line 16.0 cm above the Earth's surface and label that line *THE STRATOPAUSE*.
 7. Color the area from the tropopause to the stratopause green and label it *THE STRATOSPHERE*.
 8. Measure and draw a line 26.6 cm above the Earth's surface and label that line *THE MESOPAUSE*.
 9. Color the area from the stratopause to the mesopause yellow and label it *THE MESOSPHERE*.
 10. Measure and draw a line 183.3 cm above the Earth's surface and label that line *THE UPPER LIMIT OF THE THERMOSPHERE*.
 11. Color the area from the mesopause to the upper limit of the ionosphere orange and label it *THE THERMOSPHERE*.
 12. Color the area from the upper limit of the ionosphere to the edge of your tape red and label it *THE EXOSPHERE*.
 13. Measure and draw a line 233.3 cm above the surface of the Earth and label that line *AREA OF THE AURORA*.
 14. Measure and draw a line 166.6 cm above the surface of the Earth and label that line *THE ORBITAL DISTANCE OF GRACE*.
 15. Measure and draw a line 100 cm above the Earth's surface and label that line *AN AVERAGE ORBIT OF THE SPACE SHUTTLE*.
 16. Measure and draw a line 4.1 cm above the Earth's surface and label that line *A COMMON PATH OF A JET*.
 17. Measure and draw a line 2.9 cm above the Earth's surface and label that line *THE HEIGHT OF MT. EVEREST*.
 18. Measure and draw a line 1 mm (NOTICE THAT IT SAYS MM!) above the Earth's surface and label that line *THE HEIGHT OF A 110 STORY BUILDING*.
 19. Measure and draw a line 3.7 cm below the Earth's surface (NOTICE THAT IT SAYS BELOW THE EARTH'S SURFACE!) and label that line *THE DEPTH OF THE MARIANA TRENCH*.
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CONCLUSIONS: Answer each using complete sentences!

1. In which layer of the atmosphere do you live?
2. In which layer of Earth's atmosphere do the GRACE satellites travel?
3. If the scale of this model is 1 cm : 3 km, how many centimeters away on the tape would the Moon have to be if its actual distance is 384,000 km? Hint: Solve the proportion below by cross multiplying $384,000 \times 1$ and then dividing that answer by 3.

$$\frac{1 \text{ cm}}{3 \text{ km}} = \frac{\quad \times \quad}{384,000 \text{ km}}$$

4. Why was the Moon NOT included in this scale model?
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Answer Sheet

CONCLUSIONS: Answer each using complete sentences!

5. In which layer of the atmosphere do you live?

troposphere

6. In which layer of Earth's atmosphere do the GRACE satellites travel?

mesosphere

7. If the scale of this model is 1 cm : 3 km, how many centimeters away on the tape would the Moon have to be if its actual distance is 384,000 km? Hint: Solve the proportion below by cross multiplying $384,000 \times 1$ and then dividing that answer by 3.

$$\frac{1 \text{ cm}}{3 \text{ km}} = \frac{\underline{\mathbf{128,000 \text{ cm}}}}{384,000 \text{ km}}$$

4. Why was the Moon NOT included in this scale model?

The tape is too short so the Moon would not fit on it. Also, it is a model of Earth's atmosphere and the Moon is not located in Earth's atmosphere.
