

## Determining How Temperature Changes with Altitude

### Introduction

The atmosphere is divided into four layers based on temperature: the **troposphere**, the **stratosphere**, the **mesosphere**, and the **thermosphere**. The temperature in the lower 12 km of the atmosphere decreases with altitude. However, at altitudes from about 12 to 45 km, the temperature increases.

In this investigation, you will explore the temperature changes in Earth's atmosphere as altitude increases and investigate what causes these temperature changes.

### Problem

How does the temperature of Earth's atmosphere change with altitude?

### Pre-Lab Discussion

*Read the entire investigation. Then work with a partner to answer the following questions.*

1. **Posing Questions** Write a question that summarizes the purpose of this investigation.

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2. **Inferring** What are the possible sources of heat for the atmosphere?

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3. **Predicting** What substance in the upper atmosphere is important to temperature changes in the upper atmospheric layers?

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## Materials *(per group of students)*

ruler or straight edge  
colored pencils  
tracing paper  
Resource 12 in the DataBank

## Procedure

1. Carefully study the Atmospheric Temperature Curve shown in Resource 12.
2. Using tracing paper and the ruler, trace Resource 12.
3. Use the ruler to draw in the lines for the tropopause, stratopause, and mesopause. Label each line. If necessary, use your textbook as a reference.
4. Label the troposphere, mesosphere, stratosphere, and thermosphere.
5. Shade in each section. Use a different color for each section.

## Analysis and Conclusions

1. **Using Graphs** What is the approximate temperature of the atmosphere at each of the following altitudes?

10 km: \_\_\_\_\_ °C

50 km: \_\_\_\_\_ °C

80 km: \_\_\_\_\_ °C

2. **Using Graphs** How does the temperature change with altitude in the troposphere?

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3. **Drawing Conclusions** What causes the temperature change in the troposphere?

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4. **Using Graphs** How does the temperature change with altitude in the stratosphere?

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**5. Drawing Conclusions** What causes the temperature change in the stratosphere?

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**6. Using Graphs** How does the temperature change with altitude in the mesosphere and thermosphere?

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**7. Drawing Conclusions** Explain the temperature change with altitude in the thermosphere.

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**8. Calculating** If the average normal temperature decrease with altitude in the troposphere is  $6.5^{\circ}\text{C}/\text{km}$ , calculate the approximate temperature at 6,000 m if the surface temperature is  $16^{\circ}\text{C}$ . Show your work.

**9. Calculating** If the average or normal temperature decrease with altitude in the troposphere is  $6.5^{\circ}\text{C}/\text{km}$ , calculate the approximate altitude in which a pilot would expect to find each of the following atmospheric temperatures, if the surface temperature is  $27^{\circ}\text{C}$ . Show your work.

$10^{\circ}\text{C}$ : \_\_\_\_\_ meters

$0^{\circ}\text{C}$ : \_\_\_\_\_ meters

## Resource 12 Atmospheric Temperature Curve

DataBank

