

# LESSON 3

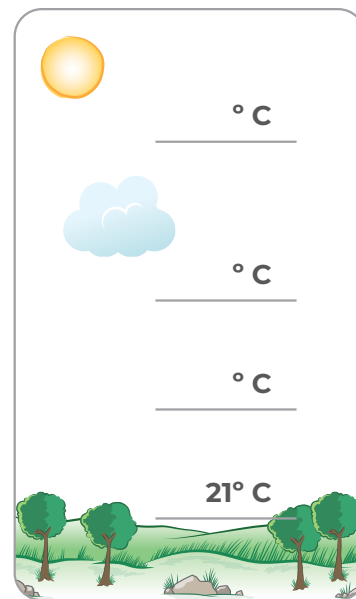
## How does temperature relate to cloud formation?

Weather balloons carry instruments into the atmosphere to collect temperature data at different altitudes – from near the ground to up where clouds form and even higher. In this lesson you'll explore data collected by a weather balloon to learn about how air changes with altitude.



### STEP 1: Use the temperature near the ground to predict the other temperatures.

Fill in the blanks in the graphic at the right to make a prediction about how air temperature changes with altitude.



### STEP 2: Collect temperature data.

At a computer or tablet, open the Virtual Ballooning interactive ([scied.ucar.edu/virtual-ballooning](http://scied.ucar.edu/virtual-ballooning)). With this simulation you can launch virtual weather balloons and record the temperature at different altitudes in the atmosphere.

1. Click "Explore the Troposphere" to get into the game.
2. **Get to know the graph.** Notice that altitude is on the vertical axis (the y-axis) and temperature is on the horizontal axis (the x-axis).
3. **Choose settings for a balloon launch.** Each balloon you launch will make three measurements of temperature. Set the altitude to start recording the temperature by dragging the "Collect Data" arrow up or down the y-axis.
4. Click the "Launch Balloon" button and watch as your balloon collects temperature data.
5. **Record that temperature in the table on the next page.** Read the points that the balloon made on the graph to find the temperature at different altitudes.
6. Click the "New Flight" button and choose new settings for another balloon launch to collect more data. Collect as much data as you can with four balloon launches.



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## STEP 2 CONTINUED: Collect temperature data.

ALTITUDE	TEMPERATURE (°C)
10 km	
9 km	
8 km	
7 km	
6 km	
5 km	
4 km	
3 km	
2 km	
1 km	
0 km	

high clouds

low clouds

## STEP 3: Analyze and interpret the data.

1. Describe the pattern you see in the temperature data from the ground to where storm clouds form.
  
2. Is this the pattern you predicted? Why or why not?
  
3. What do you think is *causing* the temperature pattern?
  
4. How does the temperature pattern relate to storms forming?  
(Draw or write your ideas below.)



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## STEP 4: How do air and surface temperatures change during a day?

To learn why air temperature changes with altitude, take a look at how the temperature of the ground (surface temperature) relates to the temperature of the air just above the ground (air temperature) in the graph below. Students at Westview Middle School in Longmont, Colorado, collected the data in this graph. Every hour during a day they measured surface temperature and air temperature outside their school.

Compare the two data trends in the graph by following these directions:



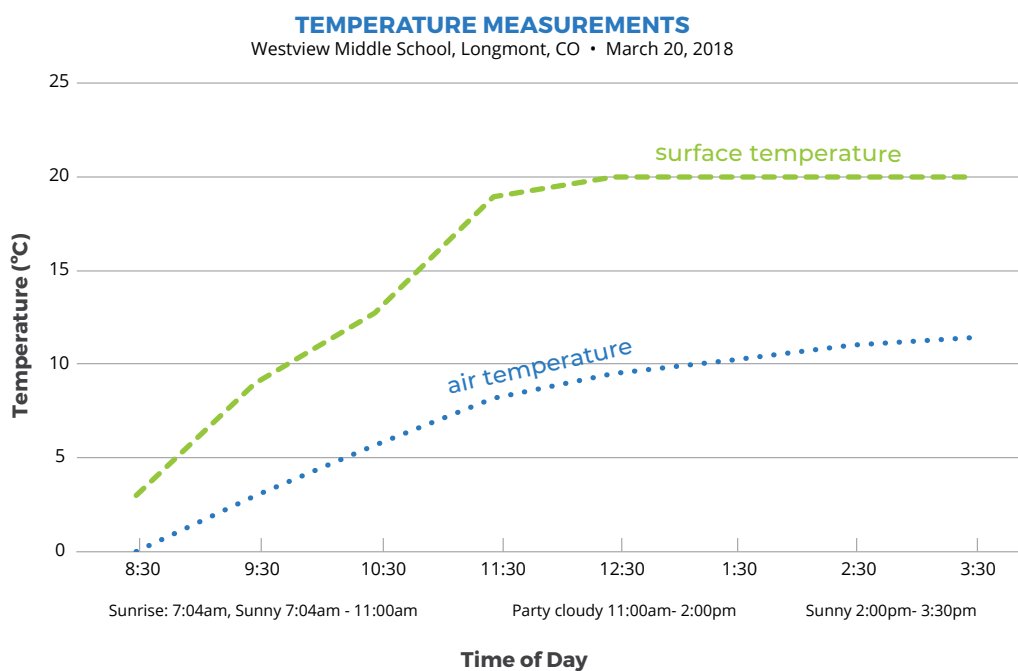
### WHAT I SEE

1. Look at different parts of the graph. Do you notice patterns? Do you notice interesting differences? Write **What I See** statements on the graph to record your observations.
2. Share your statements when directed by your teacher.



### WHAT IT MEANS

1. Next to each **What I See** statement, write a **What It Means** statement to explain what you think is happening in each part of the graph.
2. Share your statements when directed by your teacher.



Write a caption for the graph that compares the two data trends.



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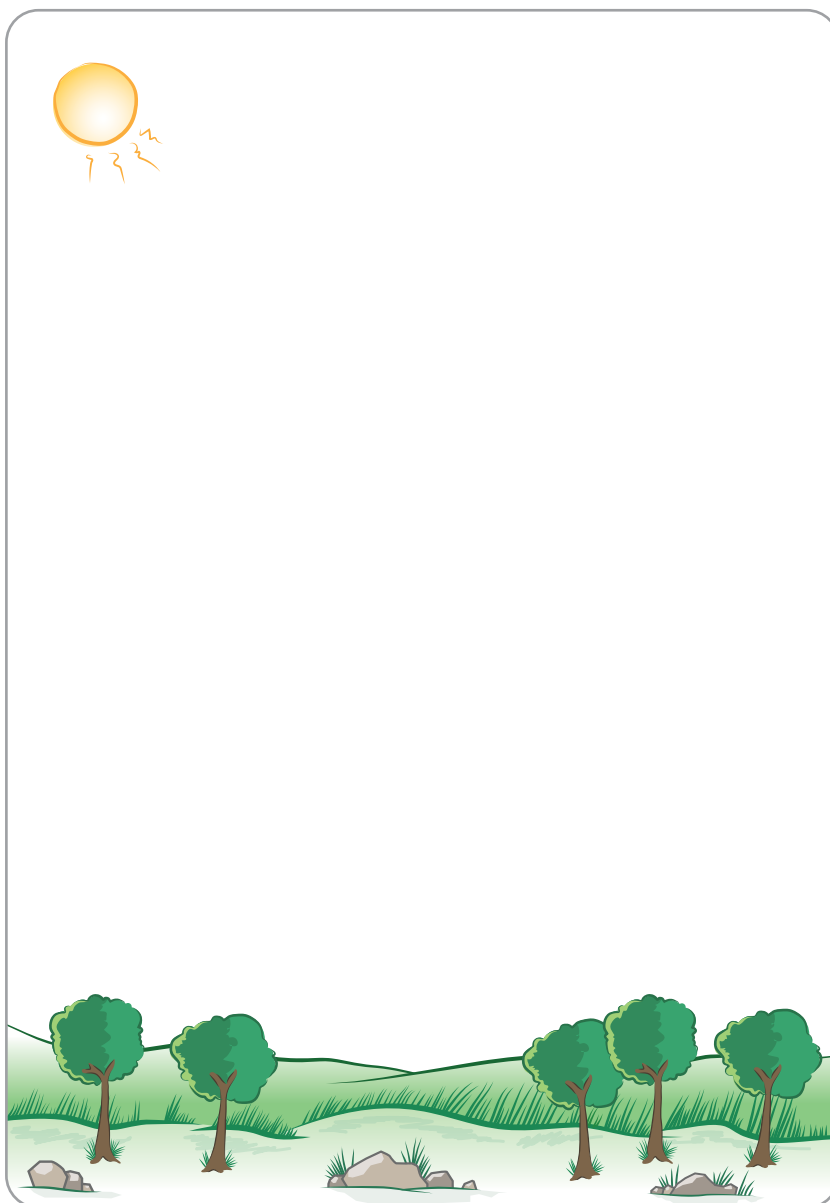
## STEP 5: Make a model of how sunlight warms the atmosphere.

Draw a model in the box below that helps to answer the following question:

**Why does the surface temperature warm over the day, and why is the surface warmer than the air above it?**

Your model should explain:

- How surface temperature is related to the sunlight
- How air temperature is related to surface temperature
- How the air temperature changes from the ground to higher altitudes
- How you know the above three things using evidence from temperature data



**KEY**

*(Choose colors to represent sunlight and temperature.)*

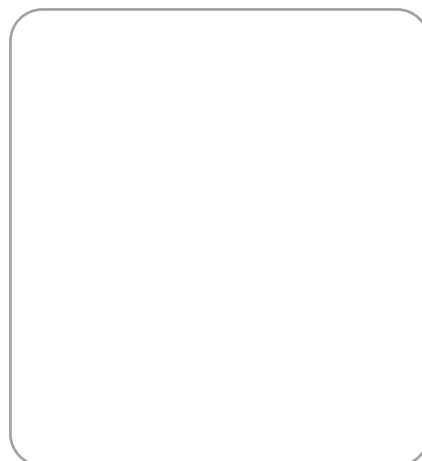


sunlight



temperature

Write a caption for your model that describes how sunlight warms the atmosphere.



## How does temperature relate to cloud formation?

### STEP 6: How does your model relate to storms?

There wasn't a storm on the day when the Westview Middle School students collected surface temperature and air temperature data, but it did get cloudy in the afternoon.

The time-lapse video showed that clouds started to build in the morning and by afternoon there was rain.

**Write a sentence to answer the question: How do you think temperature relates to the clouds and storm forming?**

**List evidence from your model to support your answer above.**

**Describe the reason that the evidence you listed supports your answer.**

