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# Sparking Curiosity: Hands-on Experiments for Elementary Students

## Experiments

### How Do Mittens Keep You Warm?

- Go Direct Temperature Probe

### What a Drag!

- Go Direct Force and Acceleration Sensor

### Reflectivity of Light

- Go Direct Light and Color Sensor

## Workshop Presenter

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Name: _____

**Graphical Analysis 2**

# How Do Mittens Keep You Warm?

Do you have a favorite pair of mittens or gloves? Even if you do not live in a cold place, it is possible that you have been somewhere cold or will go to a cold place when you are older. When you wear mittens or gloves to keep you warm, where do you think the warmth comes from? In this experiment, you are going to find the source of the heat.

## OBJECTIVES

- Find the temperature of the classroom and the temperature of your hand.
- Try to predict temperature changes that happen when the Temperature Probe is placed in various locations.
- Test how warm mittens help your hands stay warm.

## MATERIALS

Chromebook, computer, **or** mobile device
Graphical Analysis app
Go Direct Temperature
mitten

## KEY QUESTION

Do mittens make heat or hold heat in?

## HYPOTHESIS

Choose one of the following by checking the box in front of the statement that you think is right.

□ 1. Mittens make their own heat.

□ 2. Mittens hold heat in.

Why do you think so?

_____

_____

_____

## PROCEDURE

1. Get the equipment ready for data collection:
   a. Launch Graphical Analysis.
   b. Connect the Temperature Probe to your Chromebook, computer, or mobile device.
   c. Put the Temperature Probe on the desk and don't touch it until you are told to do so later on.
2. Click or tap Mode to open Data Collection Settings. Set End Collection to 60 s. Click or tap Done.
3. Do the following to find the temperature of the classroom:
   a. Make sure the Temperature Probe is lying on the desk and hasn't been touched by anyone. If it has been lying there for a few minutes, it will be the temperature of the room.
   b. Look at the meter and write down the temperature as the Room temperature in the Data Table.

| Data Table | | Room temperature _____ °C | |
|---|---|---|---|
| | Prediction (°C) | Maximum temperature (°C) | Was your prediction high or low? |
| Open hand | | | |
| Empty mitten | | | |
| Open hand in mitten | | | |

4. Make a prediction:
   a. Think about what will happen to the temperature on the screen if you hold the probe across the palm of your open hand during data collection. Think about your body temperature compared to the room temperature.
   b. Guess how high the temperature will be at the end of data collection and write down your prediction in the Data Table.

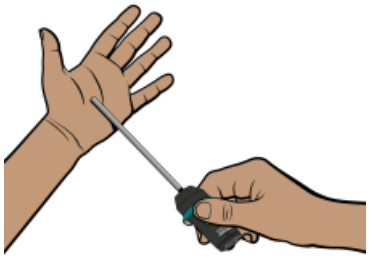

*Figure 1*

5. Now, collect data for the temperature of your open palm:

   a. Make sure the temperature values on the meter are very close to the value you recorded as the room temperature in your Data Table in Step 3.

   b. Click or tap Collect to start data collection.

   c. Place the tip of the metal part of the probe in the middle of your open palm, holding it by the black end with your other hand. **Important**: The tip of the probe should be gently touching your palm. Don't close your fingers over the metal part.

   d. Hold the probe in the correct position during data collection.

6. Do the following to find the maximum temperature of your open palm:

   a. Click or tap View, , and turn on Data Table. Dismiss the View menu.

   b. Look through the data table on the screen and find the maximum (largest) temperature value.

   c. Record this value in the correct place on the Data Table.

7. After you have finished finding the temperature of your open palm, place the Temperature Probe on your table and allow it to sit there without being touched. This way, the probe will cool down to the temperature of the room. While it cools, continue with the next step.

8. During this part of the experiment, you will place the Temperature Probe inside the mitten so you can measure the temperature inside the mitten. You will not have a hand inside the mitten, just the Temperature Probe.

   a. Think about what will happen to the temperature inside a mitten while it is sitting on the desk. The Temperature Probe will be inside the mitten but your hand will not be.

   b. Now, guess how high the temperature will be at the end of data collection and write down your prediction in the Data Table.

   c. Without touching the Temperature Probe, look at the temperature values in the digital meter on the screen. Make sure the temperature is very close to the value you recorded as the room temperature in your Data Table. If the temperature is not very close, wait until it is.

   d. Place the mitten on the table and slip the Temperature Probe into the mitten. Make sure you do not touch the metal part of the probe.

   e. Click or tap Collect to start data collection. **Note**: The first data set is automatically saved.

   f. When data collection is done, look through the data table on the screen.

   g. Find the maximum (largest) temperature value for the Latest data. Record this value in the correct place on the Data Table.

   h. Place the Temperature Probe on the table and allow it to sit there without being touched.

9. During this part of the experiment, you will measure the temperature of your hand inside the mitten.

   a. Think about what will happen to the temperature of your hand inside the mitten.

   b. Now, make a prediction about how high the temperature will be at the end of data collection and write down your prediction in the Data Table.

   c. Without touching the Temperature Probe, look at the temperature values in the digital meter on the screen. Make sure the temperature is very close to the value you recorded as the room temperature in your Data Table in Step 3.

   d. Place the mitten on your hand and slip the Temperature Probe into the mitten (see Figure 2). Position the tip of the probe in the middle of your palm. Leave your hand open during data collection, do not close your fist.

   e. Start data collection.

   f. When data collection is done, look through the data table on the screen.

   g. Find the maximum (largest) temperature value for the Latest data. Record this value in the correct place on the Data Table.

*Figure 2*

## ANALYZE YOUR DATA

1. What is the source of heat in this experiment?

2. If the mitten does not produce heat on its own, then how do mittens keep your hands warm?

3. Thinking about the previous question, explain the difference between heat production and heat retention.

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**Graphical Analysis 29**

# What a Drag!

Why do you have to wear tennis shoes to your physical education class? Have you ever worn slippery-soled dress shoes? In this activity, you will observe the differences between the slickness of the bottom of different shoes. When the shoes are dragged across a surface, a frictional force opposes the motion. If the bottom of shoe is slick, you will need less force to pull it across the table because there is less friction. The opposite is also true—if the bottom of the shoe is very sticky or bumpy, there is more friction, and you will need more force to pull the shoe.

## OBJECTIVES

- Make observations and predictions about shoes.
- Measure the force needed to pull different shoes across a surface.

## MATERIALS

Chromebook, computer, **or** mobile device
Graphical Analysis app
Go Direct Force and Acceleration
3 shoes with different soles
3 loops of string

## KEY QUESTION

Does the material on the bottom of the shoe affect the amount of force it takes to move it across the ground? Feel the bottom of each of the shoes. Which one feels the slickest? Which one feels the bumpiest? Based on what you feel, complete the hypothesis.

## HYPOTHESIS

The _____ shoe will have the most friction, and the

_____ shoe will have the least friction.

*Figure 1*

## PROCEDURE

1. Get the Force Sensor ready to collect data.
   a. Launch Graphical Analysis.
   b. Connect the Force Sensor to your Chromebook, computer, or mobile device.
2. Click or tap Mode to open Data Collection Settings. Set End Collection to 4 s. Click or tap Done.
3. Get the Force Sensor ready to collect data by doing the following:
   a. Hold the Force Sensor, with the hook pointing towards the ground.
   b. Look at the force value on the screen.
   c. When the value stabilizes (stays the same), click or tap the Force meter and choose Zero. The reading should be very close to zero.
4. Attach a loop of string to the shoes in a way that will allow you to drag it across the table.
5. Measure the weight of each of the shoes by hanging them from the Force Sensor and record their weights in the Data Table. Describe the type of shoe in the table also.

| Data Table | | |
|---|---|---|
| Type of shoe | Weight of shoe (N) | Average force (N) |
| | | |
| | | |
| | | |

6. Hook the Force Sensor to the string attached to the shoe and practice using the Force Sensor to drag the shoe across the table. When you drag the shoe, be sure to pull so the Force Sensor remains horizontal to the table top. Practice a few runs to make sure you can pull the shoe slowly and steadily.
7. Collect data:
   a. Begin slowly and steadily pulling the shoe across the table.
   b. Once the shoe is moving steadily, have another person in the team click or tap Collect to start data collection.
   c. If you reach the end of the table before data collection is over, repeat the run. You want to have a relatively steady force value for the four-second run.

8. When you have successfully collected data, click or tap Graph Tools, , and choose View Statistics. Record the mean (average) force in the Data Table.

9. Repeat Steps 7–8 for each of the remaining shoes.

## ANALYZE YOUR DATA

1. Was your hypothesis about the shoes correct? Tell what you observed about the shoes that made you think this hypothesis would be true.

2. Write about the shoes that you used for this activity. What are they used for? Why do they need less or more friction?

3. Use your data to draw some conclusions about what activities might require shoes with more or less friction than the ones you tested. For example, what kinds of shoes do golfers or ballet dancers wear?

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**Graphical Analysis 35**

# Reflectivity of Light

Light is reflected from surfaces based on their texture and color. The amount of light reflected is called the *reflectivity* of the surface. Reflectivity is important in determining our climate on Earth. Things like oceans, trees, ice, and deserts greatly affect how much of the sun's light energy is reflected and how much heats the Earth.

## OBJECTIVES

- Use a Light Sensor to measure reflected light.
- Make conclusions based on your data.

## MATERIALS

Chromebook, computer, **or** mobile device
Graphical Analysis app
Go Direct Light and Color
piece of white paper
piece of black paper
2 more pieces of paper of different colors
pencil, pen, or ruler
tape
ruler

## KEY QUESTION

How reflective are different colors of paper?

## PRE-LAB PREDICTION

Predict the order of the reflectivity of your pieces of paper from lowest to highest:

| Lowest Reflectivity | | | Highest Reflectivity |
|---|---|---|---|
| _____ | _____ | _____ | _____ |

## PROCEDURE

1. Get the Light Sensor ready to collect data:
   a. Launch Graphical Analysis. Connect the Light Sensor to your Chromebook, computer, or mobile device.
   b. Tape the Light Sensor to the ruler, pen, or pencil so that the tip of the Light Sensor is 5 cm beyond the eraser end of the sensor. When you hold the ruler up and down, the tip of the Light Sensor will be 5 cm from the surface of the table (see Figure 1).

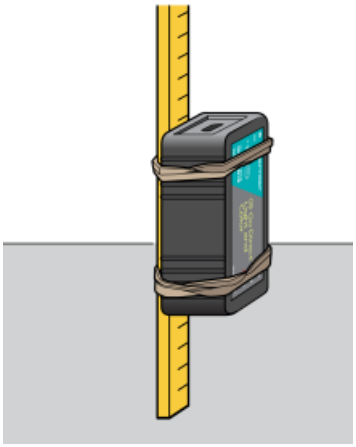

*Figure 1*

2. Set up the data-collection mode.
   a. Click or tap Mode to open Data Collection Settings. Change Mode to Event Based.
   b. Choose Selected Event as the Event Mode.
   c. Check the box next to Average sensor reading over 10 seconds.
   d. Enter Color as the Event Name and leave the Units field blank. Click or tap Done.
3. Click or tap Collect to start data collection.
4. Follow these steps to collect data.
   a. Put the white paper on the table.
   b. Pick up the Light Sensor and put the tip of the ruler in the center of the piece of paper.
   c. Make sure there are no shadows under the tip of the sensor. If there are, move your hand around so that the shadow doesn't fall over the sensor (look for the highest reading you can get).
   d. When the light level readings are constant (stay the same), click or tap Keep. Hold the Light Sensor in place for 10 seconds while data are collected.
5. Repeat Step 4 for the piece of black paper and the other two pieces from your teacher.
6. Click or tap Stop to stop data collection.

7. Fill in the data table by doing the following:

   a. Click or tap the graph to examine the light level values. **Note**: You can also adjust the Examine line by dragging the line.

   b. Find the light level values for the four pieces of paper and write them in the Data Table. Be sure to write down the name of the color in the spaces provided.

| Data Table | | | | |
|---|---|---|---|---|
| Color | White | Black | | |
| Light level | | | | |

## ANALYZE YOUR DATA

1. Which color has the highest reflectivity?

2. Which color has the lowest reflectivity?

3. What surfaces might give a planet a high reflectivity? Explain.

4. Do you think that the planet Earth has a high reflectivity? Why or why not?