FLINN SCIENTIFIC

Name_____

Conduction, Convection, and Radiation Worksheet

Station 1: Conduction

Data Table 1

Metal	Time to Melt Wax (min)
Aluminum (Al)	
Copper (Cu)	
Zinc (Zn)	

1. In Part 1, which object felt cooler to the touch—the copper strip or the plastic spoon?

2. In Part 1, what direction was heat flowing—from the objects to your wrist, or from your wrist to the objects? How do you know?

3. Which object has better thermal conductivity, the plastic spoon or the copper strip? How does this explain the perceived difference in temperature?

4. Describe the process of heat transfer by conduction in Part 2, starting with the hot plate and ending with the wax.

5. Based on the time required to melt the wax for each metal in Part 2, rank the three metals tested in order of their thermal conductivity, from highest to lowest. Explain your results.

Table 1. Thermal Conductivity of Metals

Metal	Composition	Thermal Conductivity* (J/s·°C·cm)
Aluminum	Al (pure)	2.4
Copper	Cu (pure)	4.0
Iron (low-carbon steel)	Fe (<0.3% C)	0.70
Lead	Pb (pure)	0.35
Nickel	Ni (pure)	0.91
Zinc	Zn (pure)	1.2

*Approximate values at room temperature (25 °C). Thermal conductivity is temperature dependent.

Use the Thermal Conductivity Table to answer questions 6 and 7.

6. Look at the thermal conductivity values for the three metals tested in this activity—the higher the number, the faster heat transfer will take place. Do your results agree with the data in the table? If not, what are some possible sources of error?

7. If an iron strip had been tested, when would you expect the wax to melt from the iron compared to the other metals used? Explain your prediction.

Station 2: Convection of a Liquid

Data Table 2

Time (minutes)	0	1	2	3
Temperature (°C)				

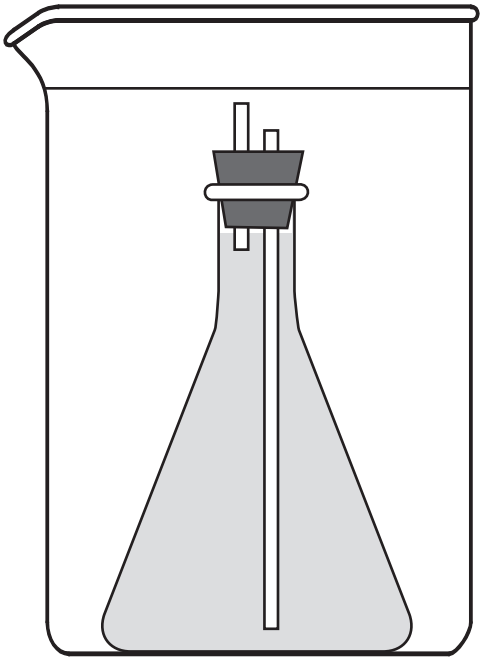
8. Describe any movement of water that was observed once the cold water covered the flask of hot water. Did this movement change over time? If so, how?

9. Did the level of water in the flask or the beaker change? Explain.

10. If the flask and beaker setup were left for a longer period of time, would the convection of water eventually stop? Why or why not?

11. Other than convection, what other method of heat transfer was taking place in this activity?

12. In the diagram below, draw arrows to show the convection current in this activity. Label the two regions of water as "hot" and "cold," respectively.



Station 3: Convection of a Gas

Data Table 3

	Without Divider	With Divider	After Divider Removed
Burning Time (seconds)			
Appearance of Flame			

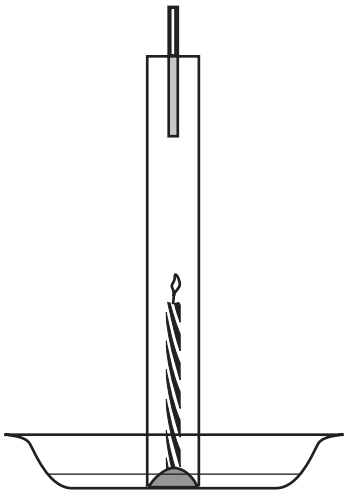
13. Describe and compare what happened to the flame in the cylinder without the divider with what happened with the divider in place. Explain what might have caused the difference.

14. Describe your observations when you placed your fingers above the cylinder on opposite sides of the divider.

15. What happened to the flame after the divider was removed?

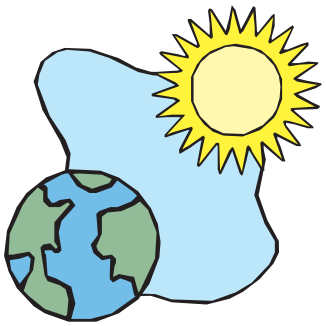
16. How do the observations from this activity demonstrate the divider allowed a convection current to form in the cylinder?

17. In the diagram below, draw arrows to show the direction of hot and cold air flow in this activity. Show the regions of hot and cold air, respectively, in the diagram.



Data Table 4

Time (minutes)	Temperature (°C)	
	Black Sand	White Sand
0		
1		
2		
3		
4		
Total change in temperature		



Graphing the Data

Plot the time and temperature data for each substance on the following graph. Each temperature recorded will be represented by one point. Use different shape data points or a different color pencil for each substance. Use the horizontal (*x*) axis for the time and the vertical (*y*) axis for the temperature. Label each axis, including units and make sure the scale is clearly marked. Draw a "best-fit" line that includes, or comes close to, as many data points as possible for each substance.

18. Calculate the total change in temperature over time by subtracting the final temperature (4 minutes) from the initial temperature (0 minutes). Record the values in Data Table 4.

19. How did the temperature in each substance vary over time? Explain the variation.

20. Explain how you can infer that the sand was heated by radiation and not by conduction or convection.

21. On a sunny summer day what color shirt—black or white—might be cooler? Why?