*Linear Modeling Project*

**Description**

Ever wanted to know how long it would take to completely burn the birthday candles on your cake? Ever thought about trying to predict the future? Algebra can help us do both of these!

In this project you will first perform an experiment to see just how fast birthday candles burn. With the data you collect you will calculate and interpret the slope (rate of change), determine a linear model for the candle height, interpret the y-intercept, graph your model, then use your model to predict how much time it would take to completely burn a birthday candle.

Next you will choose a topic to research. You will use the data you find to create another linear model, interpret the slope and y-intercept, and make a prediction about your topic.

You will also be asked to consider if a linear model is appropriate for both scenarios.

**Objectives**

This project will give you practice with:

1. modeling applications using linear functions
2. recognizing when a linear model is appropriate
3. graphing linear functions
4. distinguishing between the independent and dependent variables
5. calculating and interpreting slope and y-intercept of linear functions
6. using linear functions to predict values

**Due Dates**

(Provided by your instructor.)

\_\_\_\_\_\_\_\_\_\_Experiment

\_\_\_\_\_\_\_\_\_\_Experiment Exercises

\_\_\_\_\_\_\_\_\_\_Research

\_\_\_\_\_\_\_\_\_\_Research Exercises

**Linear Model 1: The Experiment**

*Burning Birthday Candles*

1. Measure the height of an unburned birthday candle (in cm).

2. Prepare a stop-watch or timer app on your smart phone.

3. Let $t$ be the time that has passed (in minutes) since you lit the candle. Before you light the candle, record the time (hint: if you’ve not yet lit the candle, how much time has passed since you lit it?) and height as an ordered pair in the space provided.

$\left(t\_{1},h\_{1}\right)=$ \_\_\_\_\_\_\_\_\_\_

4. Place the candle in a cupcake/piece of cake/muffin/etc. If you have none of these, you can also mold clay into a holder for the candle. Be sure the candle is standing vertically.

5. Light the candle and start your timer.

6. When approximately $\frac{1}{3}$ to $\frac{1}{2}$ of the candle has burned, blow out the candle and stop your timer.

7. Let the candle cool, remove it from the cake or clay, and measure its height. Record the time and height as an ordered pair in the space provided.

$\left(t\_{2},h\_{2}\right)=$ \_\_\_\_\_\_\_\_\_\_

Use these points to complete the exercises below.

**Exercises**

Use your data points to complete the following exercises.

1. Calculate and interpret the slope. Do you believe this value makes sense? Explain.
2. Determine a linear model for the height of the candle after t minutes. Use function notation and write your model in slope-intercept form.
3. Describe the independent and dependent variables in your experiment.
4. Interpret the y-intercept of your model.
5. Graph your model. Be sure to label your axes.



1. Use your model to predict how long it would take to completely burn the birthday candle.
2. How long would it take to burn a birthday candle that is 12 cm long, assuming it burns at the same rate as your birthday candle?
3. Is a linear model a good model for this experiment? Explain.

**Linear Model 2: Research**

Choose a topic to research, then have your topic approved by your instructor.

Sample Topics:

Netflix – Research the number of subscribers to the service $x$ years after 1999.

Movies – Research the amount of money made by a movie $x$ weeks after its theatrical release.

Family Size – Research the average size of a US family $x$ years after 1960.

Minimum Wage – Research the average minimum wage in the US $x$ years after 1970.

Home Sale Price – Research the prices of homes (in a city/state of your choosing) with $x$ square footage.

Professional Athletes – Research the amount of money your favorite athlete made $x$ years after he/she became a professional.

Other – Choose your own topic and have it approved by your instructor.

Once your topic has been approved, research your topic to obtain 2 data points. Record those data points as ordered pairs in the spaces provided. Be sure to label the independent and dependent variables.

 Topic: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 Independent: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 Dependent: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 $\left(x\_{1},y\_{1}\right)=$ \_\_\_\_\_\_\_\_\_\_

 $\left(x\_{2},y\_{2}\right)=$ \_\_\_\_\_\_\_\_\_\_

**Exercises**

Use your data points to complete the following exercises.

1. Calculate and interpret the slope. Do you believe this value makes sense? Explain.
2. Determine a linear model to represent your data. Use function notation and write your model in slope-intercept form.
3. If appropriate, interpret the y-intercept of your model. If not appropriate, explain why not.
4. Graph your model. Be sure to label your axes.



1. Choose an appropriate value for the independent variable and use your model to make a prediction about the dependent variable. (Sample predictions can be found on the next page.)
2. Does your prediction in exercise 5 make sense? Do you think a linear model is a good model for your data? Explain.

Sample Predictions:

Netflix – Predict the number of subscribers in the year 2019.

Movies – Predict the amount of money the movie will make 5 weeks after its release.

Family Size – Predict the average US family size in the year 2020.

Minimum Wage – Predict the average minimum wage in the US in the year 2020.

Home Sale Price – Predict the price of a home that is 2000 square feet.

Professional Athletes – Predict the amount of money made by your favorite athlete 10 years after he/she became a professional.

Other – See your instructor if you need additional suggestions.