SN EDUCATOR GUIDE

April 11, 2020

A Tiny Dino and Iron Rain

Teacher Answer Key: The Home as Laboratory

In this activity, students will observe and collect data on a phenomenon at home, then analyze that data to develop a research question and hypothesis. This answer key is one example of what students could do.

Background discussion questions

Scientists use observations to study the natural world and to formulate hypotheses for future experiments. These questions will ask you to think about the role of observations in science, as well as data collection and presentation.

1. Give a few examples of how scientists in particular subfields collect data through observation?

Answers will vary but may include biologists observing birds in the field to study mating rituals or geologists collecting data on seismic activity to study the sources and intensity of earthquakes.

2. What kinds of scientific data could you collect in or around your own homes?

Answers will vary but could include the length of television commercials on different channels, the air temperature outside compared with inside or the changes in sunrise times over the course of a month.

3. What does "quantitative data" mean? What forms can these data take? Give some examples of measurements that yield quantitative data.

Quantitative data are data that are expressed in numbers, such as a plant's height in centimeters or the number of birds attracted to a pile of sunflower seeds. Quantitative data can be masses, number of occurrences, lengths of time, heights, temperatures and much more.

4. How do scientists display quantitative data?

Students may mention charts, graphs or data tables. How best to represent data often depends on the type of observations and the form of data. For example, an investigation showing some form of change over time may be best shown as a line graph. When showing data that adds up to 100 percent, a pie chart might be a better approach.

Group planning

You are now going to be collecting quantitative data in or around your home. Your teacher will assign a phenomenon or give you instructions for choosing your own, as well as explaining the timeline for data collection. You will need to establish a methodology in advance. If you are working in a group, you will need to discuss with your group how you can use similar methods so that you can successfully compare your data. If you are working on your own, you will still need to consider how to collect and record your data so that other scientists can interpret and repeat your investigation.

5. What phenomenon are you interested in that can be observed or tracked over time?

How the amount of electricity used in my home varies over time due to household activities.

6. How can you observe it in a quantitative way?

I will record the electric meter values over the course of a day and what activities were performed between each measurement.

7. What data will you collect and how (be sure to include the timeframe and time interval for data collection)?

I will collect data every hour from 8 a.m. to 8 p.m.

8. What background information do you need to know in order to collect this data?

I will need to find out where our electric meter is and determine if it is a digital meter or a dial. If it is a dial meter, I will need to learn how to properly read and record the values.

9. Do any necessary background research, taking notes you may need to reference in the space provided here.

Our meter is a dial meter and is located in the basement. The tens and thousands place dials run counterclockwise, while the other dials run clockwise.

Data collection and analysis

Now that you have determined your methodology, answer the following questions about how you will record and analyze your data. Your answers may differ from other members of your group since your phenomena may differ slightly.

10. Create a data table to record your findings. Be sure to include columns for the time (or time period) and any relevant observations or notes. Remember to indicate units.

Example table:

Time period	Meter reading at start of hour (kilowatts)	Activities during hour
8 a.m.–9 a.m.		
9 a.m.–10 a.m.		
10 a.m.–11 a.m.		
…9 p.m.		

11. How could the data you collect be analyzed? What general information would you find from that analysis?

Subtracting the initial value on the electric meter from the ending value for each hour or day will reveal how much electricity is used in that timeframe.

12. Now complete your observations over the time period and fill in your table with your data. Once completed, do your analyses (adding columns to your data table as necessary). Based on what you know about representing data, how could your data best be displayed? Why?

My data could best be displayed as a bar graph, because I am measuring the amount of electricity used over time. I can create a bar graph showing how much energy is used each hour.

13. What information will your display need to include? How can you make it easy to read? Be sure to be specific about what your axis labels will be and identify any information that should be included in the key.

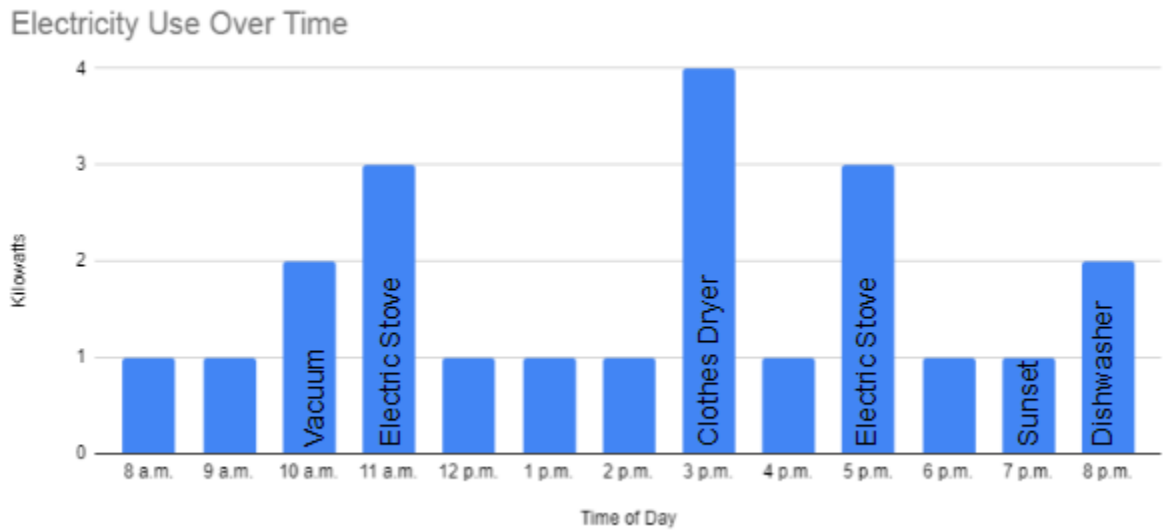
My bar graph will need to include the time of day on the x-axis because it is the independent variable and the amount of electricity in kilowatts on the y-axis because it is the dependent variable. I will also need to label the bars according to the major activities performed in each hour. I will also want to show when sunset is, since this is when my family turns on all the household lights.

14. How will you identify trends in your data?

I will examine which hourly values were the largest and which were the smallest. Additionally, I will look at how the data changed over time based on the activities performed.

15. Create your visual display of your data. Be sure to include your labels and/or a key as necessary.

Example visual display:



Data sharing
Work remotely with your group to review the outcomes from your investigations.

16. What trends did you notice in your own data?

The amount of electricity changes over the course of the day and depends on what appliances are being used. Using the clothes dryer and the electric stove had the greatest impact.

17. What trends did you notice in your group's data? Do these trends match the trend you found in your own data?

The amount of electricity changes over the course of the day and depends on what appliances are being used. Using the clothes dryer and the electric stove had the greatest impact. This matches the trend I found in my own data.

18. What do these trends suggest about electricity usage in your home?

During most hours, we used 2 kilowatts of energy regardless of what appliances were on, including lights and computers. The number only changed when large appliances such as the dryer were used. This trend indicates that lights do not use very much electricity.

19. Did anything surprise you about your data or your group's data?

Yes, I was surprised to find that more electricity was used during the day than at night. I had thought our family would use the most electricity once it was dark outside (and all the lights were on).

Developing a research question
20. What research questions could the data you collected help answer?

Answers will vary. Students may focus on how best to conserve electricity. Once they have identified which behaviors use the most electricity, they could propose alternatives that would reduce the amount used. Students may also want to determine how much energy each appliance uses or how much energy is used by a family over the course of a day.

21. Based on the data collected, what research question would you be most interested in exploring? Support your answer.

I collected data on how much electricity usage my family had over the course of a day. I would be interested in investigating how we could go about reducing that usage. I am always being told to "turn off the lights when I leave a room," so it would be interesting to investigate if turning off lights makes a difference. The research question could be, "Does turning off the lights meaningfully reduce the amount of electricity used in a home over time?"

22. How would you investigate that question? What additional observational data might be useful? What additional experimental data might be useful?

To investigate this research question, I could collect usage data for a period of time when only all the lights in the house were on and then have the same period of time when everything was off. These two values could

be compared to determine actual energy usage of the lights. Additionally, it would be helpful to measure how much electricity is used by other appliances in the home for the same time period, to determine what appliances use more electricity.

23. What would your hypothesis be, based on the existing data?

Based on the data I have already collected, I think the lights do not use as much electricity as other appliances in the average household.

24. What steps would you take to design an experiment to test your hypothesis?

To design an experiment, I would first identify the variables that I would be testing, along with potential confounding variables. After defining the variables, I would determine how I intend to analyze the data (using a mathematical calculation or statistical test, for example). Then I would develop a protocol or procedure for testing (with a design to try to minimize the potential effects of confounding variables), run the experiment and collect and analyze the data. Finally, I would determine how to write and display my results.