Example Case Study Worksheet 1 Answer Key
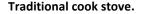
Use this real-world example to learn how to plan a study.

Instructions: First, watch a **video** provided by your teacher, then **read** the text below. Then fill in the **template** that follows to plan how you would tackle this research problem.

Cooking over open fires is a serious problem for human health and well-being, so cook stove intervention studies are conducted to test new, ***improved cook stoves***. Improved cook stoves are designed to improve combustion by achieving more complete combustion and less incomplete combustion. The objective of this technology is to improve health and quality of life by reducing harmful pollutants, as well as the amount of fuel needed to cook and heat homes. One trade-off is the higher cost of improved stoves.

A cook stove ***intervention study*** involves identifying a group of participants and providing some of them with improved cook stoves, while the rest of them continue to use ***traditional cook stoves***. Researchers then collect data to determine the benefits of improved stoves over traditional stoves, as well as the barriers to widespread implementation. Improved cook stoves must lower harmful emissions and be cost effective and easy to use. These studies can be complex because researchers need to study the problem from many different angles.

Traditional cook stove.

**Improved cook stoves:
(left) high-cost and (right) low-cost.**

Imagine that you have been awarded a grant to conduct a cook stove intervention study to investigate the impact of different stove types. You randomly sort 200 identified homes into groups; some homes will continue to use traditional methods while other homes will use the improved cook stoves. **Use the template below as a guide to plan how you would conduct this study.**

*Note, you have the capacity to measure all of the pollutants in the diagram below with small portable sampling devices, and you can also collect other data using interviews for instance. The diagram serves as a reminder of how these pollutants form and why they matter.

Processes: (the colors below match the arrow colors in the diagram)
- Complete Combustion
- Incomplete Combustion
- Thermal NOx Formation
- Ozone Formation (photochemistry)

Why We Care About:
- CO, VOCs, PM, NOx, O3 – harmful to human health
- CO2, O3, some VOCs – Causes climate change & harmful to environmental health
- PM, VOCs – Causes visibility and odor issues (e.g., smog)

Study Template

1. **Hypothesis**

   If individuals use improved cook stoves, their exposure to ____carbon monoxide__ ,

   _____volatile organic compounds__ , and _particulate matter_____ will be

   decreased/increased (circle one) because improved cook stoves cause more

   complete/incomplete combustion (circle one) to occur.

2. **Methods: How will you conduct your study?**

   Determine your variables and what you need to control.

   Independent Variables (This variable is defined by you and manipulated in order to examine its impact.)

   Stove type (traditional stove vs. improved stove)

   Dependent Variables (What you are measuring/observing as you manipulate your independent variable.)

   Pollutants (List at least three that are important to this study.)
   Answer: carbon monoxide, volatile organic compounds, particulate matter, carbon monoxide

   Health impacts (List one way in which health might change that you could observe or measure.)
   Answer: You could observe the lung function of the family or how often they are coughing. You could also ask them how they feel overall after switching to the new cook stove.

Other (List two other factors you would measure or observe, such as economic factors.)

1. Economic: How much less fuel is used in a week or month?

2. Time: How much time is saved by no longer collecting wood for cooking or how much time is saved on cooking overall?

Controls (These are other factors that can impact our understanding of the final data. When possible, minimize their impact and if not possible, at least be aware of how they affect the data.)

Example 1: If you were to sample two homes, each from a different area and one area was more polluted than another (perhaps from vehicle traffic), this might affect your ability to isolate the impacts of cooking and accurately compare the impact of cooking in each of the two homes. Therefore, you would want to control for this effect by sampling homes closer together (perhaps in the same village) because the ambient air around them would be fairly similar, making the baseline in each home fairly similar.

Example 2: Different foods may have different cooking times, temperatures and preparation instructions, therefore you would want to compare preparation of the same dish or meal across the different stoves. You would want to control for the food type and only change the stove type.

List one more variable or condition you would want to control for or keep similar across sites.

Possible answers: Depending on the family size, the amount of food that is cooked could be different and this might affect the comparison between the two stoves. Also the house size may be different due to larger or smaller families, which could have an effect on ventilation. Control for this by picking families that are similar in size and have similar size and type of houses.

3. **Outline Your Procedure**
   (What) For which pollutants will you collect data?
   Answer: Collect data on volatile organic compounds, carbon monoxide, and particulate matter (assuming that the type of monitor you have measures particulate matter).

   (Where) Describe where you will place your monitors (assume you have as many as you need).
   Answer: One monitor will be placed outside each house for an ambient air measure and one monitor will be placed inside the kitchen in each house to measure cook stove emissions.

   (Who) Are you most interested in the exposure of any specific individuals or family members?
   Answer: For this experiment, I would be interested in the mother and children because they are most likely who will be affected most by the cook stove emissions (based on statistics of who often faces health risks and deaths due to cooking emissions).

   List one other piece of data that would be helpful to have.
   (Example: participant health prior to and after the study – you could request that participants report any health issues or respiratory problems that may be impacted by the change in stove type)

   Answer: For this experiment, I would be interested in the previous health of the participants and health issues in the family. I would also be interested to know who is home at which times and what time the cooking takes place and the duration.

4. **Data Analysis Plan**

List two ways you will examine/analyze your data after collecting it. (Example: Compare the average CO in homes with traditional stoves vs. homes with improved cook stoves during a cooking event.)

1. The average of the three pollutants (CO, VOCs, PM) will compare the inside monitors vs. the outside monitors in order to determine the effect/rise of pollutants due to a cooking event.
2. The averages of the three pollutants in the home with the tradition stove will be compared to the average of the three pollutants in the home with the improved cook stove.