# Assignment Summary

In this project, you will design, construct, test, and modify a device that releases thermal energy by chemical processes. You will be provided specific materials by your instructor, and will use these materials to design a device that releases energy to the environment. Next, you will build the device and test it by gathering temperature data. Finally, you will use your data to evaluate the design and decide how to improve your device.

# Assignment Instructions

**Step 1: Gather materials and necessary information.**

1. You will be provided with these initial materials:

* 2 plastic resealable bags
* 3–5 “000” size empty gelatin capsules
* One 10 mL graduated cylinder to measure purified or distilled water
* 5 mL distilled water
* 1 g calcium chloride
* 1 Fahrenheit or Celsius thermometer
* 1 funnel
* Clock or stopwatch

1. Make sure you use the materials given only for reference purposes in Steps 1 and 2 to help you with ideas in the design phase. Building the device does not occur at this point and any materials you alter or destroy will not be replaced.
2. Be sure to organize your materials and make sure that the chemicals are handled safely.
3. Do not allow substances to mix until the testing phase begins.
4. Be sure you have paper and a pen or pencil to record data before, during, and after the testing phase of the project. This data will be reported in your final report.
5. The reaction that will be used is the dissolving of calcium chloride in distilled or purified water. The action of dissolving calcium chloride is an exothermic process that can be detected by an increase in temperature.
6. Remember to treat tools and materials with care and respect, and to use all safety precautions that you would in a laboratory exercise.

**Step 2: Design the device.**

1. Begin by writing a description and/or drawing a diagram of the expected design of your device, using these requirements:

* Your device must allow temperature data to be collected both before and after the device is activated.
* Your device must release energy to the environment and it must be a controlled reaction. This means that you must have a way to start the reaction at a set time. Your device must maintain the room temperature for 15 seconds or more, then be activated by you to increase the temperature.

1. Ask your teacher where you should save your device design plans as you work on them. Your teacher may also have specific guidelines about the file name you should use.
2. Once your teacher has approved the design, you will be able to start the construction of your device.

**Step 3: Construct the device.**

1. Use the materials you have been given to create your device, based on your design.
2. Be sure to:
   * Have your timing device and thermometer ready before you finish constructing your device.
   * Record the temperature of the water you are using before installing it into your device.
   * Assemble your device and keep temperature data for 15 seconds before “activating” it.

**Step 4: Test the device and collect data.**

1. After collecting the needed data from Step 3, activate the device.
2. After activating the device be sure to:
   * Continue collecting temperature data from your device after you activate it: every 30 seconds for at least 2 minutes.
   * Ensure that the chemicals mix and the water dissolves the calcium chloride.
   * Ensure proper temperature readings.
   * Dispose of your device when finished, in accordance with your teacher’s instructions.
3. Make sure all data is collected for your lab before moving on to the next step.

**Step 5: Write a preliminary conclusion based on the results of the first trial.**

1. Use the data collected to identify the effectiveness of your device. If you were able to control the activation of the device and measure a change in temperature, then your device was effective at releasing energy.
2. Use this initial report to determine how you will redesign the device.
3. Remember to save your work as you go.

**Step 6: Design an improved device.**

1. Based on the initial data and report on the first trial, write a description and/or draw a diagram of the possible changes in design to improve your device. You need to be able to control when the reaction begins. You also need to maximize the release of energy. In the next step, think of ways you can improve one or both of these factors by modifying the experimental variables.
2. Make clear what you intend to do to improve the device. Some variables you may want to change:
   * Increase the amount of calcium chloride by 1 or 2 grams.
   * Increase the amount of water by 1 or 2 mL.
   * Increase both the water and calcium chloride by a factor of 1 or 2.
   * Decrease the amount of water by 1 or 2 mL.
   * Decrease the amount of calcium chloride to 0.5g.
3. Once your teacher has approved the new design, you will be able to start construction of your improved device.

**Step 7: Test the device and collect data (second trial).**

1. After collecting the initial water temperature, activate the new device.
2. After activating the device, be sure to:
   * Continue collecting temperature data from your device: every 30 seconds for at least 2 minutes.
   * Check that the chemicals mix and the water dissolves the calcium chloride.
   * Read the temperature properly.
   * Dispose of your device when finished in accordance with your teacher’s instructions.
3. Make sure all data is collected for your lab before moving on to the next step.

**Step 8: Write a final conclusion based on the results of the second trial.**

1. Use the data collected to identify the effectiveness of your device. The effectiveness is based on the control of the activation of the reaction and the temperature change observed.
2. Use this final report to determine how effective your redesign was in releasing energy to the environment. Ask these questions about the redesign:
   * Was it more effective, where a greater temperature increase was observed?
   * Was it less effective, where a lesser temperature increase was observed?
   * Was it neutral, where no difference in temperature increase was observed?
   * Was there another result, where some other temperature change was observed?
3. Remember to save your work as you go.

**Step 9: Evaluate your final report using this checklist.**

If you can check each criterion below, you are ready to submit your report.

* Does your report include the design considerations you made before and after the trials?
* Does your report include the explanation that dissolving calcium chloride produces an exothermic result?
* Does your report include temperature data before and after activating the device?
* Does your report include an analysis of the temperature data and how it relates to the release of energy to the environment?
* Does your report include what variable was changed as part of the redesign?
* Does your report include an analysis of the effectiveness of the changed variable in the redesigned device?
* Does your report include considerations of other factors that may be possible explanations for temperature variations during the process?
* If other information sources were used, does your report include a “works cited” section, which includes citations for all the sources you used?

**Step 10: After viewing the checklist, revise (if needed) and submit your report.**

1. If you were unable to check off all the requirements on the checklist, edit and revise your report and save it before submitting.
2. When you have completed your report, return to the virtual classroom and use the “Browse for file” option to locate and submit your assignment. Congratulations! You have submitted your report on constructing a device to regulate the release of energy!