

## HOW LONG WOULD YOU HAVE TO YELL TO HEAT YOUR CUP OF COFFEE?

Thermal energy question appropriate for a high school chemistry or physics class

### DESCRIPTION OF STUDENT ACTIVITY

- Students will randomly be assigned to groups of three or four and will be asked the following prompt: "How long (in years, minutes, and/or seconds - instructor specifies) would you have to yell in order to heat a cup of coffee?"
- Students will be able to select their coffee beverage and cup size with the other students in their group.

### MATERIALS REQUIRED

- Students may complete this assignment in a computer lab and/or using their cell phones, laptops, or tablets. Students may use their resources to access information such as the size of their chosen drink.
- Calculator
- Individual white boards (optional). See ["My Favorite Place to Get School Supplies is...The Hardware Store"](#) for more information.

### GUIDELINES FOR ADMINISTRATION

- Group or individual help allowed: This assignment will be completed in the groups assigned by the instructor. Students from different groups may not assist one another.
- Important information:
  1. The average human yells at about 80 decibels, which carries along with it approximately .001 watts of energy (from Physics Central)
  2. We will assume that the coffee is starting out at room temperature, 25 degrees C, and we want to raise the temperature to 75 degrees C.

### TEACHER'S GUIDE

Start out using the thermal energy equation:  $Q = mc(t_f - t_i)$

where m is the mass in kg: 1 L water = 1 kg (this number will vary depending on the size of drink that the group selects)

c is the specific heat of water: 4200

the change of temperature should be 50 degrees C for all groups (75-25)

At this point, we have found the thermal energy required to heat up the cup of coffee. To find the amount of time it will take, we use the equation  $Q = \text{Power} \times \text{time}$ .

This is where we plug in the 0.001 watts for power which you provided to the students in the prompt.

### ADDITIONAL QUESTION

Visit [www.yourclassroomhelper.com](http://www.yourclassroomhelper.com) for more free resources

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You can continue with the investigation by asking your students to figure out how long it would take to heat the same cup of coffee by whispering.

The average person whispers at about 40 decibels, which translates out to about  $10^{-8}$  watts.

### TIME REQUIREMENTS

Varies drastically depending on your students' confidence with these types of problems. The main question takes students approximately 10 - 25 minutes. The additional question takes around 5 minutes. I have had students spend up to 45 minutes actively working on these problems, but you shouldn't count on it taking an entire class period.

### SOURCES

Question is adapted from [Physics Central](#). Visit their site for a free poster to download. I like to display them on my door and on the walls of my classroom to get students excited about the activity.

Their site also includes a sample calculation which may be helpful to look over before leading the activity.