Activity Design

WORKSHOP

John Goodwin

Abstract:	Process-oriented activities can be written to emphasize different skills in learning. One type of activity in chemistry is focused on development of problem solving skills and has been supported by the National Science Foundation as the Process Oriented Guided Inquiry Learning In Context or POGIL-IC pedagogy. Examination of a POGIL-IC activity, discussion of its implementation and an exercise in writing an activity will be the focus of this presentation.

Learning Outcome:	1. Identifying features of a POGIL-IC activity.
	2. Considerations in implementation of a POGIL-IC activity.
	3. Writing a POGIL-IC activity.
Facilitation Plan:	1. Overview of POGIL-IC activities and their implementation.
	2. Group assessment of a model activity.
	3. Group writing activity.
Resources:	Available on the following pages:
	• POGIL-IC Activity (Activity 1 Cheap Gas: Is It Worth the Drive?, from Solving Real Problems with Chemistry)
	• Group Assessment Form

ACTIVITY 1

CHEAP GAS:
IS IT WORTH THE DRIVE?

College students need to be frugal because they usually have lots of expenses and little income. It is expensive to have a car, so saving a few cents, or even more, on each gallon of gasoline purchased can make a real difference in a budget.

Gas prices are not the same in all parts of a community. Some stations are always the price leaders, trading off cost for volume, and the cheapest gas is usually not near an expressway or affluent neighborhood. You can find gas prices in your area at

www.gasbuddy.com

When is it worthwhile to make a special trip across town to buy gas at that one station that is cheaper than all the rest?

This activity will help you learn what must be done to answer that question. In the process, you also will begin to learn how to analyze quantitative (numerical) problems that have several parts. In addition, you will practice using units, unit analysis, and unit conversion. All of these things are extremely important in solving problems that you will encounter later involving atoms, molecules, and chemical reactions.

✔ PREREQUISITE KNOWLEDGE

Before beginning this activity, you should be able to

- Identify the units associated with quantities like length or distance, time, and volume

- Convert from one unit to another (e.g., kilometers to miles, minutes to hours, and liters to gallons)

- Use unit or dimensional analysis (e.g., miles per gallon) to obtain the units associated with a numerical answer or to show that the arithmetic used is correct

◎ APPLYING YOUR NEW SKILLS

Upon completing this activity, you should be able to

- Analyze gas prices at different stations and identify when it is reasonable to drive some distance to purchase gas

- Analyze information about two products and decide which one is the better buy

THE PROBLEM

The gas station with the cheapest gas in your area has been found. The relevant information about this station is given below. If you drive to the station with the cheapest gas, will you end up saving or losing money when you consider all the factors listed below? Support your answer with calculations.

To answer this question, you need to compare **all** the costs of using the station next door with **all** the costs of driving to the station with the cheapest gas. If you need additional information, look it up or make assumptions, as appropriate.

INFORMATION

- Driving distance to the cheap gas station is 5.4 mi.

- Gas costs $3.51/gal next door, but $0.90/liter at the cheap station, which is located in Metric Village

- You could earn $7.50/hour at your job instead of driving to get gas

- It takes 3.5 minutes to fill your tank with gas

- Your car can travel 27.6 miles on one gallon of gasoline

- You have just enough gas to drive to the cheap station, and your tank can presently hold an additional 15.6 gallons

- You have to make a round trip

- Assume your average driving speed to and from the gas station is 45 mph. Average speed is equal to total distance traveled divided by the time it took to travel that distance.

SOLVE THE PROBLEM AND DOCUMENT YOUR SOLUTION

Name: _____

Other Team Members: _____

Date: _____   Activity Title: _____

Level of Help used to solve this problem by the team: *none* ☐   *Au* ☐   *Ag* ☐   *Cu* ☐

Work with your team to solve the problem. Your instructor can provide three levels of help called gold, silver, and copper. *Au Help* presents a strategy that resembles the way experts think when they solve problems. The use of this strategy is illustrated and prompted to different degrees in *Ag Help* and *Cu Help*. As the semester progresses, you should move through these stages of *Help* to grow your problem solving skills. Your instructor will tell you what you need to do to document your solution. One method would be to provide the information requested in *Au Help*.

? DOES YOUR ANSWER MAKE SENSE?

1. Which two factors are most important in determining where to purchase the gas? Explain.

2. Is the amount of money saved or lost reasonable? Explain why you think so.

3. Do the units in your answer make sense? Show that they follow from your calculations.

BUILDING YOUR PROBLEM-SOLVING SKILLS

You will be able to complete the *Got It!* section, which comes next, more efficiently, and you will do better on exams if you take a few minutes now to improve your problem-solving skills. Communicating the steps in your problem solution to others and thinking back on the problem that you just completed will help you to improve.

1. Share your team's problem solution with your class as called upon by the instructor.

2. Identify the most important thing you learned today about either the problem-solving process or a problem-solving skill that will help you solve new problems.

3. Consider whether you could solve this problem using a more efficient procedure so you can answer a similar exam question more quickly. If you find one, describe this more efficient procedure.

4. Identify whether there are any issues or assumptions contained in the problem and its solution that would limit using the same procedure for other problems.

5. Identify features of this problem and its solution that could apply to other problems.

1. What would the price of gas have to be in Metric Village for you to save $1.00 when you fill up with gas?

2. A small keg of imported beer costs $19.95 and contains 5.0 L. A case of the same beer costs $31.99 and contains twenty-four 12 oz bottles. Which is the better buy? Explain why. (These are actual prices obtained from a local beverage store.)

Activity 1 — *Cheap Gas: Is It Worth the Drive?*

VCOAST Problem-Solving Method

Au
HELP

Visualize the problem

- Restate the problem in your own words
- Draw a picture or diagram or construct a table
- Include molecular structures and reaction equations
- Add physical properties

Collect information from the written problem

Organize the information

- Identify what is given and what needs to be found
- Identify the relationships provided

Analyze

- Identify the concepts or ideas that are needed
- Identify the procedures and equations that are relevant
- Add the necessary conversion factors
- Think about how the concepts, procedures, and equations connect what is given to what you need to find
- Consider whether you need any additional information
- Check whether you have made or need to make assumptions or approximations

Solve it

- Separate the problem into sub-problems if possible
- Apply the analysis to the information

Think about it

- Check your math!
- Check that the units come out right!
- Make sure the value makes physical sense!
- Examine how you can use your strategy more effectively in the future, what worked, and what didn't
- Generalize the nature of the problem and how such problems can be solved

Ag
HELP

Visualize the problem:

This problem is a cost analysis of buying gas at a local station compared to one across town. Considering all the factors, determine which option is cheaper overall.

Collect information from the written problem:

Create a table to collect and organize the information given in the problem. Some information will be used to convert other physical factors into money saved or lost. Identify these as conversion factors.

Organize the information and include units:

Item	Local Station	Cheap Station
Driving distance to station		
Driving distance back		
Gas used in driving one way (27.6 mi/gal)		
Driving time (45 mph)		
Cost of gas		
Gas needed to fill tank		
Time spent driving ($7.50 / hr)		
Time filling the tank (3.5 min)		

Analyze:

1. What factors in the above table determine the cost of filling up at the station next door?

2. What factors in the above table determine the cost of filling up at the station in Metric Village?

3. Was any unnecessary information given to you in the statement of the problem? If so, what was it?

Activity 1 — *Cheap Gas: Is It Worth the Drive?*

Solve: Apply the analysis to the information

    4. For each of the factors that you identified in Question 1, calculate the cost in dollars.

    5. For each of the factors that you identified in Question 2, calculate the cost in dollars.

    6. Determine how much money was saved or lost by driving to Metric Village to buy gas.

Think about it:

    Check your math! Check that the units come out right! Does the value make physical sense?

Cu

HELP
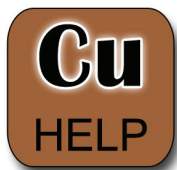
Visualize the problem:

This problem is a cost analysis of buying gas at a local station compared to one across town. There may be a cost savings in buying less expensive gas, but there are also losses from using gas to travel across town, spending the time which is worth something, and so forth. Considering all the factors, determine which option is cheaper overall.

Collect information from the written problem:

Create a table to collect and organize the information given in the problem. Some information will be used to convert other physical factors into money saved or lost. Identify these as conversion factors.

Organize the information and include units:

Item	Local Station	Cheap Station
Driving distance to station		
Driving distance back		
Gas used in driving one way (27.6 mi/gal)		
Driving time (45 mph)		
Cost of gas		
Gas needed to fill tank		
Time spent driving ($7.50 / hr)		
Time filling the tank (3.5 min)		

Analyze:

From the information in the first table, complete the table below that coverts each step of the process of filling up with gasoline into a cost. You will need to use the following equality statement: 3.785 L = 1 gal.

Item	Local Station Cost	Cheap Station Cost
Gas used in driving one way		
Cost to fill up at each station		
Cost of gas driving back		
Cost of driving time		
Total cost at each station		

Activity 1 — *Cheap Gas: Is It Worth the Drive?*

Solve: Apply the analysis to the information

So what was saved or lost by driving to Metric Village to buy gas?

Think about it:

Check your math! Check that the units come out right! Does the value make physical sense?

Recorder's Report Sheet: Analyzing a POGIL-IC Activity

1. What is the core problem of the activity?

2. What components of the activity prepare the student to engage with the core problem?

3. How is the student guided through the VCOAST problem-solving methodology?

4. Why are different levels of help useful?

5. What components are used after the VCOAST problem-solving methodology?

6. How are these post-problem solving components helpful?