You and a friend buy a straight-sided glass of soda that is filled to the top. You each pay half, so you want to share the drink 50-50. However, you have no measuring utensils (for either volume or height); nor do you have any container to transfer the drink to. How can you ensure that you each get your fair share?

This booklet is designed to introduce you to the concept of problem solving in a classroom setting.

Problem solving involves situations where no one clear answer is present. The same query posed to 10 different people could result in 10 very different, yet equally viable, solutions. The importance of problem solving is not necessarily reaching the final answer. The process of problem solving is as important as, if not more than, the final solution. Problem solving is important because it gives students an opportunity to delve deep into a situation and look at it from many different angles.

Not all the problems presented in this booklet are subject specific. Some of the examples presented have nothing to do with the topics you are teaching. But the strategies for solving them are the same. They can be used as warm-up activities for you or your students.

This booklet is designed to be self-explanatory and stand-alone. However, as educators, we don’t exist in a vacuum. It is highly recommended that you discuss your answers and ideas with your colleagues. There are no right or wrong answers. But by sharing your responses with others they will gain insight from you and you will gain insight from them.
These are the icons that you will see throughout this booklet to highlight some important features:

These are some of the more important aspects that you want to focus on.

Reflect on the examples given and add some of your own thoughts or ideas.

This will indicate that a guided example is given.

Here is the opportunity for you to try an example on your own.

This refers to review and practice questions.

Why Problem Solving?

Problem solving is an important skill for students in a vocational environment. Although you teach your students the proper ways to use equipment and to address specific problems, the environment in which the students are applying this knowledge can sometimes be very contrived. After a lesson on carburetors students are pretty safe to assume that the problem with the example engine is due to the carburetor or fuel supply rather than the ignition, electrical circuit or air supply. However, when students go into the ‘real-world’ to apply this knowledge, their application will be very different from that experienced in the lab setting.

Does this mean that you are not teaching your students enough? No. It’s impossible to think that you can go through every possible scenario with them. You teach them the skills they need to perfect their craft. Yet, they also need to be taught to make decisions about when and how to apply these skills. They need to understand that not every situation is a perfect textbook example.
That is why problem solving is an important skill to present to your students. You need to give them the skills to address a problem. And through guided and unguided practice, give them the opportunity to try out their new skills. They need to be able to recognize a situation that is different, determine possible solutions, move forward and evaluate their decision.

**Advantages**

Problem solving is an important instructional device because:

- It reinforces and synthesizes prior knowledge.
- It forces students to take responsibility for their own learning and progress.
- It gives students the opportunity to gain control of their environment.
- It gives students a better understanding of what their career and future will entail.
- Students learn to cooperate with other learners and the teacher.

**Disadvantages**

Problem solving activities also have some disadvantages:

- They can be time consuming to plan.
- It can be frustrating for students, and in turn, instructors.
- Instructors need to be creative when trying to determine problem-solving activities.
How to Problem Solve:

One approach to problem solving is the IDEAL model (Bransford & Steen, 1984), which incorporates the following 5 steps:

**Identify the problem.** At this stage students will use their observational skills to identify that a problem does exist. They need to ensure that they understand the problem and that they have stated it clearly.

**Define the terms.** Students should define the problem and assess the needs. They need to be sure that they understand all words used in the identified problem. They also should look at breaking the problem into the smaller problems.

**Explore strategies.** Students can use a variety of cognitive strategies to determine ways to approach and solve the problem. Some of these can include: brainstorming, making a table, drawing a diagram, using manipulatives, working backwards, or looking for a pattern.

**Act on the strategy.** After they looked at different potential approaches they need to make a decision as to the best course of action and follow it through.

**Look at the effects.** After attempting (either in part or to completion) their chosen strategy, the students need to reflect on their choice and its outcome. They should determine if the solved the problem and if they chose the best course of action. They should also be able to offer alternative solutions if they think there was a better way and explain possible reasons why their choice didn’t work.
How to Problem Solve: Example

Here’s a problem that many of your students have probably faced during a lesson.

**Identify the Problem:** My instructor has just finished explaining how to use a piece of equipment. I was paying attention, but I’m unsure about one part of a procedure. What do I do?

**Define the Problem:**
- By not knowing what to do I could make a mistake and end up damaging the machine.
- By telling the instructor that I don’t understand I could end up looking like I’m either slow or not paying attention.

**Explore Strategies:**
- I could just try to use the equipment and hope that everything works out okay. But if it doesn’t, what would I do then?
- I could ask another student for help. This would save me from looking bad in front of the instructor. But it might cause me to lose face in front of my classmate. Plus, how do I know that they know what they’re doing? Maybe they’ll give me wrong information.
- I could simply tell my instructor that I need help. That’s his/her job. I’m sure I’m not the first person to have difficulty understanding the equipment. And I bet that s/he’d rather repeat the explanation than have to fix the equipment.

**Apply a Solution:** I’ll ask my instructor. I know most of the steps; it’s just one part that I’m having trouble with.
**Look at the Effects:**
If I’m able to operate the equipment safely, then I’ll know that I solved the problem. If I don’t get an adverse reaction from the instructor, then I’ll know that I chose the right course of action.

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**How to Problem Solve: Practice**

Here’s a problem that many of you may have faced during your career. Your students may experience this when they enter the workforce. See if you can work through this problem-solving example.

**Identify the Problem:**
You are on a freelance job. You think that things are going along well, everything is pretty much on schedule and there hasn’t been any major delays or mishaps. Yet the owner of the residence/business is continually complaining about the quality of work, the noise, the timing, the mess ... just about anything you could think of.

**Define the Problem:**
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**Explore Strategies:**
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Offering Assistance During Problem-Solving Activities:

This experience, especially the first few times, can be a frustrating experience for students and their instructor. You will be tempted to assist your students too much; you only want to help. But you have to be careful about making a distinction between helping a student problem solve and helping a student solve the problem. You want your student to come up with a possible solution on their own; you don’t want to give them the answer.

This can be an awkward situation. When students experience difficulty you don’t want to do the problem for them or give them the answer. Yet at the same time you don’t want them to go down the wrong track.

Here are some suggestions to give to students when they are trying to work through problem solving questions:

- Reread the question and ensure you understand what is being asked.
- Ensure that you are using all the information given, both explicit and implicit.
• Review a class example of problem solving.
• Review previous notes related to this topic.
• Change only one variable; keep all other variables constant.
• Maybe you think your solution is wrong too quickly. Keep going for another step or two.
• Break the problem into pieces and try to solve only a part of the problem.
• Try going in the wrong direction for a few steps. Maybe it will be the right way to proceed or maybe it will give an indication as to why other trials haven’t worked.
• Solve an analogous problem and then look at the parallel to the problem you’re working on.

### Offering Assistance During Problem-Solving Activities: Example and Practice

Here are some problem-solving scenarios. What are some possible suggestions that you could give to students as they are working through the problem? Remember: You don’t want to give them the answers. You only want to offer them assistance in solving the problem.

The student needs to prepare a meal for 30 people. The main dish is going to have a tomato and meat sauce. The supplier made a mistake and only delivered enough meat for 20 people. The student needs to determine the course of action to take.

• “What are your priorities?”
• “Are there any dishes you could make in its place?”
• “Review notes regarding filler” and “How would you want this filler to act?”
• “What food would be tasteless, add bulk and have the same consistency as ground meat?”

*By the way, for those of you not in the culinary trade, oatmeal would work really well in this situation.*
A student has just started to use a machine (piece of equipment), but it doesn’t appear to be working. As the student sits and stares at it you offer advice. What are 3 things that you can suggest to get the student exploring strategies?

The figure below represents a ring. Using only three straight cuts, determine the greatest number of pieces you can make. You are not allowed to rearrange the pieces between cuts.

What can you suggest to students to nudge them in the right direction?

**Hints and Reminders:**

When working through problem solving activities with your students you will find that many jump directly to trying to evaluate strategies. They don’t take the time to fully define the problem. The error with this is that they end up solving the wrong problem. All of their work has gone into a great solution for a problem that doesn’t really exist.
Students will need to be constantly reminded that:

- Although it may seem like more work, doing all 5 steps will make the problem easier and the solution more meaningful.
- For any one problem there may be an infinite amount of solutions.
- No solution is perfect.
- Don’t choose the first, most obvious solution to a problem. Delve into the problem and determine several possible solutions before acting.

And remember, all problem-solving activities are valuable. Students learn just as much, sometimes more, by not being able to solve the problem posed to them. Learning to deal with frustration, asking for help, and knowing when to give up are also important factors that we want our students to learn.

Review and Reflection:

1. What are the 5 steps of the problem solving method?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
2. Name 3 advantages and 2 disadvantages of using problem solving in lessons

Advantages:

Disadvantages:

3. Which of the following activities could be used in a problem-solving scenario?

a) Determining why a motor won’t start.
b) Rounding a table edge with a router.
c) Finishing a project when your main piece of equipment breaks down.
d) Changing a tire.
e) Changing a tire with lug-locks without the key.

4. State 4 things that you could do to assist students when they are experiencing difficulty problem solving.
5. Use the 5 steps of the problem solving method to work through the following scenario:

You are in the middle of a project. You go over your budget and at this point you are closer to the limit than you thought you would be. There weren't any delays or unexpected costs that you know of. How do you proceed?
6. Use the 5-step process to solve the following quandary. The “Define” step is very important here.

Two mother and two daughters went out for dessert. They bought a rectangular piece of cake and divided it into equal parts by cutting 5 straight lines. They each have equal shares of the cake. How did they do it? (Hint below)
7. What are some problem-solving activities that you could include in your class/subject?

Answers to selected problems:

Introductory problem: Drink until the soda runs from the lip of the glass to the top of the opposite bottom rim. There will be exactly half left.

Offering Assistance during Problem Solving Activities: You can make 9 pieces.

Review and Reflection:
3. a), c) and e). Notice how we were able to make d) into a problem solving situation by changing part of the environment.
5. There were only 3 people. A grandmother, a mother and a daughter. They cut the cake into 6 pieces and each had 2 pieces.