1.3: Problem Solving

Problem Solving

Educators and employers alike have all argued strongly in recent years that the ability to solve problems is one of the most important skills that should be taught to and nurtured in university students. Medical, professional, and graduate schools alike look for students with demonstrated ability to solve problems; the MCAT has even recently changed its format to more specifically assess student's ability to solve problems. Life is full of problems to solve, irrespective of the profession one chooses. **Effective problem-solving skills are important!**

Despite a clear demand for this skill set, it is surprisingly rare to find problem solving taught explicitly in formal educational settings, particularly in core science courses where the transmission and memorization of “facts” usually take precedence.

In BIS2A, we want to start changing this. After all, nobody really cares if you’ve memorized the name or catalytic rate of the third enzyme in the citric acid cycle (not even standardized tests), but a lot of people care if you can use information about that enzyme and the context it functions in to help develop a new drug, design a metabolic pathway for making a new fuel, or help understand its importance in the evolution of biological energy transformations.

Your instructors believe that the ability to solve problems is a skill like any other. It is NOT an innate (i.e. you’ve either got it or you don’t) aptitude. Problem solving can be broken down into a set of skills that can be taught and practiced to mastery. So, even if you do not consider yourself a good problem solver today, there is no reason why you can’t become a better problem solver with some guidance and practice. If you think that you are already a good problem solver, you can still get better.

Cognitive scientists have thought about problem solving a lot. Some of this thinking has focused on trying to classify problems into different types. While problems come in many different flavors (and we’ll see some different types
throughout the course), most problems can be classified along a continuum of how well-structured they are.

At one end of the continuum are well-structured problems. These are the types of problems that you usually encounter in school. They usually have most of the information required to solve the problem, ask you to apply some known rules or formulas, and have a pre-prescribed answer. On the other end of the continuum are ill-structured problems. These are the types of problems you will usually face in real life or at work. Ill-structured problems are often poorly defined and usually do not include all of the information required to solve them. There may be multiple ways of solving them, and even multiple possible "correct" outcomes/answers.

Note: Possible Discussion

Well-structured problems (like the story problems you might often encounter in text books) are often set in an artificial context, while the ill-structured problems one faces in day-to-day life are often set in a very specific context (your life). Is it possible for multiple people to observe the same situation and perceive different problems associated with it? How does context and perception influence how one might identify a problem, its solution, or its importance?

To have a fruitful/enriching discussion it pays to start by presenting an example AND some direct reasoning. Replies that acknowledge the initial comment and either provide an extension of the original argument (by way of a new perspective or example) or provide a reasoned counter-argument the are most valuable follow-ups.

Problems can also be “simple” or “complex,” depending on how many different variables need to be considered to find a solution. They can also be considered as “dynamic” if they change over time. Other problem classification schemes include story problems, rule-based problems, decision-making problems, troubleshooting problems, policy problems, design problems, and dilemmas. As you can see, problem solving is a complicated topic, and a proper, in-depth discussion about it could take up multiple courses.

While the topic of problem solving is fascinating, in BIS2A we aren’t interested in teaching the theories of problem solving per se. However, we ARE interested in teaching students skills that are applicable to solving most types of problems, giving students an opportunity to practice these skills, and assessing whether or not they are improving their problem-solving abilities.

Note: Since we are asking you to think explicitly about problem solving, it is fair to expect that your ability to do so will be evaluated on exams. Do not be surprised by this.

We are going to incorporate problem solving into the class in a number of different ways:

1. We will be explicitly teaching elements of problem solving in class.
2. We will have some questions on the study guides that encourage problem solving.
3. We will make frequent use of the pedagogical tool we call the “Design Challenge” to help structure our discussion of the topics we cover in class.

When we are using the Design Challenge in class, we are working on problem solving. Within the context of the Design Challenge, your instructor may also present other specific concepts related to problem solving – like decision-making. Slides will be marked explicitly to engage you to think about problem solving. Your instructor will also remind you verbally on a regular basis.