

Activity 1.1.3 The Problem-Solving Process

Purpose

Research and development stem from the need to solve problems and find solutions. Scientists and engineers use a systematic process to solve problems in a manner that others can replicate and reproduce. While the steps may be identified in slightly different terms across various applications, the overall process of problem-solving remains the same. For this course, the problem-solving process will include defining the problem, proposing a solution, developing a protocol, collecting and analyzing data, and communicating results.

Prior to beginning any type of research, the problem needs to be defined clearly. Defining the problem starts with observing conditions or wondering why something happens or does not happen. Asking questions is an important part of defining the problem. Before you solve the problem, write a brief statement outlining the problem that explains why it interests you. Often while defining a problem, background research and literature reviews are needed to determine what work has been done in the area of the problem and what studies may help solve the problem. It may be necessary to narrow the focus or break a topic into components to allow for practical and solvable research.

After defining a problem, a researcher must propose a solution. This also may be called forming a hypothesis. During this step, research options are considered. Considerations include the following questions.

- What are possible causes for the problem observed?
- Could the causes reliably and consistently predict or determine the same outcome?
- What causes are the least likely to affect the outcome?

State the proposed solution in a manner that explains the cause and effect of the problem and the factors tested or modeled in the solution.

Developing a protocol is the third step in problem-solving. To develop a protocol, consider what is required to test your solution, the type or types of data that need to be collected, the equipment and materials required to perform the tests, and step-by-step procedures of what will be done. If you are testing a variable, define both the variable and the control.

Upon completion of the protocol, it is time to collect and analyze data by running a series of experiments or building a prototype. Test how the experiment or model fits your solution. Scientific experiments need to be tested multiple times to ensure valid results. Models or prototypes may need to be adjusted several times to meet the criteria of the solution. Repeat the test as often as necessary to verify your results. Observe differences or errors in the experiment as they relate to the proposed solution. Be sure to make and record accurate measurements. Carefully documenting every step, material, and result is important in validating the research and applying for patents in the future. After collecting the data, analyze your results by considering the following questions.

- Do the outcomes support the prediction?
- Do the outcomes solve the original problem?
- If not, how could the protocol be adjusted?
- What errors may have occurred?

When you have completed your research and analyzed the data, communicate the results to your peer group or others with interest in your research area. Draw conclusions based on your data. Note difficulties and problems, items for further research, or what could be done differently. If you did not prove your

hypothesis, you have succeeded in eliminating options and narrowing the focus for further research. Your results may be shared in reports, science fairs, journals, and other publications.

How have you used the problem-solving process in the past? Can you identify how others have used problem-solving in their research?

Materials

Per pair of students:

- Computer with Internet access
- Records from previous course

Per student:

- *Agriscience Notebook*
- *Laboratory Notebook*
- Pencil

Procedure

In this activity, you will review the steps used in the research and development processes. First you will read a narrative and identify the steps in the process. Next you will review your major project from the previous course and identify the problem-solving steps used to complete it.

Part One – Problem Solvers

Your teacher will provide you with a brief biography of a World Food Prize laureate. Laureates of the World Food Prize are recognized for their contribution to improving the quality, quantity, or availability of food in the world. Read the biography and identify how the laureate used the problem-solving process within their studies. Record each step of the problem-solving process and the correlating evidence from the biography in your *Laboratory Notebook*. If the biography does not provide adequate information, you may need to conduct further research about the person or persons.

Problem: Rinderpest or cattle plaque

Proposing a solution: Develop a vaccine with fewer side effects to animals

Developing Protocol: Produce a live virus to use as vaccine

Collect/Analyze Data: Vaccine worked and had no side effects

Communicate Results: Developed large scale production techniques and optimal conditions for application.

Part Two – Your Studies

In the previous course, you completed a major project. Review your processes and results. Identify how you used the problem-solving process during the project. Record each step and the correlating item from your project in your *Laboratory Notebook*.

We used the problem solving processes by breaking down the problem as a whole and figuring out the best way to tackle the solution we felt would fix the problem. Our data collection help us better the possible solution so the problem could be tackled in the best possible way.

Conclusion

1. Why is a systematic approach to problem-solving important?

This approach is important so that you can break down the big picture and tackle your solution step by step while analyzing error along the process in smaller segments.

2. What challenges might you face when problem-solving?

Human error, different outcome than expected, error in protocol

3. In the biography you read, how did the researcher define the problem and propose a solution?

He saw an disease effecting herd populations that had a vaccine with major side effects and decided to develop a vaccine with fewer side effects to keep herd populations healthy.