Ten Minutes on the Spot

Facilitating the success of project teams from day one through final presentation.

Welcome!

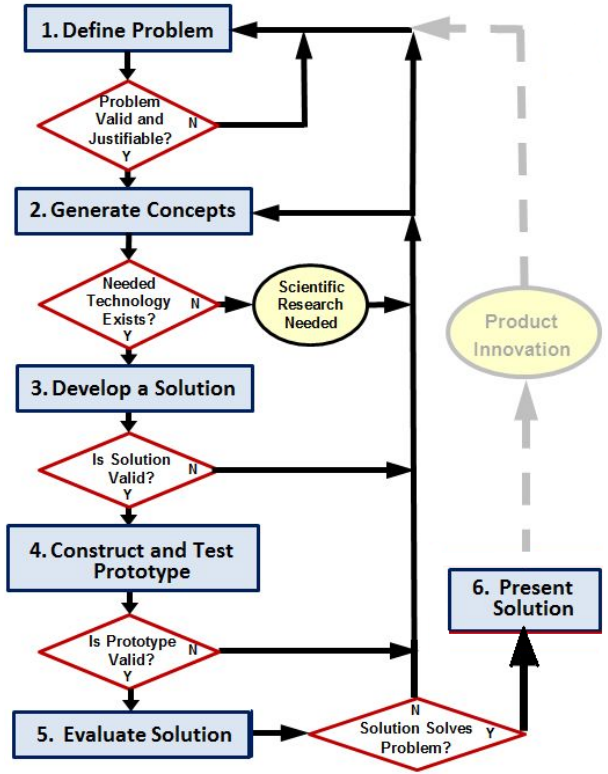
How does one let students grapple with learning to manage and undertake a long term project without coming up short when they finally come face to face with the judges?

During this presentation, I will share my experiences, successes, and failures in facilitating teams of senior capstone engineering students in a comprehensive high school setting. The takeaways can be applied to any project team.

My Priorities Along the Way

In this order…

1. A full year of rigorous project based learning
2. Students who are at least as happy about STEM on the way out of my class as they were on the way in
3. Facilitate multiple year-long projects to successful completion



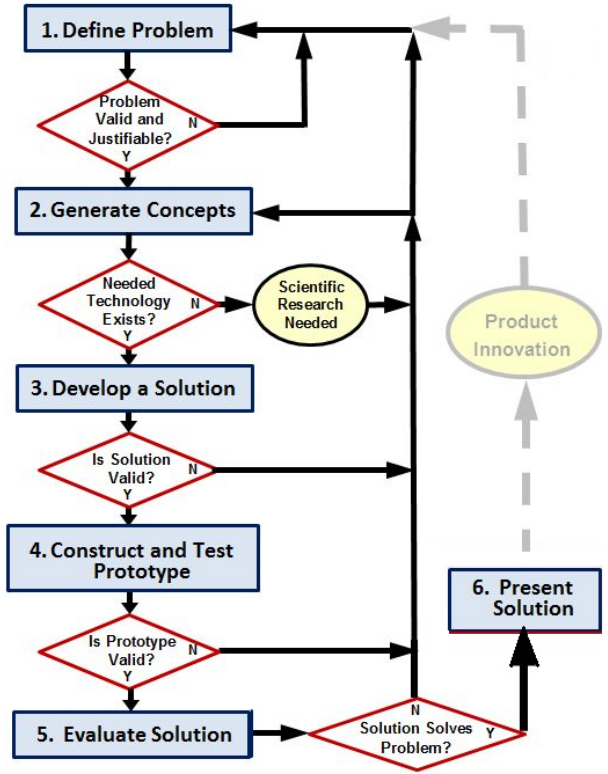
Framing learning around a design process

The steps are all important, but...

Developing a solution is my overall focus

Problem, concepts, and validation must be of sufficient quality to lead to a solution

Construction and testing of prototype must be true to the solution

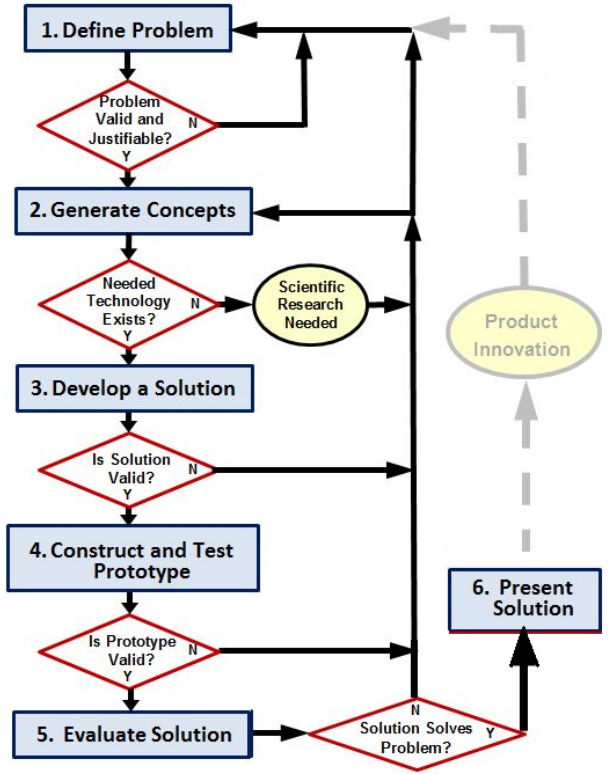


And Scheduling that Process...

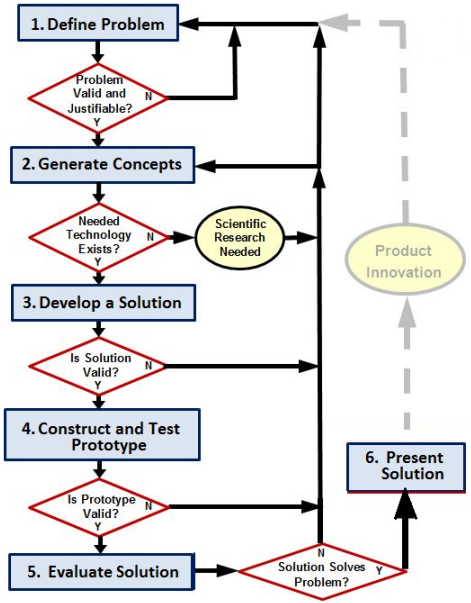
Keep “Developing a Solution” fixed in time, roughly November first to winter break

Spread final presentation work throughout the year

Take what you can get from seniors in term 4 (which may not be much)



Defining the Problem

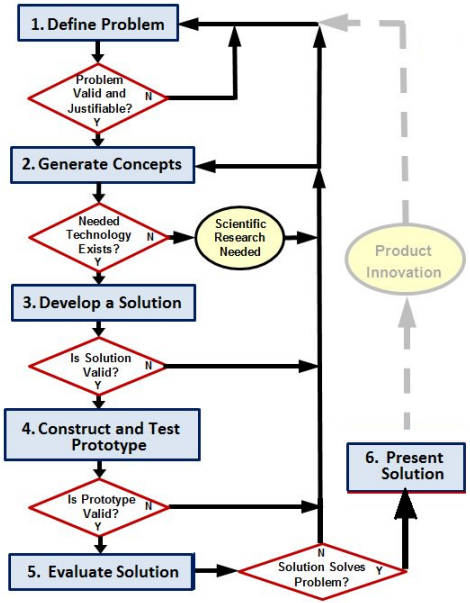


With Seniors, I start the process in the summer if possible

My goal is to enable students to solve a problem that they truly have interest in

During several weeks of team forming and mini-projects, we expand the “I hate it when” list

Defining the Problem - A little team building

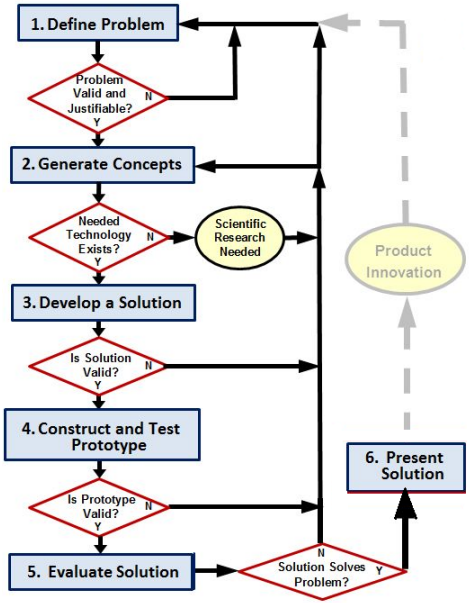


This is a fun step, but can get long

Team building activities are a good break

Evaluate skills and interpersonal dynamics

Defining the Problem - Some EDD problems...



Some problems from my EDD classes that made the cut

Athletic field logos are expensive to apply

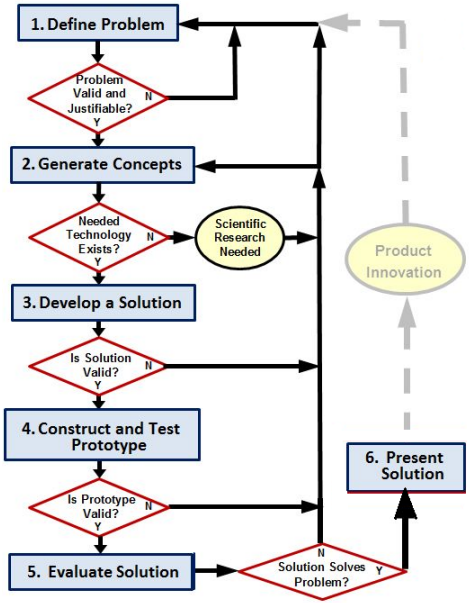
Aquariums need care during owner absence

Basketball line violations are frequently called incorrectly

Disability of one arm can make guitar playing impossible

Filling station tanks suffer water contamination

Defining the Problem - Justifiable? Achievable?



This can be tricky

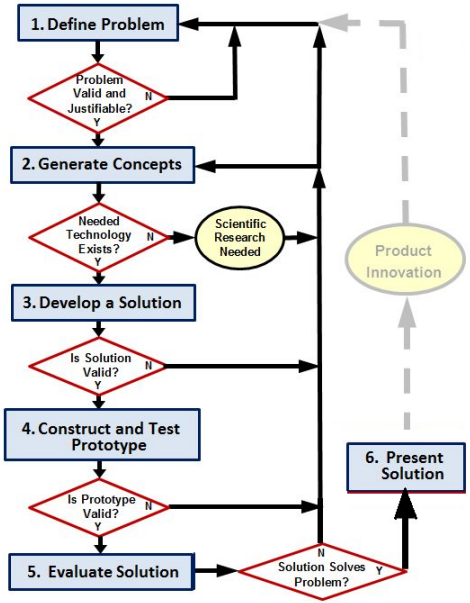
I try to lead students into culling ideas independently

If need be, I will let them follow bad leads

If timing dictates, I will veto an idea

This is my last resort… I try to let them drive the process (or think that they are)

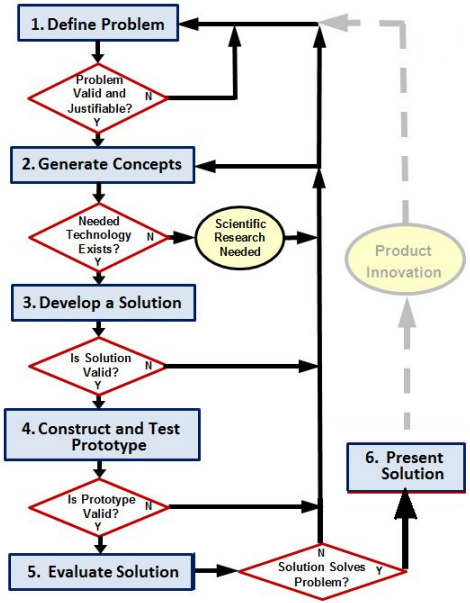
Defining the Problem - Successes



Amazing levels of enthusiasm and participation

Opportunity to repeatedly discuss the EDP

Defining the Problem - Difficulties

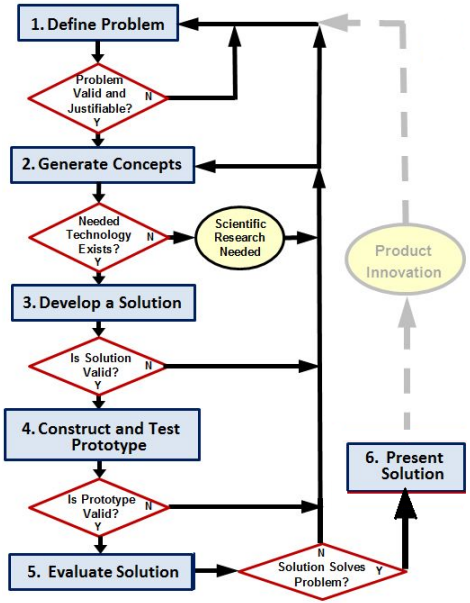


Team disagreements - choosing from a narrowed down list can lead to true anger for students who lose out

Wild diversity in likely solutions

Getting students to remove questionable problems themselves

Research and Justification



Most successful when I start by late September

Middle of the first third of the project

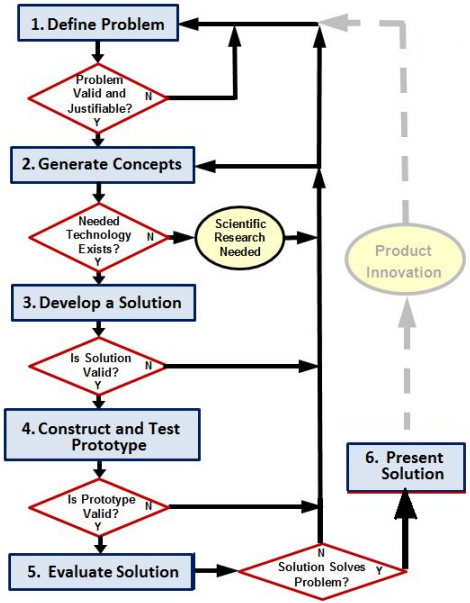
Can blend with the end of problem definition

Students spend substantial time on re-work…

Invalid sources, unjustifiable problems

Multiple problems are researched

Research and Justification - Difficulties

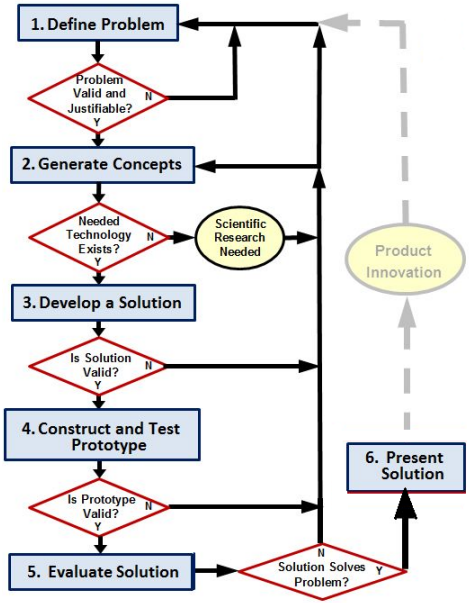


Real justification can be very difficult

How do you keep the bar high without burning kids out?

You may need to teach more basic research skills than you thought!

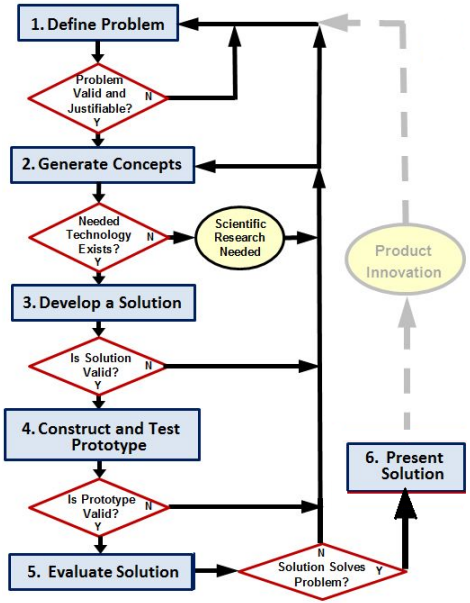
Research and Justification - Successes



Great opportunity for cross curricular work

- Objective, technical writing
- Critical research
- Done well, the foundation for the year is complete

Generate Concepts - Brainstorming!



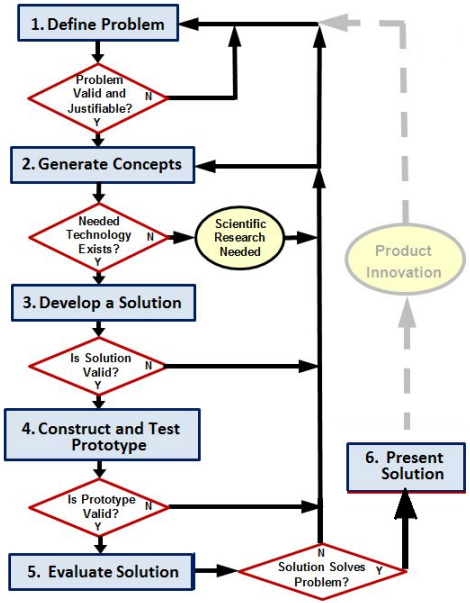
One of the most enjoyable segments

Ideally wraps up by the end of term one

So fun that I use some time for less fun things…

- Formatting work to date for final presentation
- Beginning the project website

Generate Concepts - Successes

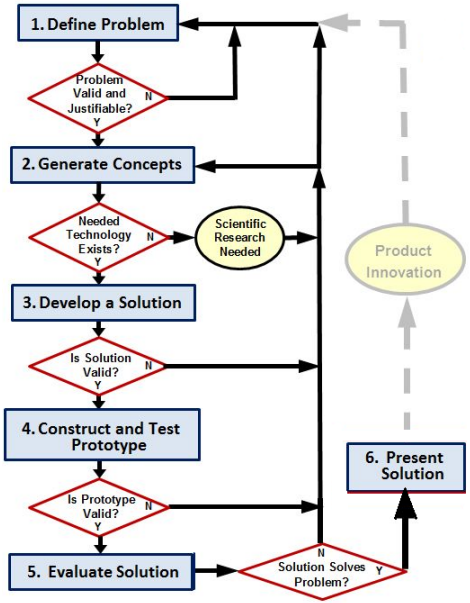


Great opportunity for students to contribute to other projects

Take a break from your own project

Opportunity for other students to verify problem validity

Generate Concepts - Difficulties



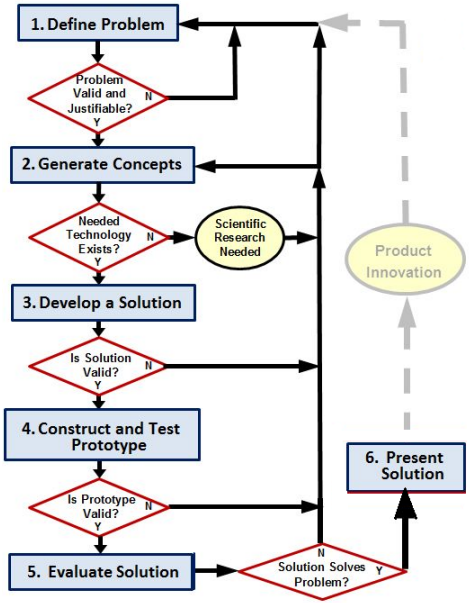
Some students don’t deal well with the lack of structure

Many ideas stray from the actual problem

Quite outside the academic norm

Some students need substantial encouragement

Developing a Solution



This is where things come together for me

I try to devote all of term two

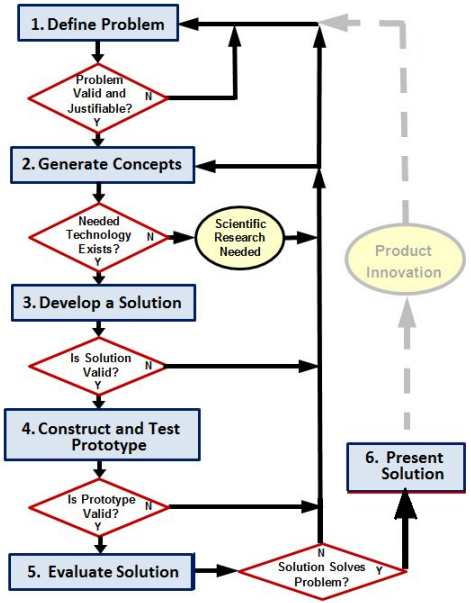
Fully ⅓ of the project timeline

Still creative while developing final options

Stem principles are applied - for real!

Critical to the success of the build/test/evaluate steps

Developing a Solution - Applied Science!



Some actual questions from previous projects...

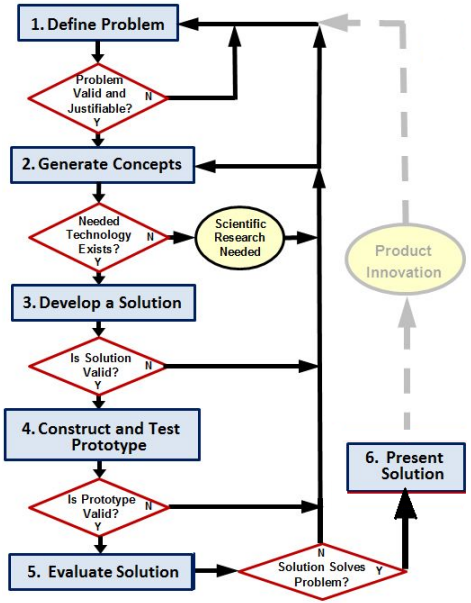
Can a pump pull water from 20 feet underground?

How about 40?

Can a pump push water from 40 feet underground?

What size pump?

Developing a Solution - Applied Math!



What is the volume of a cylindrical tank?

On its side?

Of four inches of water in that tank?

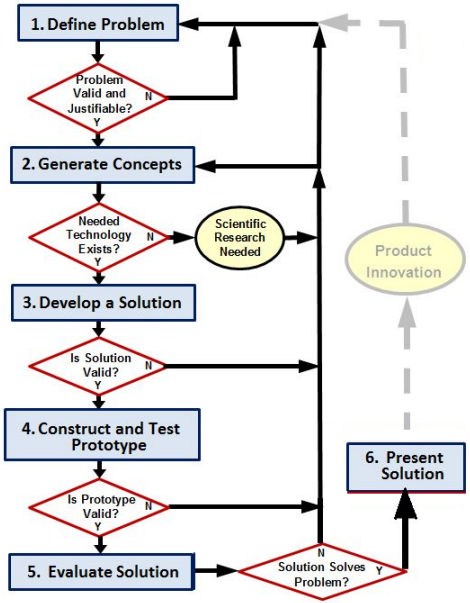
If the tank is tilted?

Really great problems for students!

They need to discover the question

They need to answer the question

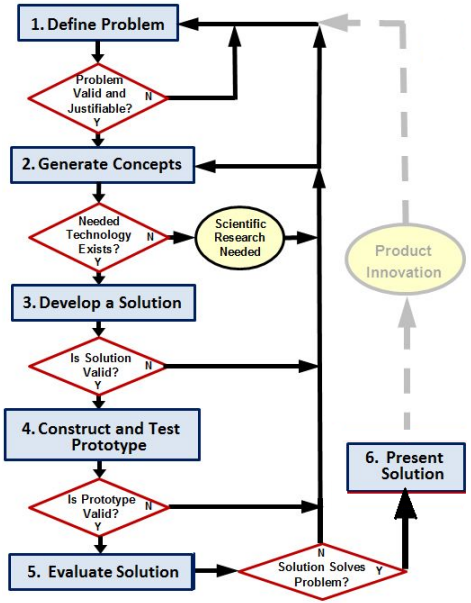
Developing a Solution - Critical thinking!



Developing a solution means choosing from a selection of concepts

Quantifying this decision is a great process

Developing a Solution - Successes



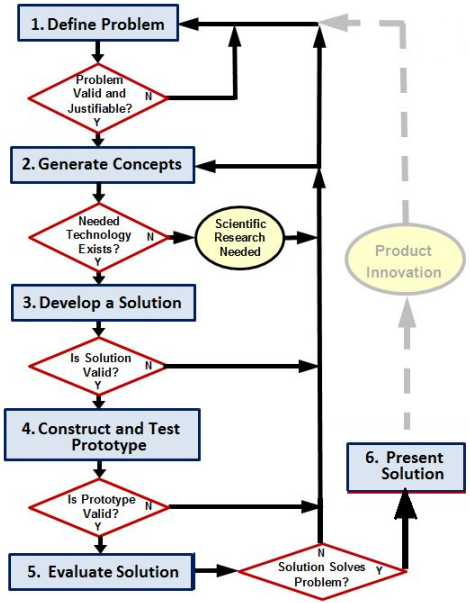
Students creatively apply math and science

Continually referring to problem requirements

Learning about technology and concepts specific to their projects

Students learn what they need to, not what they are told to

Developing a Solution - Difficulties



Get ready to learn and review!

Coding for Arduino

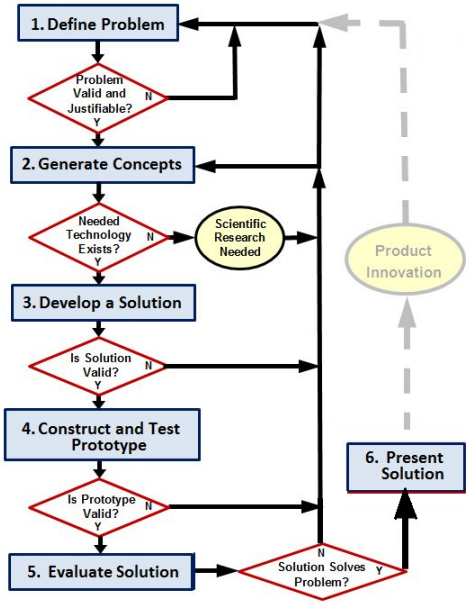
3D printing

Math and Physics

And, all with minimal lead time!

Trying not to make decisions for students

Construct and Test Prototype



Term three is dedicated to construction and testing

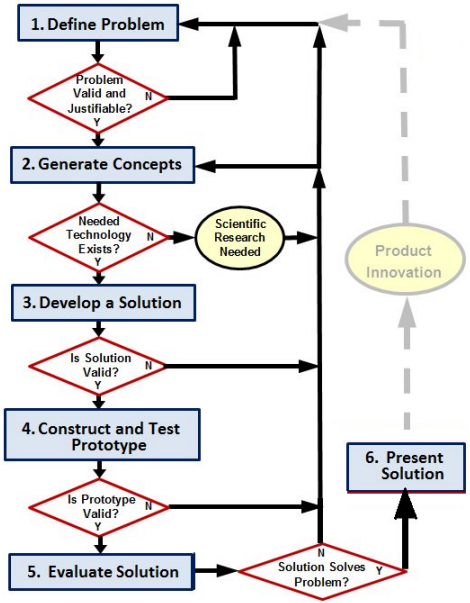
3D printing

An excellent choice in many cases

Acquiring materials quickly

If you are in a school where purchases take a long time, this is a major concern…

Construct and Test Prototype - Successes

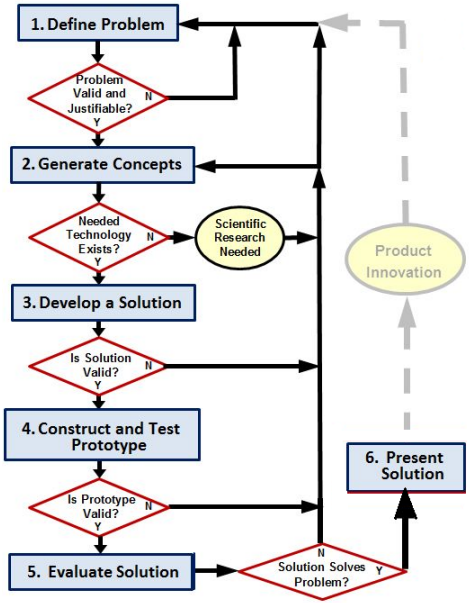


Students take tremendous pride in their creations

New skills are acquired and applied

Another great opportunity for applied STEM

Construct and Test Prototype - Difficulties



Watch for changes!

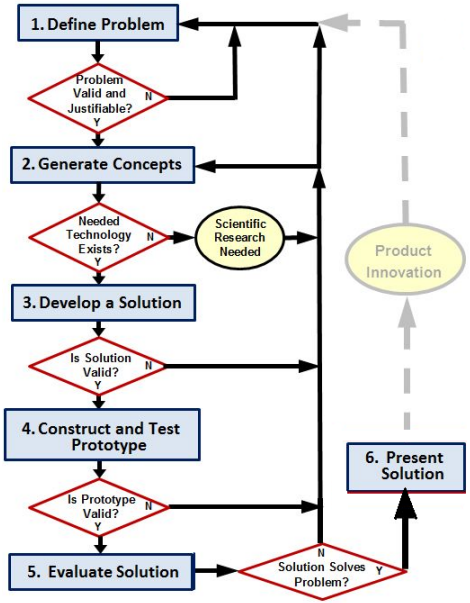
Students will begin tinkering instead of building what they designed

Revision is OK, but send them back to the design phase

At some point, you may need to relax and let them make changes on the fly, but fight until there is no more time

Keeping tests aligned to problem statement

Evaluate Solution and Present Results



Timing - This is the start of term 4, if you are lucky…

Did the solution meet the requirements of the problem?

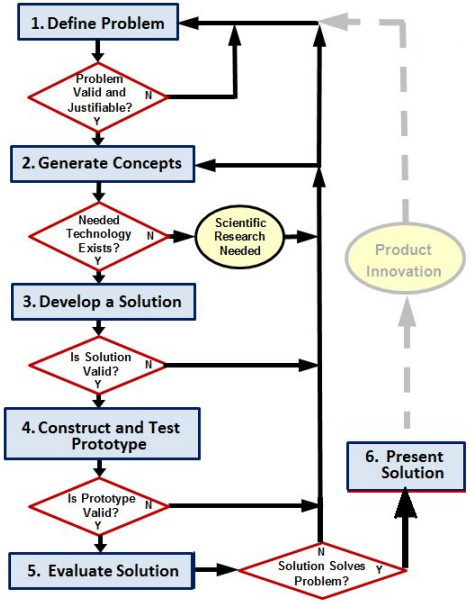
Which areas might be improved?

This is the most difficult to make happen

Students know they will not be refining the design

Succeed in making this happen by making it integral with the development/refinement of the final

Present Results - Ten Minutes on the Spot



What needs to be done?

Refine materials

Practice presentation

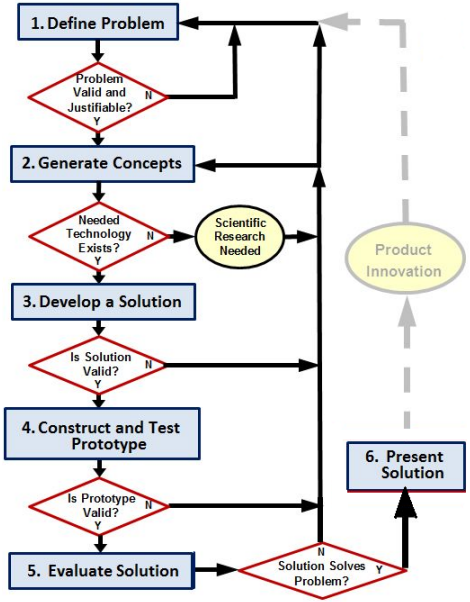
I try to motivate by setting up a “practice review” early

Bring in teachers, professionals

Students almost always feel nervous and unprepared

Fear of feeling the same way at WPI motivates!

Wrapping it all up



Timing

Continual focus on solution step

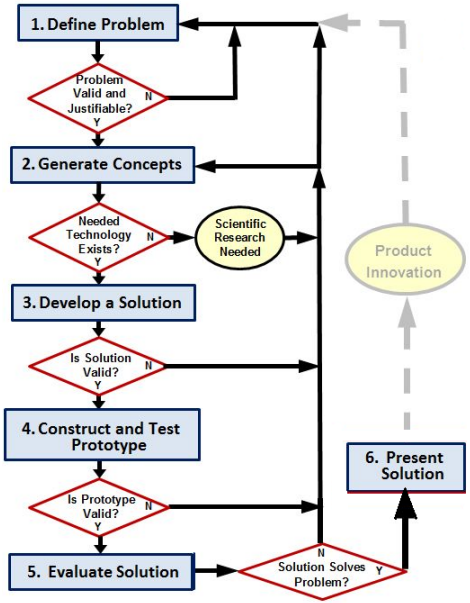
Substantially complete presentation by end of term 3 (just refine)

Don’t lose sight of the real purpose, the destination is great but the journey is where the learning happens

There is no such thing as “I’m done with this step”

Reiterate that the goal is to learn by doing,

Wrapping it all up



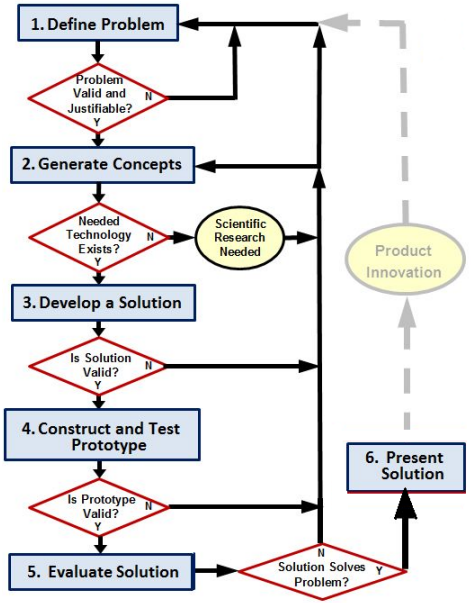
Timing is important for…

Keeping students motivated

Spreading around less enjoyable work

Ensuring that a project is reasonably complete

Wrapping it all up



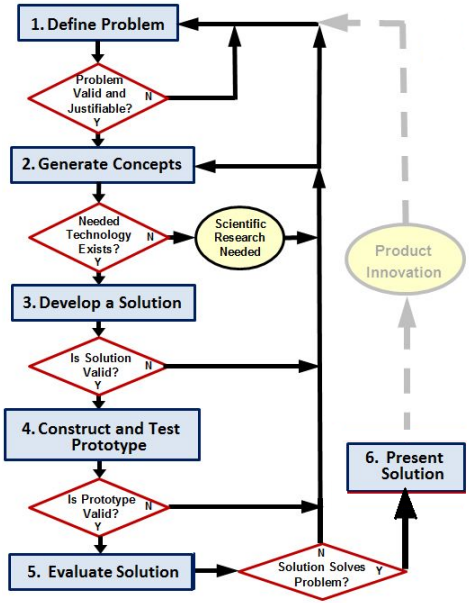
Focusing on the “Develop a Solution” step

Gives students a goal during the first phases

Gives students a focus in the last phases

Helps to anchor your schedule

Any Questions?



PLTW is a community.

Please feel free to be in touch with questions if you feel that I may be of help!

I really enjoy what I teach, and I'd love to share what I can and listen to what you have to say!