Engineering Notebooks and the Engineering Design Process

More important than you may think!

FIRST TECH CHALLENGE BRITISH COLUMBIA

University of Victoria

ENGINEERING AND COMPUTER SCIENCE

The Engineering Notebook - What?

- A notebook (or binder) to document your team's season
- A useful tool for team communication
- Mandatory criteria for many awards
- A good way to impress the judges
- Invaluable if something happens to your robot
- A good habit to have if you become an engineer!

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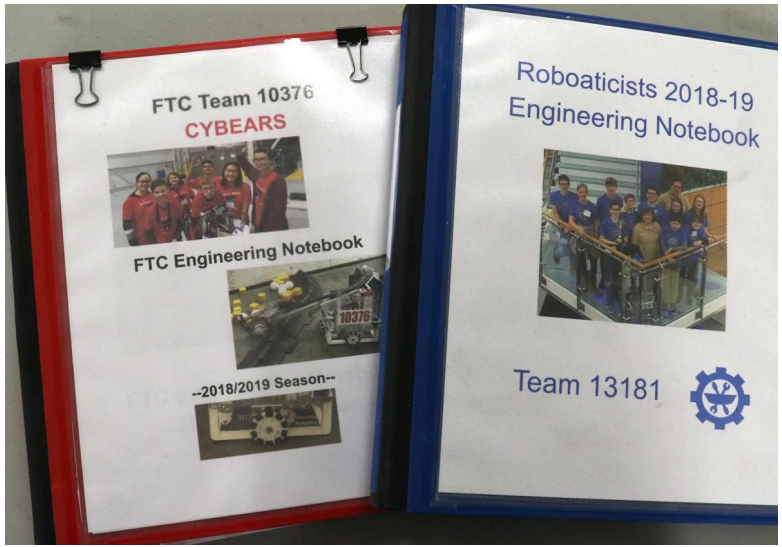
Sections of an Engineering Notebook

- Business/ Outreach/ Community involvement
- About the Team/ About the Robot
- Robot Entries
- Programming Submissions?
- Summary Pages!



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Formatting of an Engineering Notebook

- However you want!
- Show your personality to the judges
- Ask to see how other teams do theirs
- Just make sure you have:
  - Who was there?
  - What was done?
  - Why was it done?
  - When did you meet?
  - Photos or diagrams if needed

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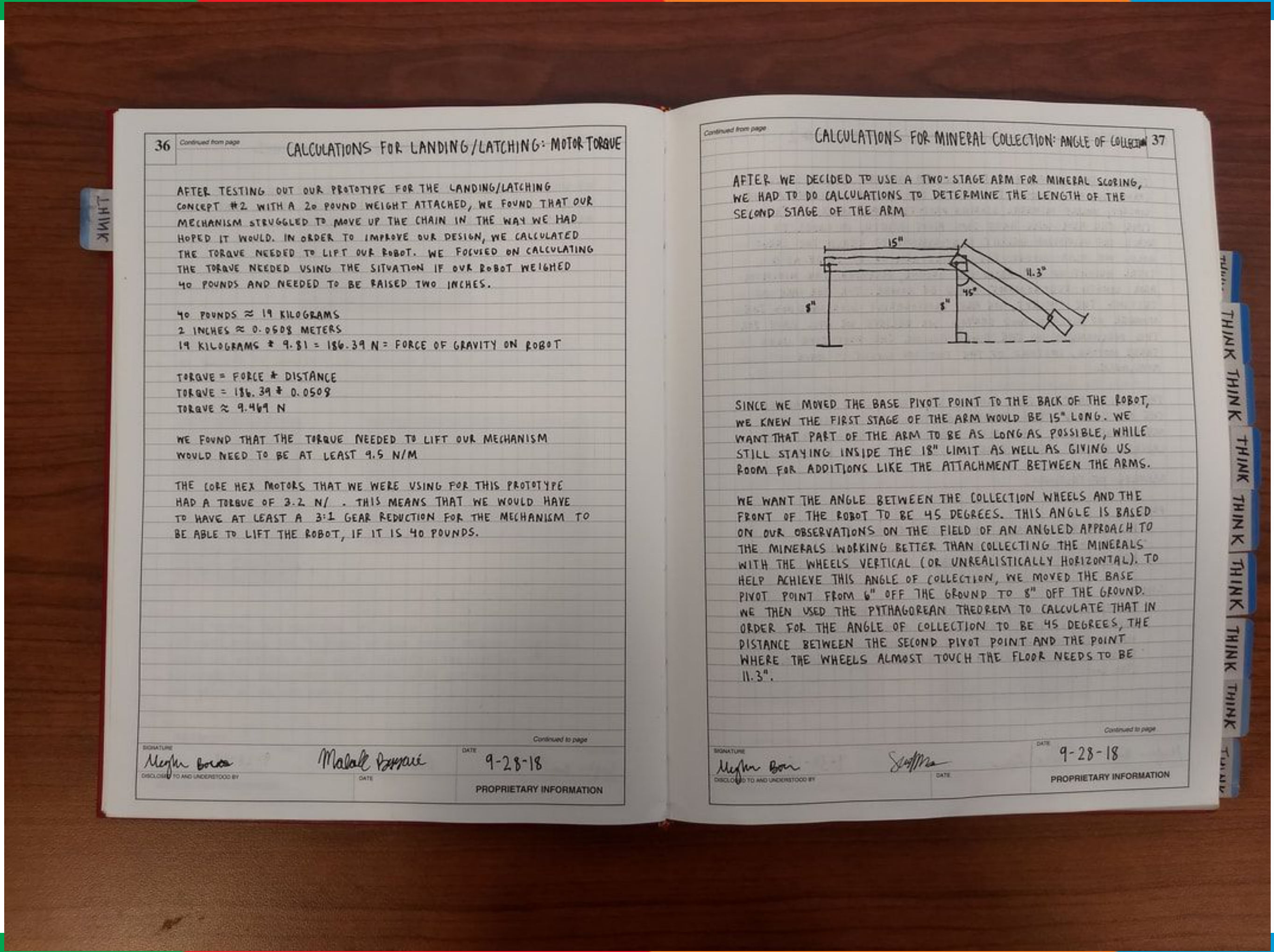

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CALCULATIONS FOR LANDING/LATCHING: MOTOR TORQUE

AFTER TESTING OUT OUR PROTOTYPE FOR THE LANDING/LATCHING CONCEPT #2 WITH A 20 POUND WEIGHT ATTACHED, WE FOUND THAT OUR MECHANISM STRUGGLED TO MOVE UP THE CHAIN IN THE WAY WE HAD HOPED IT WOULD. IN ORDER TO IMPROVE OUR DESIGN, WE CALCULATED THE TORQUE NEEDED TO LIFT OUR ROBOT. WE FOCUSED ON CALCULATING THE TORQUE NEEDED USING THE SITUATION IF OUR ROBOT WEIGHED 40 POUNDS AND NEEDED TO BE RAISED TWO INCHES.

40 POUNDS ≈ 19 KILOGRAMS
2 INCHES ≈ 0.0508 METERS
19 KILOGRAMS * 9.81 = 186.39 N = FORCE OF GRAVITY ON ROBOT

TORQUE = FORCE * DISTANCE
TORQUE = 186.39 * 0.0508
TORQUE ≈ 9.469 N

WE FOUND THAT THE TORQUE NEEDED TO LIFT OUR MECHANISM WOULD NEED TO BE AT LEAST 9.5 N/M

THE CORE HEX MOTORS THAT WE WERE USING FOR THIS PROTOTYPE HAD A TORQUE OF 3.2 N/ . THIS MEANS THAT WE WOULD HAVE TO HAVE AT LEAST A 3:1 GEAR REDUCTION FOR THE MECHANISM TO BE ABLE TO LIFT THE ROBOT, IF IT IS 40 POUNDS.

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PROPRIETARY INFORMATION

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CALCULATIONS FOR MINERAL COLLECTION: ANGLE OF COLLECTION 37

AFTER WE DECIDED TO USE A TWO-STAGE ARM FOR MINERAL SCORING, WE HAD TO DO CALCULATIONS TO DETERMINE THE LENGTH OF THE SECOND STAGE OF THE ARM

SINCE WE MOVED THE BASE PIVOT POINT TO THE BACK OF THE ROBOT, WE KNEW THE FIRST STAGE OF THE ARM WOULD BE 15" LONG. WE WANT THAT PART OF THE ARM TO BE AS LONG AS POSSIBLE, WHILE STILL STAYING INSIDE THE 18" LIMIT AS WELL AS GIVING US ROOM FOR ADDITIONS LIKE THE ATTACHMENT BETWEEN THE ARMS.

WE WANT THE ANGLE BETWEEN THE COLLECTION WHEELS AND THE FRONT OF THE ROBOT TO BE 45 DEGREES. THIS ANGLE IS BASED ON OUR OBSERVATIONS ON THE FIELD OF AN ANGLED APPROACH TO THE MINERALS WORKING BETTER THAN COLLECTING THE MINERALS WITH THE WHEELS VERTICAL (OR UNREALISTICALLY HORIZONTAL). TO HELP ACHIEVE THIS ANGLE OF COLLECTION, WE MOVED THE BASE PIVOT POINT FROM 6" OFF THE GROUND TO 8" OFF THE GROUND. WE THEN USED THE PYTHAGOREAN THEOREM TO CALCULATE THAT IN ORDER FOR THE ANGLE OF COLLECTION TO BE 45 DEGREES, THE DISTANCE BETWEEN THE SECOND PIVOT POINT AND THE POINT WHERE THE WHEELS ALMOST TOUCH THE FLOOR NEEDS TO BE 11.3".

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PROPRIETARY INFORMATION

To Sign or Not to Sign - all the details in your entries

- You'll notice little quirks some teams have in their notebooks
  - Personal favourite: a different type of potato for each meeting
- Old requirements mean some teams sign their entries - not required
- If you have team member profiles, ask some fun questions!
- Do you want to have fun quotes in your notebook?
- There are plenty of ways to personalize your notebook
- Add some fun to the outside!

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Where to find information of what the judges want?

- In Game Manual Part 1!
- It has criteria for all awards
- Some even have MANDATORY requirements to receive the award
- Be sure to read it!

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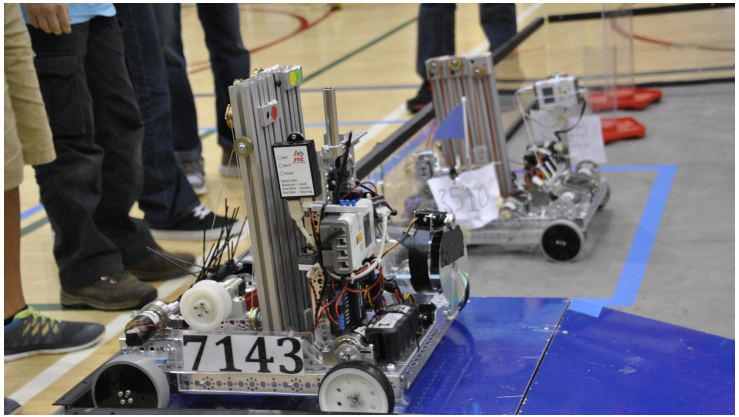
The Engineering Design Process - Why?

- It will help you to organize your ideas
- You can then apply everything and learn from what worked and what didn’t
- It’s just a way of organizing what you would do anyways
- It’s easier to figure out what to do next



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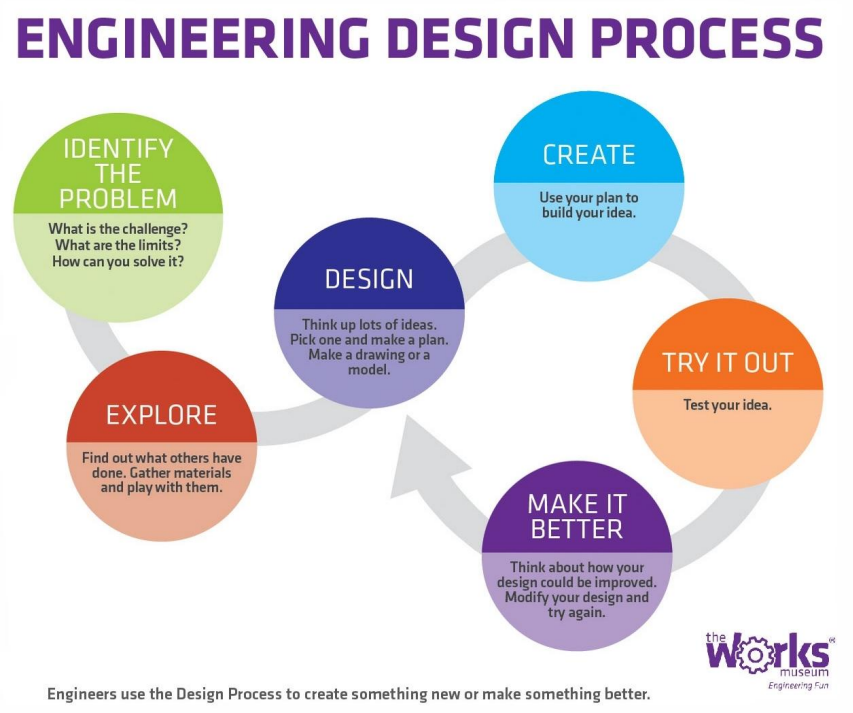
Steps of the Engineering Design Process

1. Identify the problem
2. Explore
3. Design
4. Create
5. Try it out
6. Make it better
7. Repeat steps 3-6 until you're happy with the design



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How to use this Design Process in your team

- Have a brainstorming day!
- Come up with ideas and talk about them as a team
- Come up with a preliminary design and talk about it
- Do the building and testing needed to see if your ideas work
- If not, find a way to improve them
- Get back together as a team and talk about the results

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Now go and make great notebooks and robots, and don’t forget, we’ve got a notebook review at League 1!
This is there to help you improve!

Questions & Answers

We are having trouble getting our phones to connect. What can we do?

When the robot is driving, the wheels are wiggling a lot. It’s hard to get it to drive straight. Is that normal?

What should we do when we can’t agree about the robot? Most of the team wants a simple drive system, but one team member wants a robot that drives sideways. How should we make the decision?

Next Workshop
Nov. 8, 4:30 - 6:00pm

Designing parts in CAD

Learn how to create parts that can be 3D printed, laser cut or made on a CNC machine.