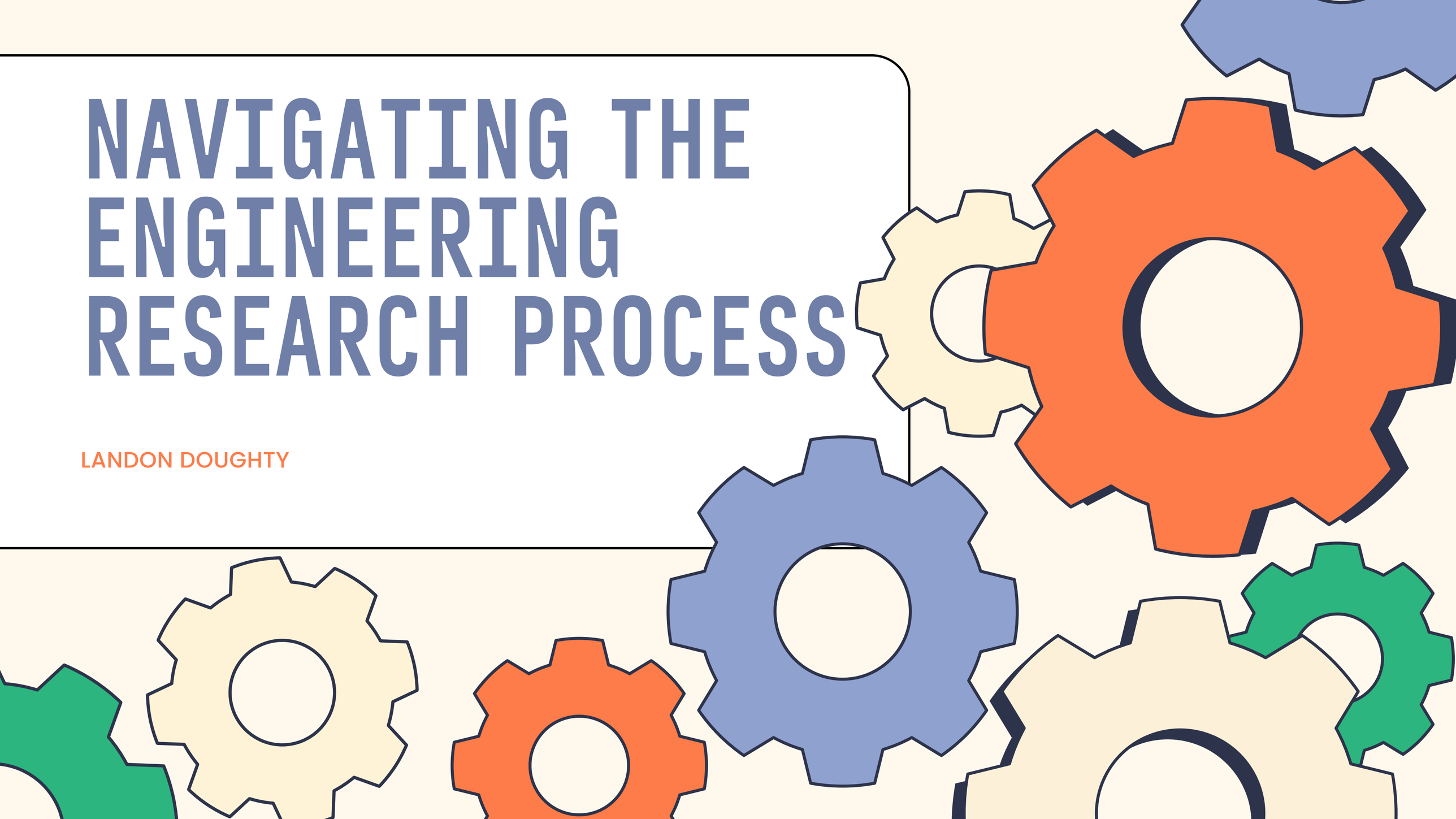
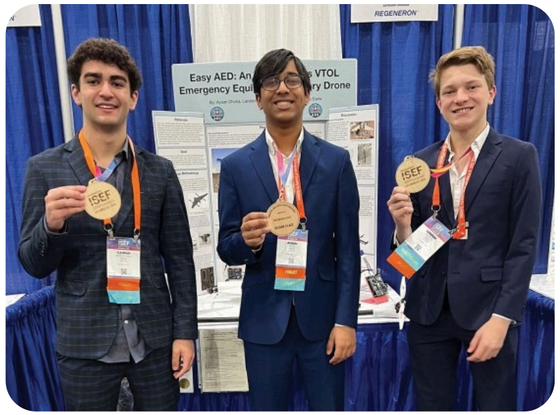
NAVIGATING THE ENGINEERING RESEARCH PROCESS

LANDON DOUGHTY



ABOUT ME



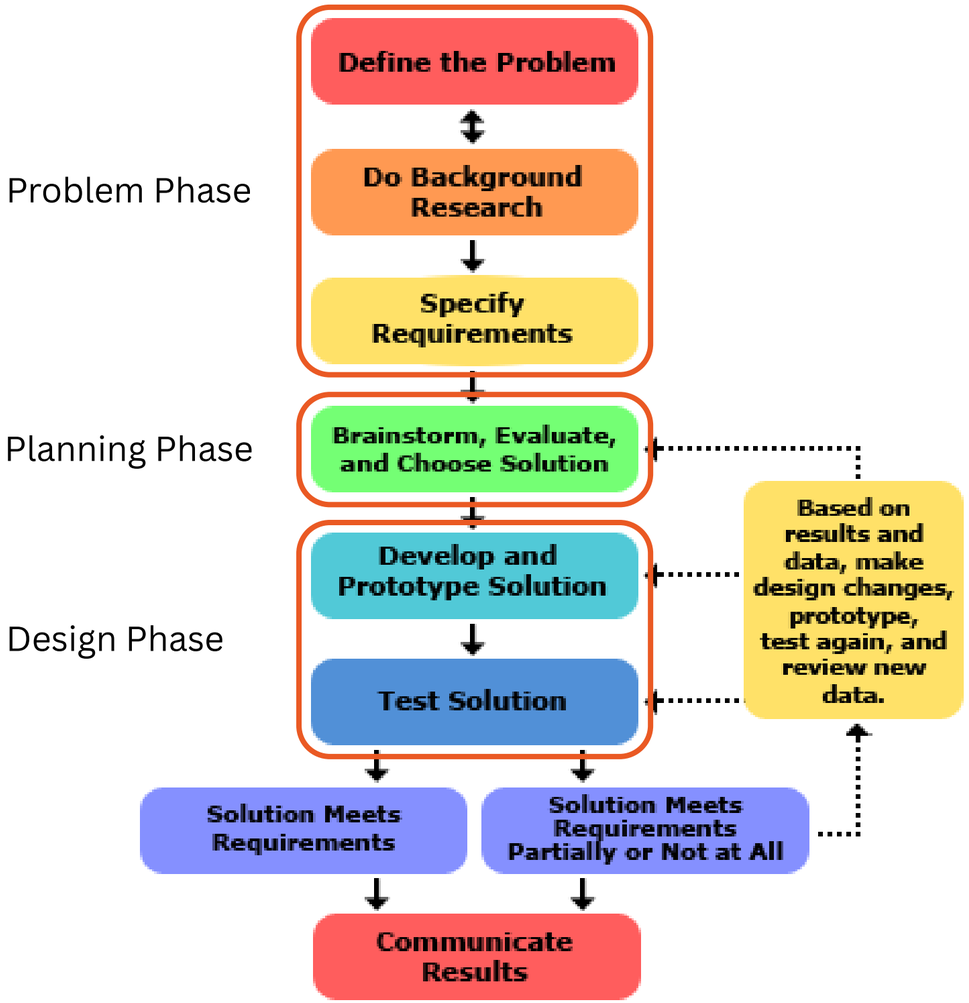
SCIENCE FAIR EXPERIENCE:

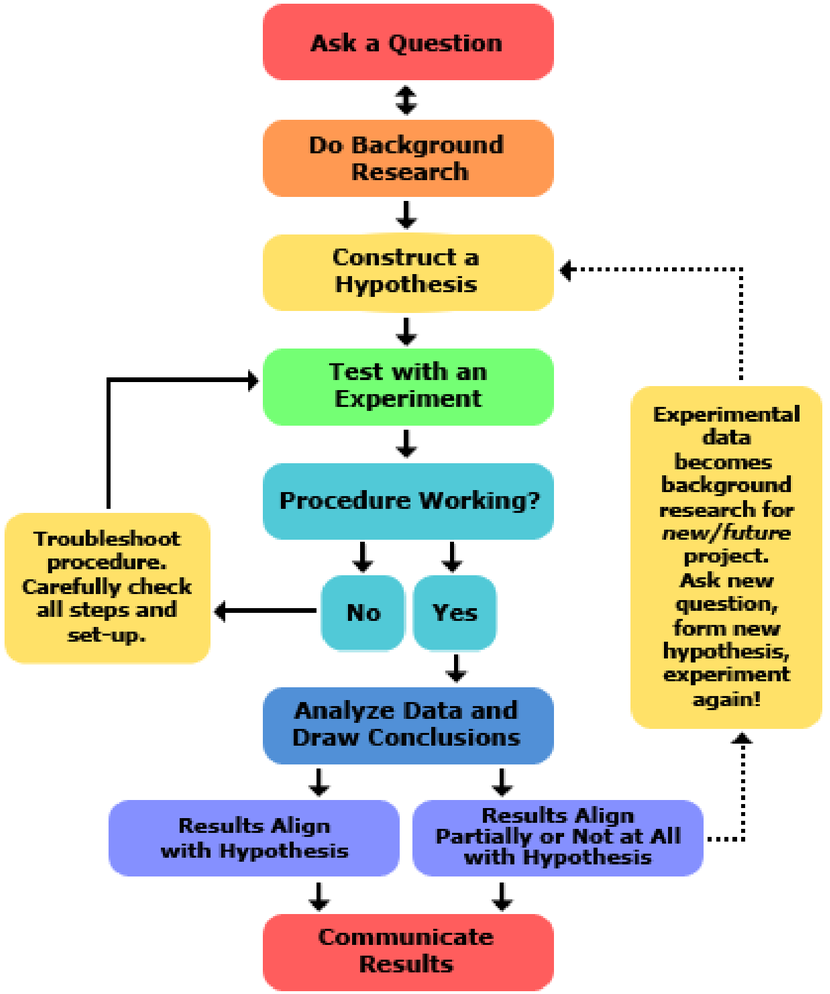
- SEFH 2023-2025
- ISEF 2023, 2024
- 2ND ROBOTICS AND INTELLIGENT MACHINES

CURRENTLY:

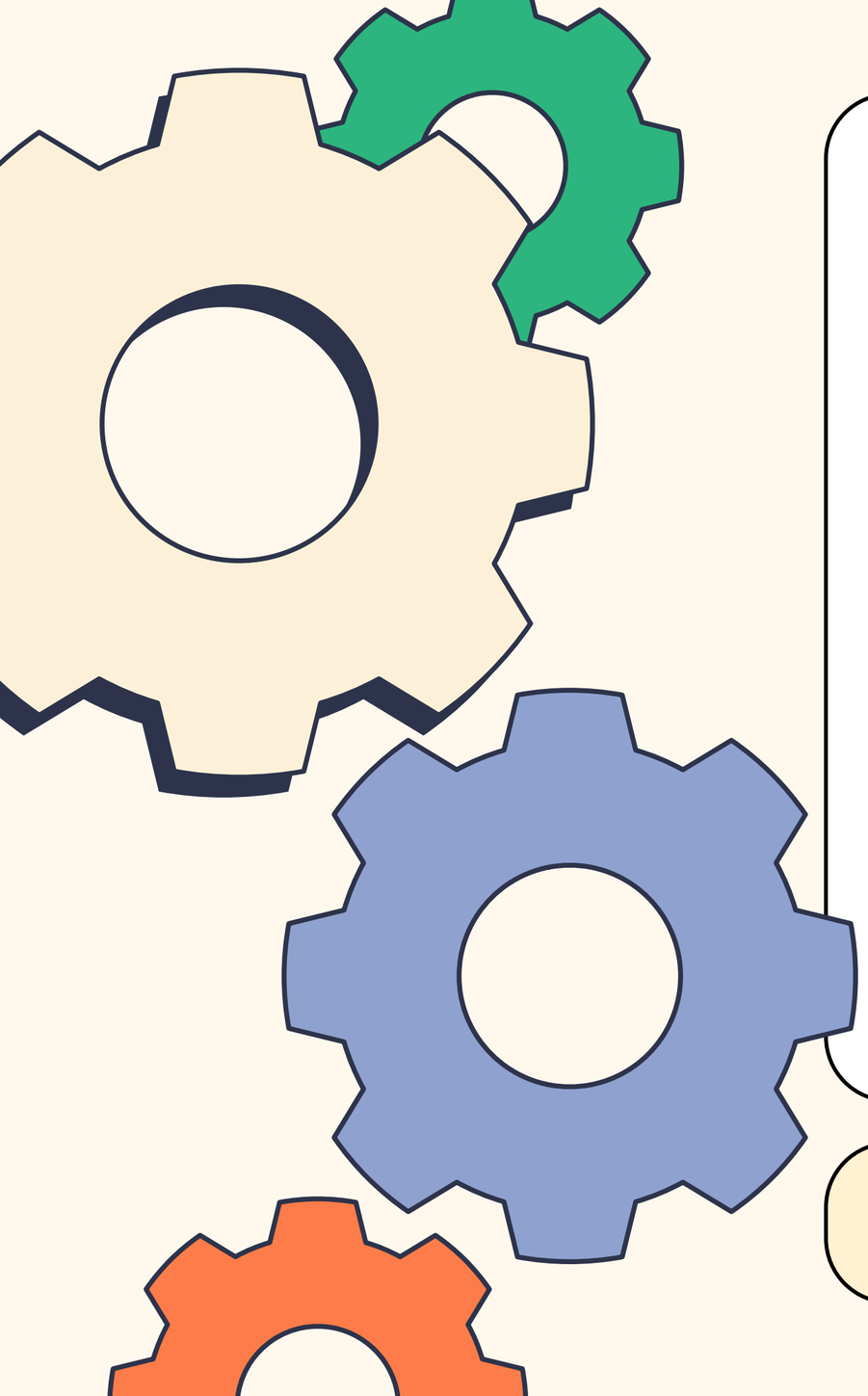
- RICE UNIVERSITY ‘29 (GO OWLS!!)
- ELECTRICAL ENGINEERING

ENGINEERING VS SCIENCE





sciencebuddies.org



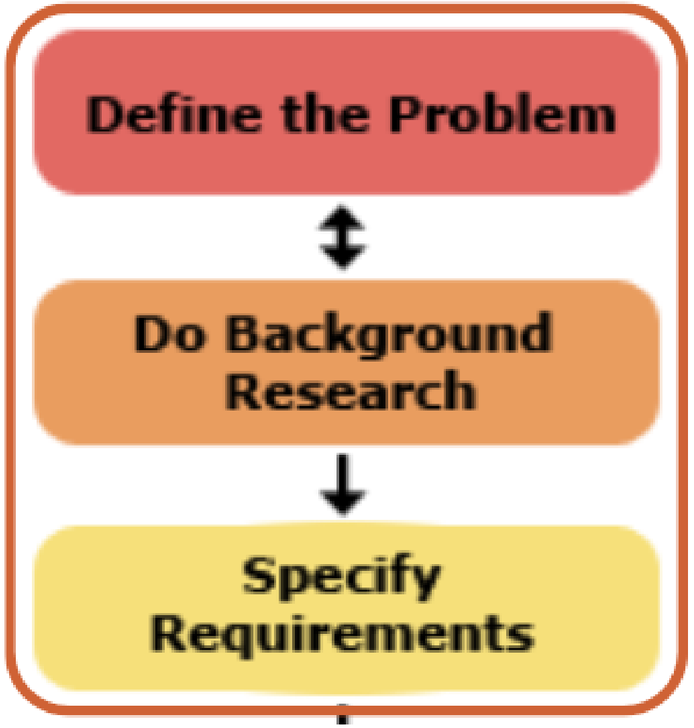
WHAT IS A DESIGN PROBLEM?

A DESIGN PROBLEM IS A CHALLENGE THAT NEEDS A SOLUTION.

IT SHOULD REFLECT A REAL NEED OR WANT THAT PEOPLE HAVE.

What's something in your life that could be **easier** or **better**?

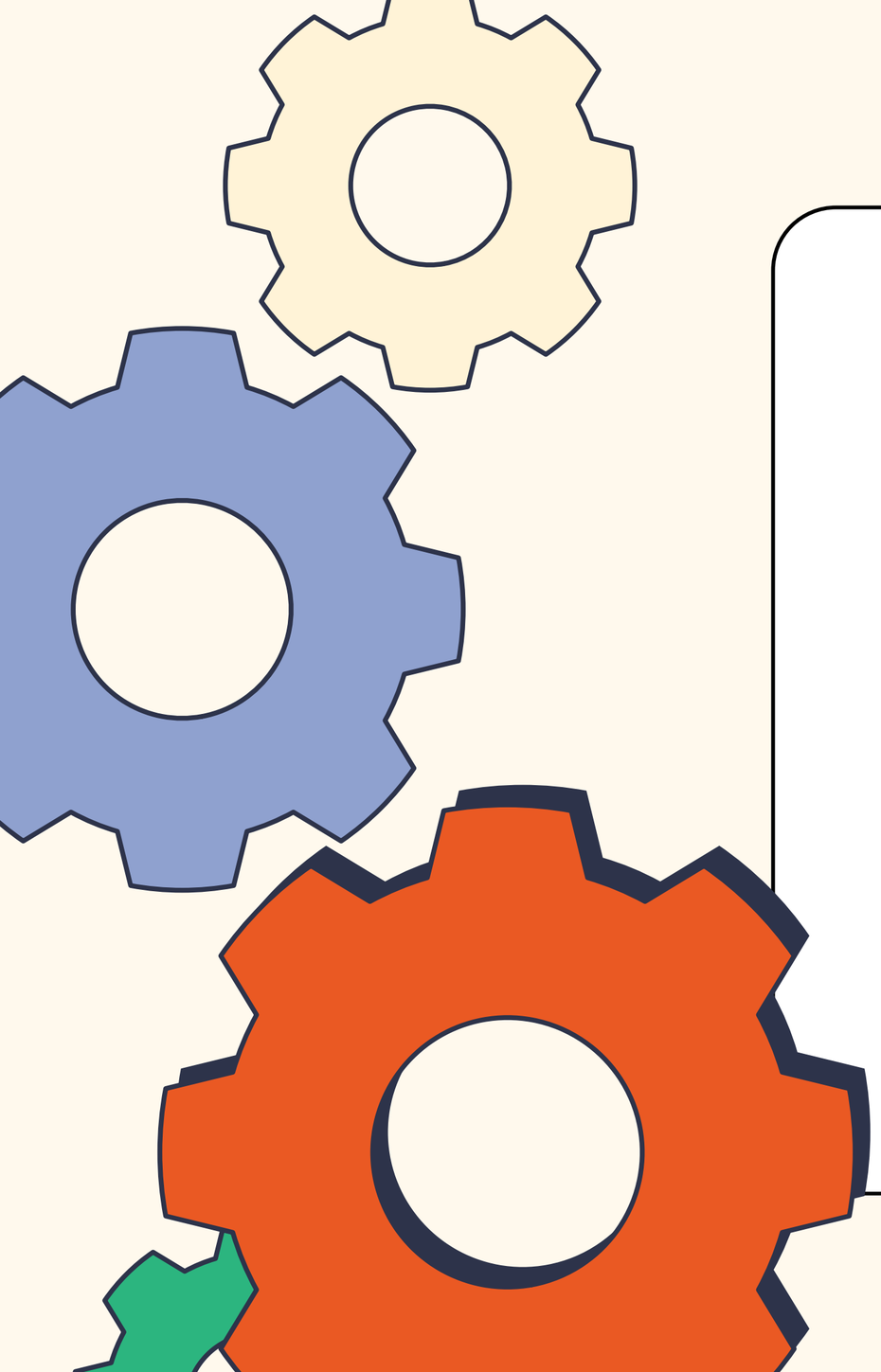
WHAT MAKES A GOOD DESIGN PROBLEM?



A GOOD DESIGN PROBLEM INCLUDES:

- A CLEAR GOAL (WHAT, WHO, WHY?)
- CRITERIA FOR SUCCESS (HOW WILL WE KNOW IT WORKS?)
- CONSTRAINTS (LIMITS LIKE MATERIALS, TIME, OR MONEY)

Using your project idea, try to answer these questions.



PLANNING STAGE

IMPORTANT: Only start this after problem stage is COMPLETE

START BY ASKING:

WHAT IS EVERY SOLUTION TECHNIQUE I CAN THINK OF?

- GIVE YOURSELF A SET TIME PERIOD
- ANY IDEA COUNTS, THEY DONT HAVE TO BE FEASIBLE OR EVEN PHYSICALLY POSSIBLE

NEXT:

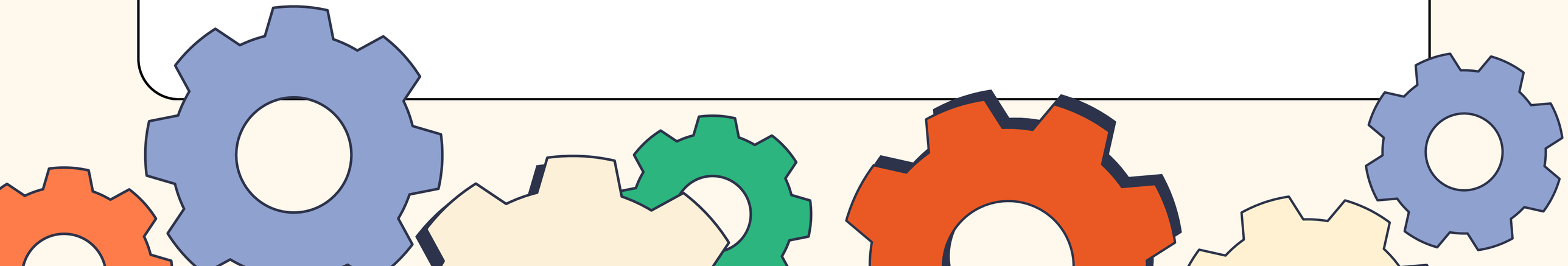
- RESEARCH EXISTING SOLUTIONS
- IMPROVE/COMBINE EXISTING AND NEW SOLUTIONS?
- MORE BRAINSTORMING!

CHOOSING A DESIGN

LOOK AT WHICH SOLUTIONS MATCH YOUR CRITERIA/CONSTRAINTS

- FEASIBLILITY
- PERFORMANCE
- COST
- RELIABILITY
- SAFETY
- AESTHETICS
- NOVELTY

Tip: Use a weighted decision matrix!



WEIGHTED DECISION MATRIX

Category	Weight	Apples		Bananas		Oranges	
		SCORE	Weighted	SCORE	Weighted	SCORE	Weighted
Taste	0.4	8	3.2	9	3.6	7	2.8
Cost	0.2	6	1.2	10	2	7	1.4
Health	0.4	8	3.2	9	3.6	10	4
Total	1	7.6		9.2		8.2	

DESIGN STAGE!

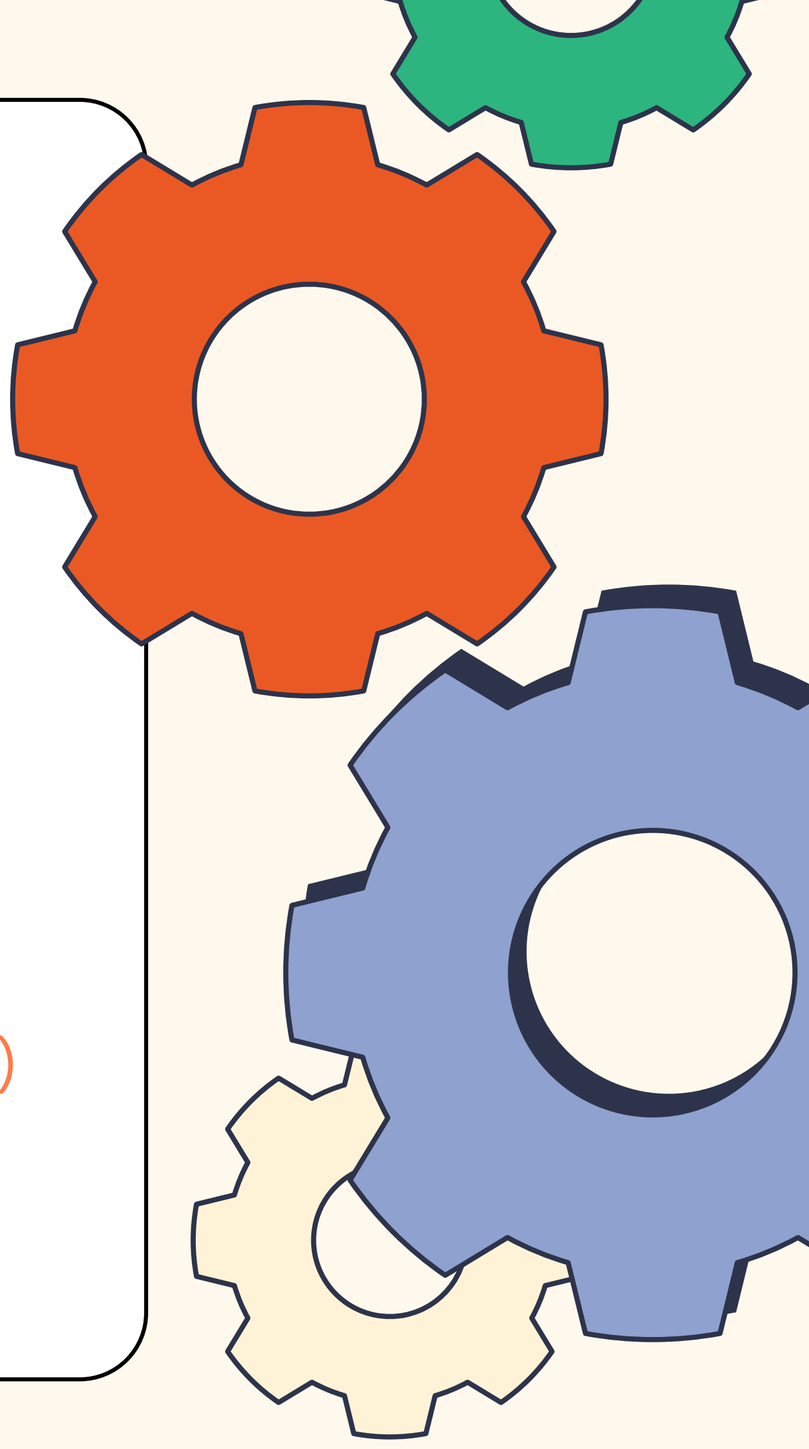
THIS IS THE “FUN” PART

START BUILDING!

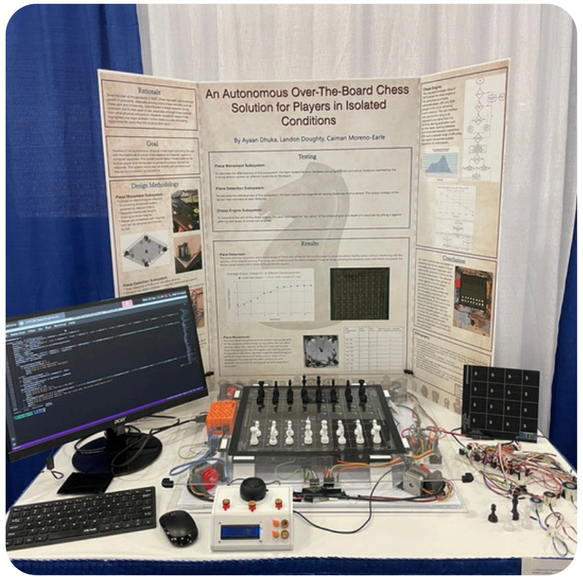
- PROTOTYPE EACH SYBSYSTEM SEPPARATELY
- TEST, TEST, AND TEST SOME MORE
- DO SMALL SCALE INTEGRATION TESTS BEFORE FULL ASSEMBLY

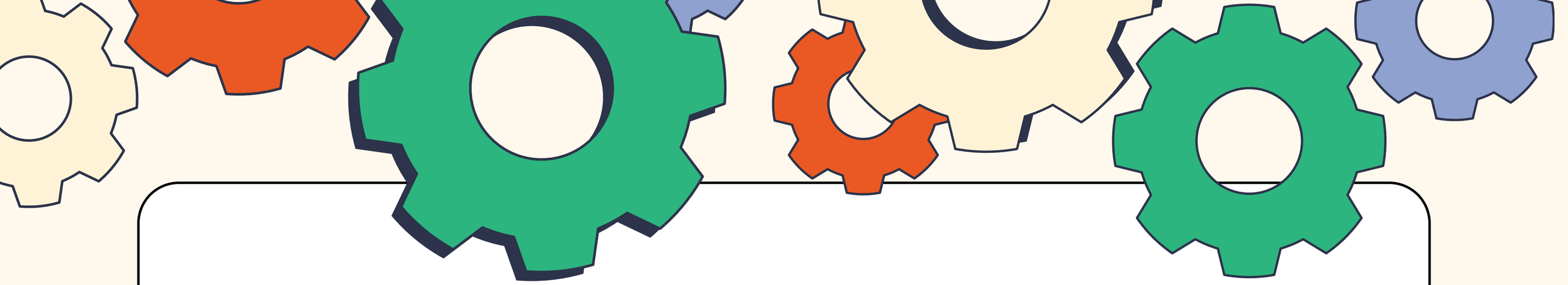
OTHER NOTES

- IT IS OK TO CHANGE PLANS AND IDEAS
- THE EARLIER THE BETTER (DON’T PROCRASTINATE)
- IT DOESN’T NEED TO BE PERFECT
- SHOWING IS BETTER THAN TELLING



EXAMPLE DESIGN PROBLEM





ADVICE FOR TEAMS

THINK OF A REAL-WORLD PROBLEM YOU COULD SOLVE.

- SPLIT PROJECT UP BY SUBSYSTEM
- RUN IDEAS/PLANS BY TEAMMATES, BE FLEXIBLE
- UNDERSTAND YOU AND YOUR TEAMMATE'S ABILITIES
- ESTABLISH CLEAR PLANS OF ACTION
- COMMUNICATION IS ALWAYS KEY

FEEDBACK