Engineering Notebook

LOUDOUN ROBOTICS

Robotics Enrichment Program · Fall 2026

Stone Hill Middle School

YOUR NAME

_____

TEAM NAME

_____

TEAMMATES

_____

Your Team

Everyone does every job

You work in a team of three. Each week one of you is the **builder**, one is the **programmer**, and one is the **tester**. You swap every week, so by December you will have done all three.

WEEK	BUILDER	PROGRAMMER	TESTER
1			
2			
3			
4			
5			
6			

What the jobs mean

- **Builder** — puts the robot together and decides how it is made.
- **Programmer** — writes the code and works out why it isn't doing what you meant.
- **Tester** — runs it, measures what happened, and writes it down here.

> **The one rule of this notebook: guess first.** Before you test anything, write down what you think will happen. Then write down what actually happened. When those two do not match, you have just found something you did not know — and that is the most useful thing on the page.

Safety

- Robots stay on the floor or the table — never carried while running.
- Keep fingers, hair and cables away from moving gears.
- Nothing gets thrown. Not parts, not robots.

SIGNED

Week 1 — Build and Test

SEPTEMBER 16

Today

You will build your first robot and program it to drive **exactly one metre**. It will not go exactly one metre. That is the point.

> **The engineering process.** Try it → measure what really happened → change one thing → try again. Engineers do not get it right first time. They get it right eventually, on purpose.

Why one metre is hard

- Wheels slip a little on the floor.
- Motors do not stop the instant you tell them to.
- A bigger wheel travels further per turn than a smaller one.

Your job

Get the robot to finish within **2 cm** of the line. Write down every attempt on the next page — including the bad ones.

Notes from today

Week 1 — Your Results

RECORD IT

Before you start — how far do you think try 1 will actually go?

Now test it

TRY	WHAT WE TOLD IT TO DO	TARGET	ACTUAL	ERROR
1		100 cm		
2		100 cm		
3		100 cm		
4		100 cm		
5		100 cm		

What did you change between tries, and why?

Was the error always in the same direction?

If you had one more try, what would you change?

Week 2 — Grip and Strength

SEPTEMBER 23

Today

Two robots push each other. One moves the other backwards; one spins its wheels and goes nowhere. The difference is usually **grip**, not power.

> **Friction** is what stops your wheels sliding. No grip means all your motor power turns into spinning wheels and noise. In December, the robot that grips wins the shove.

The test

Put the robot on a board and slowly lift one end. Write down the angle at the moment it starts to slide. Steeper before sliding = more grip.

Also today: will it survive?

A sumo robot gets hit. Hard. Find the weak point in your build by pushing on it — then brace it.

Notes from today

Week 2 — Your Results

RECORD IT

SURFACE OR TYRE	YOU GUESS	ANGLE AT SLIP	REAL RANK

Did your guesses match? Where were you wrong?

Where did your build fall apart first?

Draw how you braced it

SKETCH — LABEL THE PART YOU ADDED

Week 3 — Speed or Strength?

SEPTEMBER 30

Today

You cannot have both. Gears let you trade one for the other, and today you find out how much.

> **Gear ratio** = teeth on the driven gear ÷ teeth on the driver gear.
> A **small gear turning a big one** gives more pushing power and less speed.
> A **big gear turning a small one** gives more speed and less pushing power.

Gears only mesh at the right distance

Add the teeth of both gears and divide by 16. That is how many studs apart the axles must be. **12 + 36 = 48 ÷ 16 = 3 studs.**

Test all three

SETUP	DRIVER → DRIVEN	RATIO	WHAT IT SHOULD DO
A	24t → 24t	1 : 1	Normal
B	12t → 36t	1 : 3	Strong, slow
C	36t → 12t	3 : 1	Fast, weak

All three sit 3 studs apart, so you only swap gears — never rebuild.

Notes from today

Week 3 — Your Results

RECORD IT

Guess first — which setup will be fastest? Which will win a tug of war?

Speed — time to cross 2 metres

SETUP	TRY 1	TRY 2	TRY 3	AVERAGE
A 1:1				
B 1:3				
C 3:1				

Strength — tug of war

SETUP VS SETUP	YOU PREDICT	WHO WAS DRAGGED?
A vs B		
A vs C		
B vs C		

Were your predictions right? What surprised you?

For a sumo match, which would you pick — and what are you giving up?

Week 4 — Design Your Fighter

OCTOBER 7

Today you stop following instructions

This is the robot you keep. It is the one that competes in December. Every choice is yours — and you have three weeks of evidence to make them with.

> **Look back at weeks 1, 2 and 3.** You already measured which gearing pushes hardest and which tyres grip best. A design decision backed by your own data is an engineering decision. A guess is not.

Decide these four things

- **Gear ratio** — speed to strike first, or torque to win the shove?
- **Wheels** — which gripped best in week 2?
- **Height** — low robots are hard to get under. Being got under loses matches.
- **Weight and balance** — where should it be heaviest?

Rules to build inside

- It must fit inside the starting square.
- No sticky surfaces, no projectiles, nothing designed to damage another robot.
- It must run on its own once started.

Notes from today

Week 4 — Your Design

Our decisions, and our evidence

CHOICE	WHAT WE PICKED	WHY — WHAT DID WE MEASURE?
Gear ratio		
Wheels		
Height		
Weight		

Draw your robot from the side

LABEL THE GEARS, THE WHEELS AND THE LOWEST POINT

What do you think will beat you?