

ROBOT IN 3 DAYS



Robo Raiders
FTC 7129

WHAT: Rapid design and build of a simple robot for a new FTC game challenge

WHY: Focus, engage, and empower your team with understanding, skills, and resources for a highly successful season

HOW: Execute an intense all-team project to design, build, and test a simple robot in three long work sessions, starting as soon as the year's game challenge has been released

**Build teamwork,
design competence,
self-confidence, . . .
and a working robot!**

Start:

End:

1

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Day 1

Define game strategy,
subsystems, requirements;
brainstorm ideas (A-C)

Day 2

Screen ideas, prototype &
test promising subsystems;
select robot concept (D-F)

Day 3

Build & test robot concept;
fit in sensors & controls; test
& refine robot (G-I)



Hard work brings a profit, but mere talk leads to poverty. (Proverbs 14:23)

- Builds team knowledge and cohesiveness
- Mentors the team in engineering process
- Yields a basic robot as a learning aid

Start:

End:

2

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A. DEFINE INITIAL PLAN

1. Analyze game scoring opportunities:
 - a. Points for successful attempt,
 - b. Time required to score, and
 - c. Level of difficulty for robot to score.
2. Develop initial robot strategy based on:
 - a. Robot functions needed to score,
 - b. Known workable concepts, and
 - c. Team ability to finish in time allotted.
3. Define a plan forward:
 - a. Identify subsystems to be built,
 - b. Assign people to work needs, and
 - c. Set deadlines for each design step.

In our hearts we plan our course, but the LORD determines our steps. (Proverbs 16:9)

Documentation

1. Document your development of a robot design strategy.
2. Record the plan, assignments, and timeline for your team's work.

Start:

End:

3

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B. DEFINE ROBOT REQUIREMENTS

1. Write a statement of what the initial robot must do.
2. For each subsystem, discuss:
 - a. Specific actions it must perform,
 - b. Desired size, speed, strength, etc.,
 - c. How it must relate to other parts.
3. Define design requirements:
 - a. For each subsystem of the robot,
 - b. For the initial robot as a whole.
4. Identify which requirements are most important for your initial robot.

It is not good to be without knowledge. Hasty feet will miss the right way! (Proverbs 19:2)

Documentation

1. Document your statement of what the robot must do.
2. Record specific requirements to be met.
3. Record what you have learned.

Start:

End:

4

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C. GENERATE IDEAS

1. For each subsystem, in small groups **brainstorm** to identify ideas:
 - a. Encourage ideas from everyone.
 - b. Seek creative, even crazy, ideas.
 - c. Record all ideas, with sketch as needed.
 - d. Ideas may be original, taken from others, or modified previous ideas.
2. Members seek to **expand on** ideas:
 - a. Search for other useful ideas,
 - b. Refine ideas by sketching, modeling, prototyping, seeking others' opinions.

Those who diligently seek wisdom will find it and more. (Proverbs 8:17-19)

Documentation and homework

1. Document all of your ideas. Sketch as needed. Identify sources as appropriate.
2. As homework, continue looking for ideas and refining ideas already identified.

Start:

End:

5

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D. SCREEN IDEAS FOR SUBSYSTEMS

1. Prepare tools for evaluating ideas:
 - a. Identify criteria for each subsystem.
 - b. Model (build, sketch, CAD) subsystem.
2. Identify best ideas for each subsystem.
 - a. List criteria as row labels. (see below)
 - b. Use idea names as column labels.
 - c. Score (1=poor, 3=great) ideas by criteria

God gives favor when judgments are made using honest weights and measures. (Proverbs 11:1)

Screening ideas for ball gathering subsystem

Criteria	Idea 1	Idea 2	Idea 3	Idea 4
Balls/min.	2	3	1	3
Durability	1	2	1	2
Defensible	1	1	3	2
Repairable	2	2	2	3
TOTAL	6	8	7	10

Start:

End:

6

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E. COMBINE IDEAS INTO CONCEPTS

1. Tabulate good ideas for each subsystem.
 - a. Label rows by required robot functions.
 - b. List subsystem ideas in appropriate row.
2. Combine ideas into robot concepts:
 - a. A concept is a set of ideas that fulfill all required robot functions.
 - b. Identify your most promising concepts.
 - c. An idea may be in multiple concepts.

Listen to experts to find paths that produce life and health for the whole body. (Proverbs 4:20-22)

Document process for identifying concepts

Function	Lists of Subsystem Ideas		
Gather rings	Sweeper	Rake	Magnet
Load cartridge	Pockets	Pegs	Fingers
Position for delivery	Slider	Turret	Fishing pole
Deliver ring	Throw	Drop	Push

Start:

End:

7

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F. SELECT BEST ROBOT CONCEPTS

1. Create a selection matrix of concepts:
 - a. List overall criteria for robot (column 1).
 - b. Weight each criterion (column 2)
 - c. Label added columns with concept names.
2. Select best overall robot concepts:
 - a. Score concepts on each criterion.
 - b. Find weighted sum (total) in each column.
 - c. Select 1 or more concepts with highest total.

With your eye on your goals, consider your path,
and remain steadfast. (Proverbs 4:25-26)

Document concept selection process:

Criteria	Wt	#1	#2	#3	#4
Speed	3	3	2	1	2
Durability	2	2	1	1	2
Accuracy	3	1	2	3	2
Innovation	2	2	1	1	3
Repairable	1	2	1	2	3
TOTAL		22	17	18	25

Start:

End:

8

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G. PREPARE FOR ROBOT FABRICATION

1. Sketch or CAD details of parts, interfaces:
 - a. Connection points for subsystems,
 - b. Routing of power to parts as needed,
 - c. Sensors, controllers, and wiring.
2. Identify fabrication plan:
 - a. Time needed & independence of steps,
 - b. Sequencing of fabrication steps,
 - c. Preparation of workspace and tools,
 - d. Precision required in fabrication,
 - e. Assignment of roles to team members.

Prepare the materials and tools needed, then do the work in the time available. (Proverbs 24:27)

Documentation

1. Document your fabrication plan.
2. Keep sketches and CAD drawings needed for fabrication.
3. Identify information and pictures to be obtained during fabrication.

Start:

End:

9

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H. BUILD SELECTED ROBOT CONCEPT

1. Build robot prototype as designed:
 - a. Build each subsystem, giving attention to connections to other subsystems.
 - b. Mentor others in building techniques.
 - c. Test each subsystem as it is built.
2. Modify design as needed.
 - a. If subsystem has flaws, revise its design.
 - b. If subsystem integration has flaws, revise subsystems or interfaces.

Those who work purposefully get results;
unfocused dreamers lack sense. (Proverbs 12:11)

Documentation

1. Document your fabrication process with steps followed, pictures, and drawings.
2. Record any design changes required for assembly and/or improved function.

Start:

End:

10

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I. TEST COMPLETED ROBOT

1. Identify what to test.
 - a. Most important functions (speed, reach, accuracy, etc.).
 - b. Features that pose highest risk due to likely failure or seriousness of failure.
2. Gather data on targeted performances.
 - a. Measure & record all data, good or bad.
 - b. Repeat tests 5-10 times.
 - c. Identify causes of any failures occurring.

The wise build up, but the foolish tear down.
(Proverbs 14:1)

Documentation

1. Document testing procedures and data collected.
2. Document types of failures and any obvious causes.
3. Document how well you feel your robot has met your goals and requirements.

Start:

End:

11

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J. REFLECT ON LEARNING FROM Ri3D

1. Robot design
 - a. What went well? What did not go well?
 - b. What changes will you make in your design process to yield better designs?
2. Teamwork
 - a. What went well? What did not?
 - b. How can you improve team success?
 - c. How will you better empower team members to be valuable contributors?

The prudent person applies knowledge to guide action. (Proverbs 13:16)

FOLLOW-UP

1. Document your responses to the questions asked above.
2. Score yourself on the robot development and team development scales that follow.
3. Consider using the same scales to score yourselves at other times during the season.

Start:

End:

12

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ASSESSMENT: Robot Development

	Weak	Strong
Idea generation	<input type="range"/>	
Design decision making	<input type="range"/>	
Robot subsystem design	<input type="range"/>	
System integration	<input type="range"/>	
Robot fabrication process	<input type="range"/>	
Robot testing process	<input type="range"/>	
Robot quality delivered	<input type="range"/>	
Overall Ri3D experience	<input type="range"/>	

Let the wise listen to add to their knowledge and get guidance. (Proverbs 1:5)

Comments:

Start:

End:

13

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ASSESSMENT: Team Development

	Weak	Strong
Leadership demonstrated	<input type="range"/>	
Members productive	<input type="range"/>	
Members learning	<input type="range"/>	
Inclusivity of members	<input type="range"/>	
Gracious behaviors	<input type="range"/>	
Members documenting	<input type="range"/>	
Members seek out help	<input type="range"/>	
Overall team experience	<input type="range"/>	

Consider well what you see and learn from it.
(Proverbs 24:32)

Comments:

Start:

End:

14