ROKENBOK EDUCATION

See Like a Designer, Think Like an Engineer

STEM-Maker CURRICULUM

STEM-Maker Curriculum Phase Overview

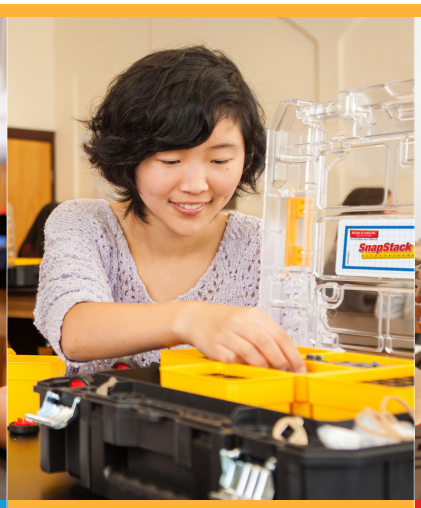
Applications in Design & Engineering

A Progression of Learning

Students start with fundamentals like spatial reasoning, how to make things strong, and how to make things move. As students progress they build on these foundations to explore mechanical and structural engineering, computer aided design and 3D printing, remote and programmable robotics, and project-based integrated STEM challenges.

Mentored Construction Play

STEM Fundamentals



Applications in Design & Engineering

Systems of Technology

Applications In Design & Engineering

Students gain deep comprehension of challenging STEM concepts that they see at work in the world around them. Applications in Design & Engineering lessons build content knowledge and applied practice in mechanical engineering and introductory robotics. Students also practice collaborative problem solving, critical thinking and perseverance.

SnapStack + Basic Robotics Mobile STEM Labs

Each module serves 4 students. Each lab contains 6 modules serving a total of 24 students.
These labs **are necessary** to teach the following learning phases: **Applications in Design & Engineering**.

Note: *This unit can also be covered using the Programmable Robotics Mobile STEM Lab.*

Students Experience and Practice:

- Convergent learning (single solution) and divergent making (open-ended problem solving)
- The Design & Engineering Process
- The 6 simple machines and the roles they play in technology
- How to calculate mechanical advantage, and apply it to problem solving
- Remote controlled robotic systems
- Using robotic mechanisms to convert motion

Applications in Design & Engineering

Detailed Unit Outline

Applications in Design & Engineering 1

		Lesson Time
1. Inclined Plane	• Learn content	1 Hour
	• Build, test, & modify	1 Hour
	• Design & engineering challenge	1 Hour
2. Lever	• Learn content	1 Hour
	• Build, test, & modify	1 Hour
	• Design & engineering challenge	1 Hour
3. Pulley	• Learn content	1 Hour
	• Build, test, & modify	1 Hour
	• Design & engineering challenge	1 Hour
		9 Hrs. Total

Applications in Design & Engineering 2

		Lesson Time
1. Wheel & Axle	• Learn content	1 Hour
	• Build, test, & modify	1 Hour
	• Design & engineering challenge	1 Hour
2. Wedge	• Learn content	1 Hour
	• Build, test, & modify	1 Hour
	• Design & engineering challenge	1 Hour
3. Screw	• Learn content	1 Hour
	• Build, test, & modify	1 Hour
	• Design & engineering challenge	1 Hour
4. Capstone Challenge: ROK Reactor Challenge	• Design & engineering challenge	2 Hour
		11 Hrs. Total

Applications in Design & Engineering 3

		Lesson Time
1. Introduction to Basic Robotics	• Learn how components can be used to create R/C robotic systems (Part 1)	1 Hour
	• Learn how components can be used to create R/C robotic systems (Part 2)	1 Hour
2. Mechanisms	• Links & linkages	1 Hour
	• Gears & gear trains (increasing torque)	1 Hour
	• Gears & gear trains (increasing speed)	1 Hour
	• Cam, slide & follower	1 Hour
3. Robotic Movement	• Creating movement, rotary to linear	1 Hour
	• Design & engineering challenge (rotary to linear)	1 Hour
	• Creating movement, rotary to oscillating (Whitworth Quick Return Mechanism)	1 Hour
	• Design & engineering challenge (Whitworth Quick Return Mechanism)	1 Hour
	• Creating movement, rotary to reciprocating	1 Hour
	• Design & engineering challenge (Scottish Yoke Mechanism)	1 Hour
		12 Hrs. Total

Applications in Design & Engineering 4

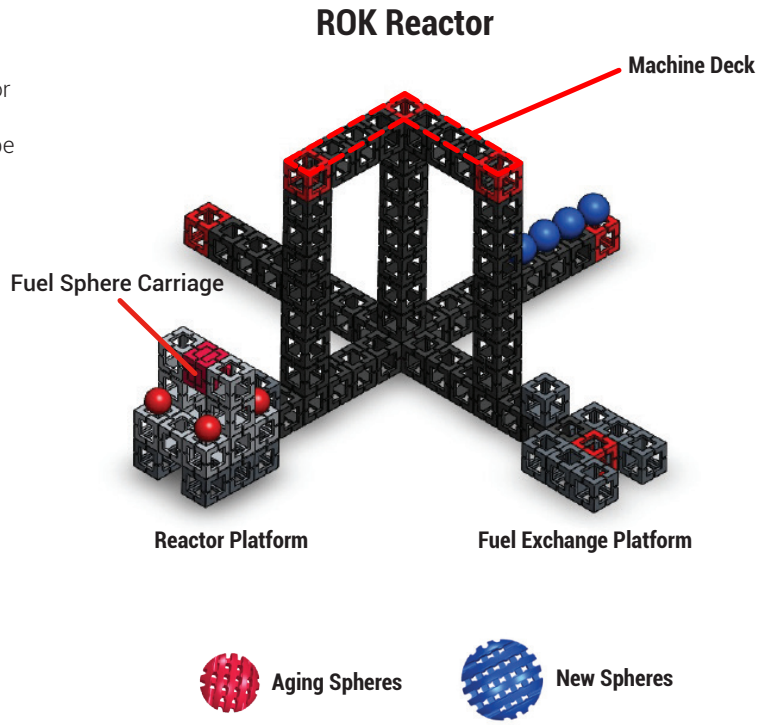
		Lesson Time
1. Compound Machines	• Gear train lift (build & analyze)	1 Hour
	• Unloading trailer (build & analyze)	1 Hour
	• Compound machine challenge (tow truck)	1 Hour
2. Mobile R/C Challenge	• Design & engineering challenge (part 1 - build, test, & modify)	1 Hour
	• Design & engineering challenge (part 2 - demonstrate & present)	1 Hour
3. Robotic Factory Lift Challenge	• Design & engineering challenge (part 1 - build, test, & modify)	1 Hour
	• Design & engineering challenge (part 2 - demonstrate & present)	1 Hour
4. Custom Project	• Invent a custom robot or robotic system that solves a problem	2 Hour
		9 Hrs. Total

Design & Engineering Challenge: Compound Machine

In this challenge, each team must design and engineer a custom compound machine. Read carefully through the design brief below, then use the design and engineering process to develop a solution to the challenge.

Design Brief: Scenario

The Rokenbok engineering team has been assigned the difficult task of replacing aging nuclear spheres at the ROK City Nuclear Power Plant. The aging spheres must be removed from the reactor and stored safely in a nuclear storage facility. Because of the possibility of radioactive contamination, the aging spheres must be transferred using a Reactor Transfer Machine (RTM) from the **Reactor Platform** to the **Fuel Exchange Platform**. The RTM can only be run for a maximum of two minutes due to federal regulations. It is crucial to exchange as many aging spheres as possible within the time allowed.



Design & Engineering Challenge

Design and Engineer a mechanical device that can safely transfer aging spheres to the **Fuel Exchange Platform**, replace them with new spheres, and safely return the new spheres to the **Reactor Platform**. The challenge is to interconnect at least two of the six simple machines (to make a compound machine) that can complete the assigned task safely and efficiently.

***Instructions to build ROK Reactor Structure and Fuel Sphere Carriage on page 5.**

Specifications & Constraints

1. The ROK Reactor Transfer Machine (RTM) must include at least two different simple machines.
2. The reactor platform and fuel exchange platform cannot be modified in any way.
3. The fuel sphere carriage cannot be modified in any way, or attached to the RTM.
4. The RTM must be connected directly to the machine deck. No other components can be attached below the machine deck.
5. The RTM must be disengaged from the fuel sphere carriage to begin the competition. It must also be disengaged every time the carriage is transferred from platform to platform to exchange fuel spheres.
6. Only one team member may use their hands to control the RTM from above the machine deck. Other team members may use their hands to secure the ROK Reactor structure to the table or floor.
7. Teams can use hands to exchange fuel spheres, only when carriage is safely positioned on either platform and RTM is disengaged.
8. The RTM must be designed and built in 45 min. Teams will consist of no more than four people.
9. Each team will have 2 minutes to exchange as many aging spheres as possible. The fuel sphere carriage can carry a maximum of four spheres per round-trip transfer.
10. Teams should work through each step in the Rokenbok Design & Engineering process to develop a high quality solution.

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