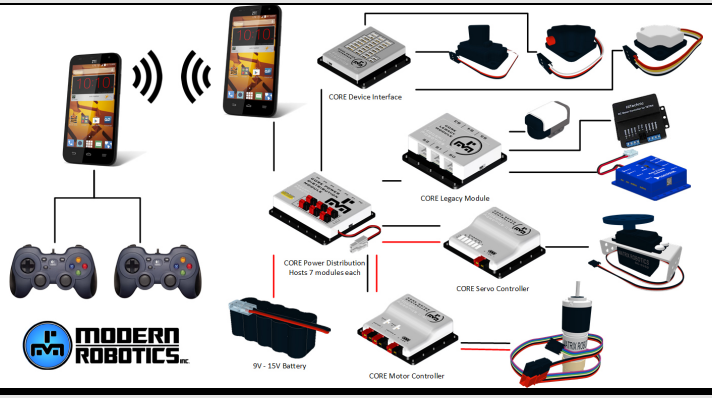
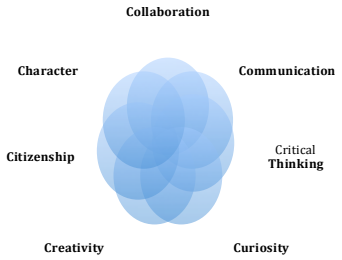
Region 14 Schools
Inspiring Excellence

Content Area: Science	Course: Engineering and Design	**Grade Level: 12**
	**R14 The Seven Cs of Learning** 	

Unit Titles	**Length of Unit**
• Design Process and Planning	• 4-5 weeks
• Building using CAD and CAM	• 4-5 weeks
• Programing using sensors and motors	• 4-5 weeks
• Re-Engineer: continuous improvement	• 3-4 weeks

Strands	Course Level Expectations
Define Problems	• Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
Design Solutions	• Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
Optimize and Revise Solutions	• Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. • Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Unit Title	Design Process and Planning	**Length of Unit**	4-5 weeks

Inquiry Questions (Engaging & Debatable)	How can we best complete this year's challenge? How can we break down this problem into smaller engineering problems?
Standards*	HS-ETS1-1, HS-ETS1-2
Unit Strands & Concepts	● Engineering design process, ● Project Management
Key Vocabulary	Electrical Engineering, Mechanical Engineering, Project, brainstorming, Design Process

*Standards based on Next Generation Science Standards (NGSS) For more information visit: https://www.nextgenscience.org/

Unit Title	Design Process and Planning	**Length of Unit**	4-5 weeks

Critical Content: **My students will Know…**	**Key Skills:** **My students will be able to (Do)…**
• How to organize their thinking to come to a consensus on a possible solution to the challenge • How to apply CAD to help visualize their solution to the challenge.	• Combine their ideas to create a design for the year's challenge • Research similar engineering solutions • Evaluate and integrate solutions to a problem • Draw their mechanical ideas in 3D using Computer Aided Design (CAD) software

Assessments:	Design book: Document where daily ideas and contributions to the project are recorded Research report on a mechanical system or control system student wants to use to complete the project. CAD drawing of their piece of the project
Teacher Resources:	Mechanical project building kit. Computers with AutoDesk Inventor.

Unit Title	Building using CAD and CAM	**Length of Unit**	4-5 weeks

Inquiry Questions **(Engaging & Debatable)**	• How can we build our project? • What are the ways other people have used to do similar things?
Standards*	HS-ETS1-2, HS-ETS1-3
Unit Strands & Concepts	● Project Management ● Engineering research
Key Vocabulary	CAD, CAM, Control System, Torque, Sensor

Unit Title	Building using CAD and CAM	**Length of Unit**	4-5 weeks

Critical Content: **My students will Know…**	**Key Skills:** **My students will be able to (Do)…**
• Engineering principles relevant to the solution of their design problems • Automated control system basics so they can make their project move.	• Apply engineering and physics principles to the solution of their design problems • Calculate torques and speeds needed for a mechanism • Combine CAD parts in an assembly drawing • Use CAD drawings to manufacture 3-D Printed parts • Design a set of controls and outline a control program for their project

Assessments:	Design book: Document where daily ideas and contributions to the project are recorded Research report on a mechanical system or control system student wants to use on their mechanism.. CAD drawing of their piece in assembly with other working pieces
Teacher Resources:	Mechanical Project building kit. Computers with AutoDesk Inventor. Tools for fabricating parts. 3-D printer

Unit Title	Programing using sensors and motors	**Length of Unit**	4-5 weeks

Inquiry Questions (Engaging & Debatable)	• How should the mechanism move to gain the objective the quickest? • How can sensor feedback be used to help control the movements of the robot?
Standards*	HS-ETS1-4
Unit Strands & Concepts	• Project Management • Engineering Research • Device Programming
Key Vocabulary	Input, Output, Open Loop Control, Closed Loop Control, PID Control Loop, Voltage, Current, Resistance

Unit Title	Programing using sensors and motors	Length of Unit	4-5 weeks

Critical Content: My students will **Know**…	Key Skills: My students will be able to **(Do)**…
• Computer Language needed to create control program • How information is Input and output to a remote mechanism • How electrical power is distributed to run a complex mechanism.	• Program their mechanism using the level of computer language appropriate to their abilities (there are many levels ranging from a web based block style to Professional Software APIs) • Wire their mechanism • Explain how power is distributed throughout the mechanism • Use the information from sensors to help control how their mechanism works

Assessments:	Design book: Document where daily ideas and contributions to the project are recorded Wire their mechanism Each student will create a program that can run the mechanism
Teacher Resources:	Computers with internet access to online programming tools and wifi. Wifi control system for projects.

Unit Title	Re-Engineer: continuous improvement	**Length of Unit**	3-4 weeks

Inquiry Questions (Engaging & Debatable)	● How can we optimize our design?
Standards*	HS-ETS1-3, HS-ETS1-4
Unit Strands & Concepts	● Design Optimization ● Engineering Research ● Device programming
Key Vocabulary	Optimization, Re-Engineering, Project Integration, Design Process

Unit Title	Re-Engineer: continuous improvement	Length of Unit	3-4 weeks

Critical Content: **My students will Know…**	**Key Skills:** **My students will be able to (Do)…**
• How to evaluate their solution to the challenge. • How to learn from their mistakes and improve their mechanism	• Build and repair their project • Debug their software • Revise their ideas and their project to make it better. • Present and explain the function of their project.

Assessments:	Design book: Document where daily ideas and contributions to the project are recorded Each student will document an improvement or redesign for their mechanism..
Teacher Resources:	Computers with internet access to online programming tools and wifi. Wifi control system for the project. Tools, 3-D printer.