

## FIRST® Tech Challenge Class Pack Curriculum Overview

### Curriculum Design and Flow

Units are designed with a guiding question and authentic real-world product that helps students achieve workforce, technical or engineering thinking skills.

#### Starting With Workforce Skills

Author Hidden

##### Guiding Question:

How does FIRST® develop workforce skills through Core Values, project management, and developing problem-solving skills through Cooperation® and Gracious Professionalism®?

In this module, you will learn about workforce skills and develop a career card with skills you could bring to the workforce and your team to help you achieve your future goals. These skills will increase throughout the course as you build a robot. The incorporation of FIRST Core Values, project management, and problem-solving skills will help you excel above the workforce's competition.

Each lesson has the guiding question, criteria, and constraints to support the question.

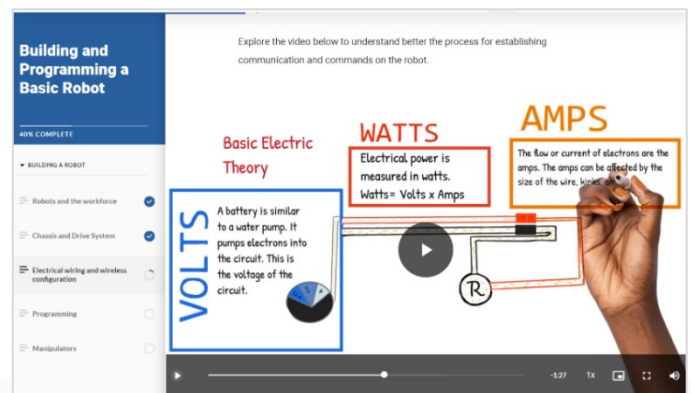
#### Problem Statement

How can we design and build a chassis that considers the center of gravity, speed, torque, and is rigid enough to hold the robot sub-systems?

#### Criteria and Constraints

1. Discover different chassis designs, and conduct a brainstorming session to choose an initial design that meets your design criteria, and student skill level.
2. Using the physics lab conduct an engineering analysis for the center of gravity for the chassis design you chose.
3. Using the physics lab conduct an engineering analysis for friction, torque, and velocity for the chassis design you chose.
4. Develop a project management plan for your chassis build.

Content knowledge is delivered in a variety of formats including videos, scenarios, processes, and interactive hotspots.



**Building and Programming a Basic Robot**

40% COMPLETE

• BUILDING A ROBOT

- Robots and the workforce
- Chassis and Drive Systems
- Electrical wiring and wireless configuration
- Programming
- Manipulators

Explore the video below to understand better the process for establishing communication and commands on the robot.

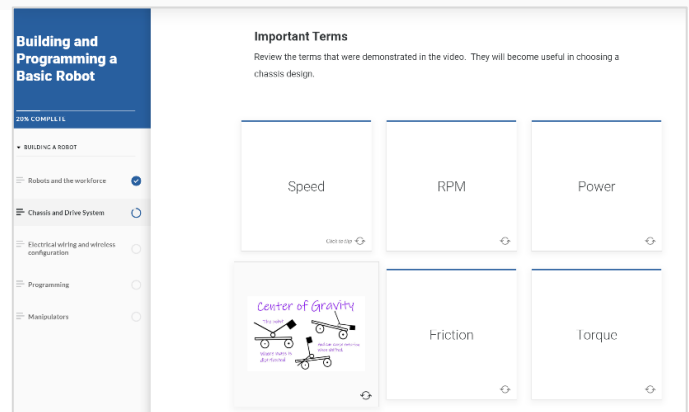
**Basic Electric Theory**

**VOLTS**  
A battery is similar to a water pump. It pumps electrons into the circuit. This is the voltage of the circuit.

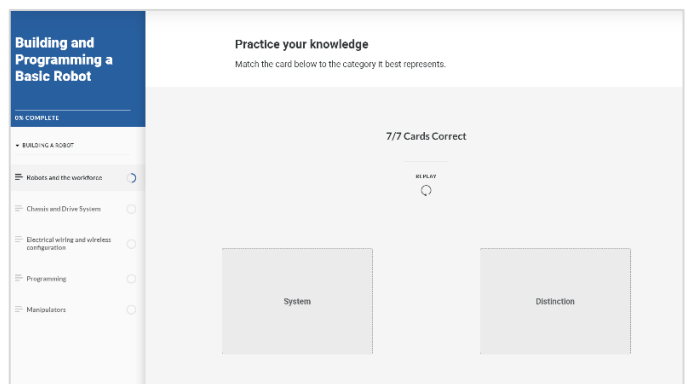
**WATTS**  
Electrical power is measured in watts.  
 $\text{Watts} = \text{Volts} \times \text{Amps}$

**AMPS**  
The flow or current of electrons are the amps. The amps can be affected by the size of the wire, length of wire, etc.

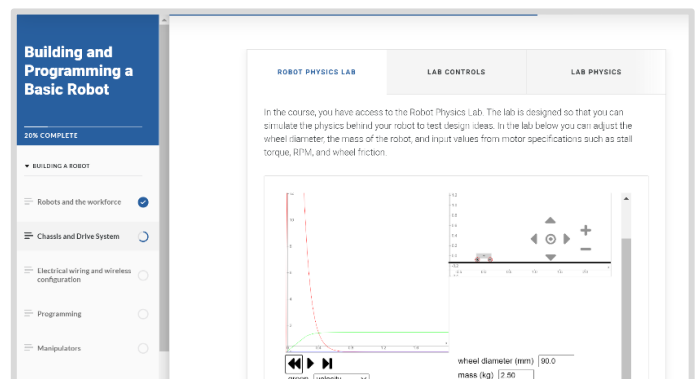
Interactive elements such as flash cards provide opportunities for students to engage in the learning process.



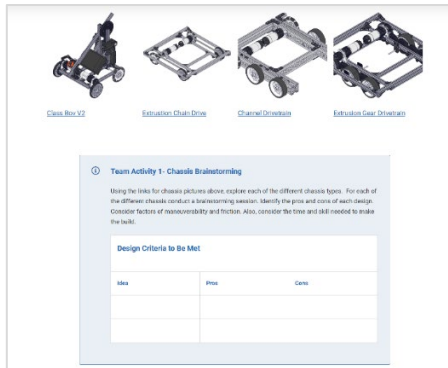
Knowledge checks allow for assessment of learning and feedback to students.



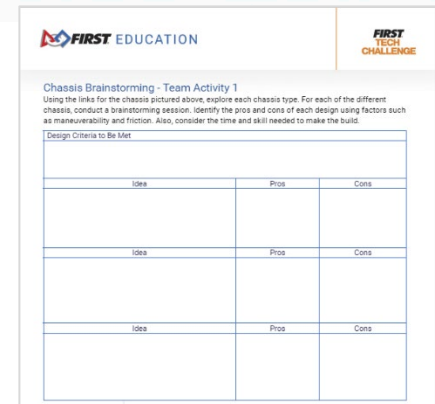
Interactive physics labs allow students to test design ideas and gain understanding of the physics that relate to their design decision.



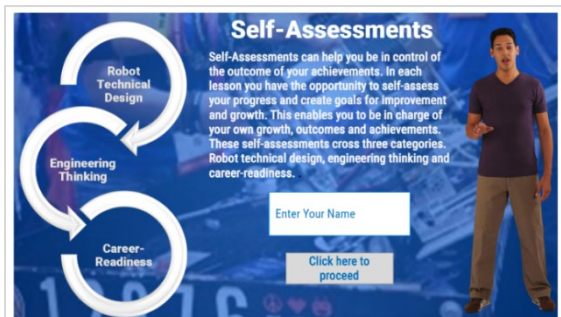
Team activities give students guidance on how to apply their learning to building the robot.



Students document their learning with an engineering notebook. Templates are embedded into the curriculum and can be easily exported to Google or other editing platforms.



Self-assessments tied to course objectives and rubrics are included in each lesson.



Students have the opportunity to earn badges through Tallo.



## Semester Course with Beginner Level Students (45-75 Hours)

One semester course only, students in this sequence would not continue to a second semester.

Unit	Weeks 1-2	Weeks 2-5	Weeks 6-8	Weeks 8-10	Weeks 11-12	Weeks 12-14	Weeks 16-18	Hours
Starting with Workforce Skills								10
Building and Programming a Basic Robot								15
Designing for the Game								5-15
Improving through Iterations I								5-15
Project Sprints and Competitions								5-10
Learning Pathways and Career Exploration								5-10

## Semester 1: Suggested Sequence of Curriculum Modules

Modules	Lessons	Student Outcomes
<b>Starting with Workforce Skills</b> <b>10 Hours</b>	<ol style="list-style-type: none"> <li>1. Core Values</li> <li>2. Project Management</li> <li>3. Tools for Problem Solving</li> <li>4. Career Card</li> </ol>	<p>Students learn about workforce skills through teamwork and problem-solving activities. The incorporation of <i>FIRST</i>® Core Values, team purpose, project management, engineering design process, and computational thinking help students develop skills they will use throughout the course which then transfer to the workforce. Students develop their own identity and purpose card as a culminating project.</p>
<b>Building and Programming a Basic Robot</b> <b>15 hours</b>	<ol style="list-style-type: none"> <li>1. Robots and the Workforce</li> <li>2. Chassis and Drive System</li> <li>3. Electrical Wiring and Configuration</li> <li>4. Programming</li> <li>5. Manipulators</li> </ol>	<p>Students work through the process of understanding the fundamentals of a <i>FIRST</i>® Tech Challenge robot and building it to plan, sense, and act. They will gain all skills needed to reach the meet category in the Robot Technical Design Rubric. Students will participate in a basic robot challenge, with maneuverability, autonomous, and a basic manipulator.</p>
<b>Designing for the Game</b> <b>5-15 hours</b>	<ol style="list-style-type: none"> <li>1. Game Plan</li> <li>2. Robot Plan</li> <li>3. Robot Challenges by Module</li> </ol>	<p>Students use computational thinking to break down the problem of the game and develop a game strategy. They then use the engineering design process and with a decision matrix to develop a robot plan. This lesson will also contain challenges that could be completed within other modules.</p>
<b>Machines to Mechanisms</b> <b>10 hours</b>	<ol style="list-style-type: none"> <li>1. Simple to Complex Machines</li> <li>2. Levers, Cams, and Linkages</li> <li>3. Conveyors, Intakes, and Trajectory</li> <li>4. Linear Pulley Systems and Mechanical Advantage</li> </ol>	<p>Students can learn the physics fundamentals behind different mechanisms that could be included in a robot design. This includes understanding Newton's laws and its relationship to simple machines involved in the designs. Students will develop and improve robot subsystems to improve a robot design.</p>
<b>Improving with Iterations I</b> <b>5-20 hours</b>	<ol style="list-style-type: none"> <li>1. Iteration and the Product Life Cycle</li> <li>2. Mechanism Improvement</li> <li>3. Algorithm Improvement</li> </ol>	<p>Students will evaluate the robot through testing and improvements and document the iteration and improvement process of the design.</p>
<b>Project Sprints and Competition</b> <b>5 hours</b>	<ol style="list-style-type: none"> <li>1. Conducting a Project Management Sprint</li> <li>2. Presentation and Competition</li> </ol>	<p>Students will learn how to meet tight deadlines with project management sprints to divide resources for preparing the robot, the notebook, and developing a team presentation.</p>

## 2<sup>nd</sup> Semester Course with Advanced Level Students (50-85)

Students in this course would have some design and engineering skills. This is the second semester of a full-year course.

Unit	Weeks 1-2	Weeks 2-5	Weeks 6-8	Weeks 8-10	Weeks 11-12	Weeks 12-14	Weeks 16-18	Hours
Industry 4.0								10
Sensors, Machine Learning and Java								10
Improving through Iterations II								10-20
Project Sprints and Competitions								5
Improving through Iterations II								5-20
Learning Pathways and Career Exploration								10-20

## Semester 2: Suggested Sequence of Curriculum Modules

Modules	Lessons	Student Outcomes
<b>Industry 4.0 and Your Community</b> 10 hours	<ol style="list-style-type: none"> <li>1. Industry 4.0</li> <li>2. Community Impact of Industry 4.0</li> <li>3. Making an Impact for Your Community</li> </ol>	Students discover Industry 4.0 technology and how it will change the future workforce. Students will identify possible industries in their area where Industry 4.0 is utilized in the workforce. They will develop a community impact project to use their robot to promote and demonstrate Industry 4.0 technology to their community.
<b>Sensors, Machine Learning and Java</b> 15 hours	<ol style="list-style-type: none"> <li>1. State Machines with Sensors and Robot Navigation</li> <li>2. Developing Robot Machine Learning</li> <li>3. Object Oriented Programming</li> </ol>	Students will learn how to set up programs with automation where they can create functions designed around robot commands. They will use this to increase robot decision making and incorporate more advanced sensor capability such as image recognition.
<b>Improving through Iterations II</b> 5-15 hours	<ol style="list-style-type: none"> <li>1. Mechanism Improvement</li> <li>2. Algorithm Improvement</li> <li>3. Gathering Data</li> <li>4. Conducting a Project Management Sprint</li> </ol>	Students will use design constraints to develop a project management plan for testing and improvement for their design to meet established constraints and criteria.
<b>Learning Pathways and Career Exploration</b> 15 hours	<ol style="list-style-type: none"> <li>1. Engineering Portfolio</li> <li>2. Resume and Digital Badges</li> <li>3. Learning Pathways and Competition Teams</li> </ol>	Students will explore industry certifications available through FIRST and STEM. They will explore learning pathways and work-based learning opportunities while on a FIRST Competitive team.

## Design Elements

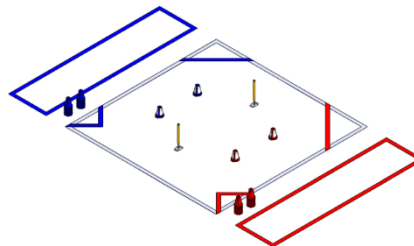
The curriculum scaffolds computational thinking into the engineering design process to help students increase critical thinking and problem-solving skills.

### Principles of Computational Thinking

Decomposition  
Abstraction  
Pattern Recognition  
Algorithmic Thinking



Project-based learning is achieved through competing with a robot and defending the design process, teamwork, and strategy through presentations. Students develop social emotional learning skills through self-assessment of their performance in the process.



### Project-Based Learning

FIRST seeks to blend training and education through project-based learning that creates authentic learning opportunities through experiences provided by our programs, both competitive team and classroom-based opportunities.



Intellectual Challenge



Authenticity



Public Product



Collaboration



Project Management



Reflection

Students explore and apply industry 4.0 skills include big data, Internet of Things, artificial intelligence, and augmented reality through their applications on the robot.

