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# Curriculum

## Overview

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*Design and Discovery* is a curriculum that can be implemented in a variety of settings, depending on the format of your program. *Design and Discovery* introduces students ages 11-15 to engineering through design. The curriculum is organized into six sections which are further divided into 18 sessions. Each session is 2.5 hours and includes two to four 20 – 90 minute hands-on activities.



Each activity includes a facilitator instruction page and a student handout with directions for students. Many activities also include a student reading. Some sessions include a Home Improvement activity, which should be completed at home with input from family members. Key Concepts provide supporting information for the facilitator on new concepts introduced in sessions 1-12.

## Understanding the Design Process

In the first two sessions, students are introduced to the designed world through a shared experience and then practice the 10-step design process that is revisited throughout the curriculum.

### Session 1: Jump Into Design

Students re-think and re-engineer everyday objects. These hands-on activities reinforce a 10-step design process that is used many times throughout the *Design and Discovery* curriculum.

### Session 2: The Designed World

Students learn that design opportunities are everywhere. This session builds the ability to analyze existing objects for improvements and helps students identify good problems to solve with design and engineering.

## Engineering Fundamentals

These four sessions provide background in materials, electrical, and mechanical engineering principles that students may want to incorporate in their designs.

**Session 3: Materials for Design** Students learn about four different classes of materials and test them to understand their properties. They apply selection criteria to determine the best materials for different applications, while learning to consider cost and environmental impact when choosing materials.

## Design and Discovery Curriculum Overview (continued)

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### **Session 4: Getting a Charge From Electricity**

Circuits are the building blocks of all electrical appliances. In this session, students explore simple, series, and parallel circuitry with bulbs, batteries, wires, and breadboards. They then build on these concepts by learning about short circuits, fuses, and then wiring an LED number display to light up their favorite numbers.

### **Session 5: Making Machines**

Students explore the mechanics of simple machines, and then apply what they learn to make a mechanical toy of their own design.

### **Session 6: One Problem, Many Solutions**

Wake up students' observation skills by having them analyze the form and function of a digital clock radio. Students compare clock radios to see how the functions are implemented in different designs.

## Thinking Creatively

In these three sessions, students identify interesting and personally meaningful problems and develop ideas for solutions.

### **Session 7: The 3 R's Of Problem Identification**

The 3 R's Of Problem Identification invites students to revisit, refine, and research design opportunities for a project of their own. Using a variety of techniques, students narrow down their list of design opportunities.

### **Session 8: A Brief Focus on Your Design Problem**

Preparing a design brief helps students to focus their understanding about a problem and propose a solution.

### **Session 9: A Solution Taking Shape**

Students delve deeper into their proposed design solution as they research patents for similar ideas and consider the necessary parts to get from "think" to "thing."

## Making, Modeling, and Materializing

Throughout these three hands-on working sessions, students turn their thinking into things and begin several cycles of building trials and testing their ideas.

### **Session 10: Bicycle Breakdown: Systems, Components, and Parts**

Some ideas have complex solutions that need to be divided into manageable parts. Students use bicycles to think about systems and components in a product they might design and engineer.

## Design and Discovery Curriculum Overview (continued)

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### **Session 11: Design Requirements and Drawings**

Design requirements help designers focus on the user and fine-tune design details. Drawings help to further the process of moving from “think” to “thing.”

### **Session 12: Planning for Models and Tests**

Students make their project ideas tangible—going from what’s in their mind to things in their hand. Students reflect on changes to their ideas and then plan what to construct—a model of systems, components, or the product itself.

### **Session 13: Making It! Models, Trials, and Tests**

Let the construction begin! Pieces, parts, and connections become trials and models of a system, a component, or the product itself.

## Prototyping

In these three sessions, students refine their projects into working prototypes.

### **Session 14: Prototype Practicalities**

Projects are taken to the next level as students plan how to develop their working prototypes. They consider the product specifications, materials, and budget.

### **Session 15: Develop It!**

This work session gives students time to construct their prototypes. Like all other stages in the design process, students may need to make several prototypes as they conduct trials and tests of the product.

### **Session 16: Test It!**

Conducting user testing allows students to try out their products, get feedback, evaluate the feedback, and plan their revisions.

## Final Presentations

*Design and Discovery* culminates with students sharing their projects. In the final two sessions, students plan for and participate in an event to showcase their projects and get feedback.

### **Session 17: Fairly There**

Students begin to prepare for a culminating celebratory event to share their projects and their engineering and design expertise—either a showcase or a mini-engineering fair. Preparation involves planning the event and designing a display.

### **Session 18: Dress Rehearsal**

Get ready for the big event! Practice makes perfect, as they say. Students practice their presentations and receive feedback from their peers. Following the event, they reflect on their *Design and Discovery* experience.