



# Inventors of New England

## High School Lesson Plan

**Topic** Technology and inventions

**Grade Levels** 9-11

### Overview

This QUEST episode, *Inventors*, explores the process of invention with some successful entrepreneurs in New England. It also reveals some of the challenges inherent in trying to develop new products. Students will learn about some of the new technologies that individuals in northern New England have created, from innovations in human transportation to medicine to handling human waste. Students will also see how each enterprising inventor saw a problem, created a potential solution, and is building and testing prototypes, hopeful of creating a solution to one of society's dilemmas. Along the way, this teaching unit will investigate what it means to be an inventor and what it takes to be successful.

### Introduction

In this unit, students will brainstorm about some inventions that have helped them in their own lives. They will view a portion of the QUEST: *Inventors* video and will follow up with a discussion of the inventors they have seen and the products these people have developed. From a given set of challenges, students will then select one problem area to explore. They will identify the design constraints of the particular situation and will work in teams to develop a new technological design, or a modification of an existing design, to address the challenge. Finally, each team will present their ideas to the class, which will evaluate both the effectiveness of the design and how well the team held to the project's set constraints.

### Time Allotment

4 class periods of 45 minutes each, or 3 longer blocks of class time

### Accessing Prior Knowledge

Students should be familiar with the technology design process that is applied in developing a product, as compared with the process of scientific inquiry that is directed at furthering our conceptual understanding of science.

**QUEST: Investigating Our World is a regional public television series  
seen on Maine Public Broadcasting Network, Vermont Public Television, and New Hampshire Public Television**



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## Concepts to Clarify

Many students cannot clearly distinguish between the technology design process and the scientific investigation process. Research has shown that in many cases it may be easier for students to apply the technology design process where they are seeking specific outcomes. The scientific investigation model, on the other hand, requires higher-order analytic thinking to derive cause-and-effect models to support scientific concepts.

Concurrently, it has been seen that when high-school students have difficulty differentiating between science and technology, they most often express views that are negative toward technology. They tend to associate technology primarily with pollution or weapons, whereas they tend to associate science with positive results, such as advances in medicine. Students should realize that there can be both technological and scientific advances in each of these realms.

Research has also revealed that students feel that scientists and engineers are more capable than other people of making decisions on matters involving science and technology. They tend to assume that these professionals fully understand the material and are somehow immune from being influenced by their personal beliefs. Somehow, students think that being a scientist or engineer gives an individual an objective outlook on all related issues.

## CONNECTIONS TO THE STANDARDS

<b>Maine Learning Results</b>	<b>New Hampshire Curriculum Framework</b>	<b>Vermont Learning Standards</b>	<b>National Science Education Standards</b>	<b>Benchmarks for Science Literacy</b>
<p>J. Inquiry and Problem Solving</p> <p>4. Design and construct a device to perform a specific function, then redesign for improvement (e.g., performance, cost).</p>	<p>SC - 1.1.10.11: Explain how scientific knowledge is applied in the design and manufacture of products or technological processes, e.g., water purification systems, sewage treatment systems, microwave ovens, resistors.</p>	<p>7.1.hh. Identify problems and opportunities, propose designs and choose among the alternatives, implement a solution and evaluate its consequences.</p>	<p>Content Standards (9-12)</p> <p>E.1 Abilities of technological design: a. Identify a problem or design an opportunity. b. Propose designs and choose between alternative solutions. d. Evaluate the solution and its consequences.</p>	<p>The Nature of Technology</p> <p>3b. Design and Systems, 9-12a: In designing a device or process, thought should be given to how it will be manufactured, operated, maintained, replaced, and disposed of and who will sell, operate, and take care of it. The costs associated with these functions may introduce yet more constraints on the design.</p>



### Materials Needed

- TV with VCR
- QUEST *Inventors* video
- Computer(s) with Internet access for teacher to print materials or for students to use for reading or online research. (Computers may also be used as a “library” of research materials that have been bookmarked or stored for use by students.)
- Chart paper and markers
- Student Handout 1: What Is an Invention?
- Student Handout 2: Technology Design Process
- Student Handout 3: QUEST: *Inventors* Viewing Guide
- Student Handout 4: Finding a Way to Fly
- Student Handout 5: QUEST *at Home* – How Does That Work?

## I. Introducing the Concepts

In this first activity, students will brainstorm inventions that have been marketed over the past year. They will explore their ideas about who inventors are, what an invention is, and how one goes about inventing a product.

### Step 1

Distribute copies of Student Handout 1: What Is an Invention? Ask students to complete Part 1 of the handout by individually brainstorming a list of inventions that have appeared in the marketplace in each of the four areas listed. Begin by having the whole class identify one example for each area before student work independently. When students have finished individually filling in their charts, have them share their ideas with the whole class. Some suggestions to help them start their work might be: **health:** nasal spray flu shot, LASIK eye surgery, magnetic resonance imaging (MRI's), wet shaver, breath strips; **environment:** low cost, low energy water purifier; oil clean-up technologies, smokestack scrubbers for removing particulates and odors, CO<sub>2</sub> Detectors, satellite imagery and sensors; **recreation:** iTunes Music, camera phone, man-made snow; and **transportation:** hydrogen cars, solar cars, 4 stroke engine snowmobiles, shaped skis.

Ask students to work in teams of 2-3 to complete Part 2 of the handout. They should first decide how they would define an invention. When each team has written out a definition, ask them to share their ideas. Then discuss with the whole class what the characteristics of an invention are. Some ideas might be something new that never existed before; something innovative and creative; something that adds value to an existing product.

Next, have each team select one of the inventions they have listed in their charts in Part 1 of the handout. Together, they should try to define and outline the steps they think an inventor would have to go through in order to develop this product. When all teams have finished their outlines, have them share their ideas.



Discuss as needed.

### Step 2

Distribute copies of Student Handout 2: Technology Design Process. Have teams compare the steps they have listed on the previous handout with the steps described on Student Handout 2. Allow them time to make changes to their outlines as needed.

## 2. Exploring the Concepts

In the next activity, students will watch the *QUEST: Inventors* video. As they view, they will take notes on the wide range of inventions presented in the film – including the problem each invention addresses, the invention process described, and possible reasons for the success or failure of a given invention.

### Step 1

Distribute copies of Student Handout 3: *QUEST: Inventors* Viewing Guide. Review the handout and discuss the kinds of information students should look for as they watch the video. Tell them that they should fill in the chart on the handout as they view. Students should still be arranged in their teams from the previous activity.

### Step 2

**Play** the first half of the video. Check to be sure that students are filling in the chart on the handout as they watch. **Stop** when you get to the section where John Todd is introducing Eric Wells. Have students discuss their notes with their team members.

When they have all completed their charts, instruct teams to complete the rest of Student Handout 3. Each team should select one of the inventions they have noted from the video. Using the description of the technology design process on Student Handout 2 as a guide, they should then list the steps in the design process for their chosen invention (as described in the video). Remind teams to specify any steps in which the inventor had problems, causing a revision of the design. Next, have teams identify the scientific concepts that have been applied during the development of this particular invention.

### Step 3

When all teams have finished their analyses, lead a whole-class discussion about some of the inventions they have chosen. Highlight steps in the design process, and focus on the process of both design and revision. Also, lead students to recognize points in the process where scientific concepts are being applied to the design solution.

## 3. Developing the Concepts

In the next activity, students will investigate the technology design process by researching an invention. They will outline the steps the inventor took to identify the problem, design a solution, create a prototype, test the



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prototype, refine the design, manufacture the product, and distribute it to customers.

### Step 1

Distribute copies of Student Handout 4: Finding a Way to Fly. Have students review the description of the invention of flight; they can do this online at Overview of the Wright Brothers Invention Process (<http://www.grc.nasa.gov/WWW/Wright/overview.htm>) or by reading the information as a handout. (**Note:** This will require that you download, print, and photocopy the Wright brothers information before the beginning of class.)

### Step 2

Using the description of the technology design process on Student Handout 2 as a guide, students in teams should now complete Handout 4 by describing each phase of the Wright brothers' design process for the first airplane. When everyone has finished, lead a class discussion about this particular process of design. Encourage students to note what the similarities and differences are between the technology design process and the scientific process. You might want to reread the section on Concepts to Clarify in the introduction to this lesson to help students refine their ideas about the Technology Design Process. Ask students what the Wright Brother might have been studying if they were applying the scientific process to their work. (They would have been researching an idea such as airflow, as opposed to applying ideas about airflow to build an airplane.)

## 4. Applying the Concepts

In the following activity, students will continue to follow the technology design process in their teams. They will be asked to select one of four areas – health, environment, transportation, or recreation – and to come up with an idea for an invention that will provide a benefit in this area. Teams will be required to design a device that would cost the consumer less than \$100, provide enough benefit to make the product marketable to their selected audience, and still produce a modest profit for the manufacturer. Teams will also be asked to draw the device, describe its functioning, and outline a rough plan for manufacturing and distributing the device.

### Step 1

Tell the class that they will now be inventors themselves. Working in their teams, they should come up with a device that addresses a human need in one of four areas: health, the environment, transportation, or recreation. Explain that each team will be required to:

- create a problem statement
- brainstorm multiple design solutions
- evaluate and select a solution
- identify the science concepts applied to the problem
- draw, diagram, model, or build a prototype of the solution to fully depict how it operates
- identify the materials from which the device is made
- identify any positive or negative consequences that might occur with use of the device



- communicate the plan, including identification of a target audience for the device

Agree upon a due date for teams to present their inventions to the rest of the class. Provide assistance as needed.

### Step 2

Teams should present their devices to the class. Each presentation should be evaluated to determine how well the device has met the design criteria listed above. Evaluation can be done as a self-evaluation by the student and as peer evaluations by other teams.

## 5. Extending the Concepts

### QUEST at Home

Distribute copies of Student Handout 5: *QUEST at Home – How Does That Work?* Review the handout with students before they take their copies home. Agree upon a due date for students to return to class with their findings.

### Community Connections

It can be surprising for students to find out how many inventors there are in the world, perhaps even in their own community. Contact your local Chamber of Commerce to see if they are aware of anyone in the area who might come in to school to share his or her experiences in inventing a product.

### Career Opportunities

There are many careers that pertain to the creation, manufacturing, marketing, and distribution of new products. Discuss the roles that individuals with the following careers may have with regard to inventions.

**Engineers:** electrical engineers, mechanical engineers, civil engineers, draftsman

**Manufacturing:** materials scientists, automation designers, programmers

**Packaging Designers**

**Marketing:** graphic artists, printers and publishers, media consultants, producers

Many small businesses devote considerable resources to keeping track of the many new devices that become available in their areas of interest. Have a local businessperson visit your class to describe how they keep up with changing products in their field, and how they decide which products to buy or to offer.

Anyone who creates a new product must make the public aware of it. This is usually the task for a marketing expert. Contact a local graphic designer or printer who might be willing to share his or her expertise and provide helpful hints about presentation and marketing.



## What Is an Invention?

### PART I

**Directions:** In the chart below, list inventions that have appeared in the marketplace over the past year.

Health	Environment	Recreation	Transportation
Arrange these inventions under the appropriate headings.			

### PART 2

**Directions:** Answer the following questions.

1. What is an invention?
  
2. What steps do inventors take to create their products? Choose one of the inventions you have listed above. Then, with your team, list as many steps in the design and development process as possible. Use the back of this sheet to show your work.



## Technology Design Process

### ■ Identify a Problem

Either find a problem that exists and is in need of a new solution, or identify an improvement to an already existing product.

### ■ Propose a Solution

Create a design, including materials, and describe its practicality as a solution.

### ■ Construct a Model or Prototype

Construct a prototype of the design, using selected materials or a simulation.

### ■ Analyze the Design

Determine whether your solution is most appropriate in usefulness, cost-effectiveness, and other predetermined design constraints.

### ■ Manufacture the Product

Determine the process for producing this design for the identified audience.

### ■ Distribute the Product

Determine the process for getting this product to its market segment (audience).

### ■ Communicate the Process

Present the problem, the design solution, the production process, and distribution plans.



## QUEST: Inventors Viewing Guide

1. Complete the chart below for each invention mentioned in the video

Invention	Inventor	Design Problem	Reason for Success

2. Select an inventor covered in the video. Describe the steps this person took to create his or her product. Use the back of this sheet to show your work. \_\_\_\_\_

3. Were there areas in which the inventor had problems and needed to revise the design? Describe. \_\_\_\_\_

4. What science concepts did the inventor apply to make this product? \_\_\_\_\_



## Finding a Way to Fly

**Directions:** Describe the activities of the Wright Brothers as they worked through each of the following stages to build the first airplane.

■ **Identify a Problem:** \_\_\_\_\_

■ **Propose a Solution:** \_\_\_\_\_

■ **Construct a Model or Prototype:** \_\_\_\_\_

■ **Analyze the Design:** \_\_\_\_\_

■ **Manufacture the Product:** \_\_\_\_\_

■ **Distribute the Product:** \_\_\_\_\_

■ **Communicate the Process:** \_\_\_\_\_



# How Does That Work?

You're on a QUEST!

**Step 1.** With your family, make a list of some of the inventions that are important to you in your everyday life.

**Step 2.** Together, complete a description of one of the devices you have listed in Step 1 above. If you need more facts about your chosen invention, use the Resource section at the end of this handout to conduct some research on this product.

**Invention:** \_\_\_\_\_

**Inventor:** \_\_\_\_\_ **Date Invented:** \_\_\_\_\_

**Its importance to me:** \_\_\_\_\_

**Drawing (with its parts identified):**

**How it works:** \_\_\_\_\_

**Changes made to it since invention:** \_\_\_\_\_

**Changes I would like to see in it:** \_\_\_\_\_

## Resources

### Inventors and Inventions

<http://www.zoomschool.com/inventors>

### Inventing Modern America

<http://web.mit.edu/invent/www/imal/index.html>

### History of Technology

<http://www.refstar.com/techhist>

### How Stuff Works

<http://howstuffworks.com>

### How Things Work

<http://rabi.phys.virginia.edu/HTW>

### National Inventors Hall of Fame

<http://www.invent.org/book/index.html>

### Time Magazine Coolest Inventions of 2003

<http://www.time.com/time/2003/inventions>

### Famous Inventions

<http://inventors.about.com/cs/famousinventions>

### Popular Science Best of What's New 2003

<http://www.popsci.com/popscilbown>

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