# Invention and Innovation

### Background

Necessity is the mother of invention. In pre-20th-centuryVermont, this certainly applied. Isolated from the nation's urban centers and challenged by a rugged landscape and an unforgiving climate, Vermonters became adept at solving problems creatively and building the things they needed to make life easier and work more productive.

Vermont Historical Society

*A horse-powered circular saw invented in Vermont in the 19th century.*

It makes sense, then, that Vermont was—and is—the home of many inventors. The first patent issued by the United States Patent Office was awarded in 1790 to Samuel Hopkins, who had lived near what is now Pittsfield Vermont, for an improved way to make potash from wood ashes. Potash, which was one of Vermont's first major products, was used to make soap. John Deere, inventor of the cast steel plow, got his start as a blacksmith in Rutland. Elisha Otis built wagons and carriages in Brattleboro before moving to Illinois in 1837 and inventing the safety elevator. In St. Johnsbury, Thaddeus Fairbanks stayed in Vermont, building an empire on the platform scale, which he invented in 1830.

At the time these inventors worked in Vermont, manufacturing was a slow process. Often, a single, highly skilled laborer would take weeks or even months to build a gun, a tool, or a piece of furniture. No two finished products were identical, and if a product broke, new parts had to be made by hand. Soon, developments in Vermont would help to change all that.

The Robbins & Lawrence Armory in Windsor, Vermont played an integral role in the development of the American System of manufacturing. The key to the American System was the invention and perfection of machine tools such as the drill press and the lathe. Using these tools, it was possible to create individual parts that were identical.

With identical parts, it no longer took a single skilled laborer weeks or even months to build a gun or other product. A semi-skilled worker could assemble one much faster. The American System helped build the Northern states into an industrial powerhouse, and the ability of the North to churn out weapons and equipment in its factories contributed greatly to the Union victory in the Civil War.

Today, the inventive spirit remains alive and well in Vermont. Inventors are doing the same thing they have always done—making tools and other products that solve people's problems.



## *About This Segment*

Produced by filmmakers Jill Vickers and Katherine Wheatley, the segment focuses on how Vermont's inventors have changed life for Americans throughout history and to the present day. A particular focus on the segment is the American Precision Museum in Windsor, Vermont.

### Before Viewing

- It has often been said that "Necessity is the mother of invention." What does this proverb mean?
- What kinds of skills does an inventor need?
- Why might those skills have been valuable in Vermont in 1850?
- Why might those skills still be needed in Vermont today?

### Vocabulary

**machine tools:** tools such as drills, lathes, and stamping machines that can be used to manufacture identical parts that can be assembled into products

**interchangeable parts:** parts manufactured to be identical so that one can replace another in the manufacture or repair process

**jig:** a device that guides a machine tool and its user to ensure that parts are identical to each others

**division of labor:** a system of working in which each person is responsible for doing only one or a few parts of the process

**American system of manufacturing:** a system in which interchangeable parts and the division of labor are used to build products

### After Viewing

- Why was the Vermont of the 1800s and early 1900s a hotspot for inventors?
- What important contributions have Vermont inventors made?
- How did machine tools changed manufacturing?
- What roles do inventors play in Vermont today?

Grades 4-5

**Inventor Wanted** Every inventor starts by exploring a problem that needs solved. Often, these problems are small ones, such as how to make a shoe easier to lace up or how to keep a cat from scratching the furniture. Look around you, and find a problem that bugs you. Then make a "Help Wanted" poster advertising the problem and seeking an inventor to solve it. On your poster, be sure to explain the problem, and to list the skills an inventor might need to solve it. Then put your poster up in your school classroom or library. You might help solve a problem that bugs other people, too.

*Vermont History and Social Sciences Grade Expectations*
Conduct research (3-4:4; 5-6:4); Communicate findings (3-4:7; 5-6:7)

**Being Mr. Fairbanks** Thaddeus Fairbanks made a fortune from the invention and sale of his platform scale. Try building a scale of your own. Fairbanks' platform scale could weigh very heavy objects like loads of wheat or coal. You can focus on smaller objects, weighing a few ounces or up to a pound. To start out, look at different types of scales, including pan and balance scales. Then use those ideas to design your scale. Remember, the goal is to weigh objects accurately—so you'll need some objects with known weights.

Build and test your scale. Does it work well as designed—or do you need to make some improvements?

*Vermont History and Social Sciences Grade Expectations*
Initiate an inquiry (3-4:1; 5-6:1); Develop a hypothesis (3-4:2; 5-6:2); Design research (3-4:3; 5-6:3); Conduct research (3-4:4; 5-6:4); Communicate findings (3-4:7; 5-6:7)

## Grades 6-8

**Building a Better Toothbrush** Sometimes inventors don't create something new—they just improve on an existing invention. Take the toothbrush. Long ago, people chewed twigs to help clean their teeth. Today, toothbrushes exist in dozens of different shapes, sizes, and bristle arrangements. See if you can make some improvements of your own. To get ideas, look at existing toothbrushes. Draw a design for an improved brush. Then build a model of it using "spare parts" from inexpensive toothbrushes. When you are finished, let a classmate try out your brush, then give you a review. Is your toothbrush destined for fame—or does it need to go back to the drawing board?

*Vermont History and Social Sciences Grade Expectations*
Initiate an inquiry (5-6:1; 7-8:1); Develop a hypothesis (5-6:2; 7-8:2); Design research (3-4:3; 5-6:3); Conduct research (3-4:4; 5-6:4); Communicate findings (3-4:7; 5-6:7)

**An Everyday Invention** The world we live in today exists because of a series of millions of inventions and improvements. Of course, we all know some: fire, the wheel, written language, the automobile, and the Internet. But where would we be without more humble inventions such as the fork, the nail, the paper bag, cement, or duct tape? Do research to find out more about an everyday invention you admire. Find out about who invented it. Find out why they did so. And learn about how the invention changed the world. Then present your findings in a short talk to your class entitled "Ode to an Everyday Invention."

*Vermont History and Social Sciences Grade Expectations*
Initiate an inquiry (5-6:1; 7-8:1); Design research (5-6:3; 7-8:3); Conduct research (5-6:4; 7-8:4); Develop reasonable supporting explanations (5-6:5; 7-8:5); Communicate findings (5-6:7; 7-8:7); Interaction/interdependence between humans, the environment, and the economy (5-6:18; 7-8:18)

**Vermont Inventors Wall of Fame** Vermont inventors have improved life for millions of people. Why not honor them with a Vermont Inventors Wall of Fame? Do research to find out about inventors from the Green Mountain State. Then draw a portrait of each inventor and one of the inventions he or she created. To accompany your pictures, make a label that includes information about the person's inventing successes and failures. Hang your portraits in a prominent place, so others can learn about Vermont's inventive spirit.

*Vermont History and Social Sciences Grade Expectations*
Initiate an inquiry (5-6:1; 7-8:1); Design research (5-6:3; 7-8:3); Conduct research (5-6:4; 7-8:4); Develop reasonable supporting explanations (5-6:5; 7-8:5); Communicate findings (5-6:7; 7-8:7); Understand issues of human interdependence (5-6: 16; 5-7:16); Interaction/interdependence between humans, the environment, and the economy (5-6:18; 7-8:18)

## Grades 9-12

**Meet the Inventor** Find out more about inventors in Vermont by inviting one into your classroom. You can start by contacting InventVermont, an organization of Vermont inventors located online at inventvermont.com. They can help you find an inventor to visit your classroom. Encourage the inventor to bring along not only a finished product, but some models or photos that shows the steps along the way. Prepare interview questions, so you can learn more about how an inventor works and makes business decisions. Write a news story about the inventor's visit for a print or online publication. Include some photos.



*Vermont History and Social Sciences Grade Expectations*
Initiate an inquiry (9-10:1; 11-12:1); Understand human interaction with the environment (9-10:12; 11-12:12); Interaction/interdependence between humans, the environment, and the economy (5-6:18; 7-8:18)

*Ben Holleran of Chester, now a Vermont Technical College student, demonstrating how gears work at the American Precision Museum, Windsor, VT.*

**Otis or Deere?** John Deere and Elisha Otis both got their start in Vermont. Deere went on to invent the steel plow, and Otis invented the safety elevator. Which invention has had a greater influence on American life? Form two groups to debate this issue. Gather evidence to find the influence of the steel plow and the elevator. You can include both written and visual evidence. Then hold a debate, with one person playing the role of John Deere and another Elisha Otis. Let your classmates serve as judges.

*Vermont History and Social Sciences Grade Expectations*
Initiate an inquiry (9-10:1; 11-12:1); Design research (9-10:3; 11-12:3); Conduct research (9-10:4; 11-12:4); Develop reasonable explanations that support research (9-10:5; 11-12:5); Communicate findings (9-10:7; 11-12:7); Interaction/interdependence between humans, the environment, and the economy (5-6:18; 7-8:18)

**Machine Tools in Action** In the mid-1800s, machine tools were new, rare, and expensive. Now you can find them in the industrial arts shop at your school. Arrange a tour of the industrial arts department. Invite students who know how to use machine tools to demonstrate the tools' capabilities. Find out how such tools can be used to make identical parts using jigs. Shoot videos of the demonstrations, and create a short film showing your findings.

*Vermont History and Social Sciences Grade Expectations*
Initiate an inquiry (9-10:1; 11-12:1); Conduct research (9-10:4; 11-12:4; Communicate findings (9-10:7; 11-12:7)

### On the Road

**The American Precision Museum** in Windsor, Vermont holds the largest collection of historically significant machine tools in the nation. You can visit the museum from June through the end of October to explore its collections and learn more about how the pioneering work done at the Robbins & Lawrence Armory helped change the manufacturing industry forever. To find out more, visit the museum's Web site at americanprecision.org.

The American Precision Museum also offers an Education Lending Kit on the Industrial Revolution. Designed for grades 7-12, the kit is keyed to NH and VT standards and contains artifacts, photos, primary source documents, activities, books, CDS, a video, and lesson plans. The cost of a three-week rental is $40, plus return shipping. Call 802.674.5781 or send email to info@americanprecision.org for more information.

## *Career Corner:* ***Prop Makers***

If you're good at inventing and making things, the film industry might have a career for you. Prop makers are responsible for building new props from scratch or adding parts to existing objects to give them new life. As a prop maker, you might need to do anything from building a miniature model of a space ship to a life-sized super-car. You'll also learn to adapt existing objects to give them the extra special something they need for their life in the spotlight. How do you get ready a job like this? Learning arts skills can help. Learning to use all sorts of tools—from a hammer and saw to a welder and a spray gun—is a must.

### RESOURCES

***Links***

***American Precision Museum, Windsor, VT***: **americanprecision.org**

***InventVermont:*** **inventvermont.com**
An organization of Vermont inventors

***United States Patent and Trademark Office:*** **uspto.gov**
Information about how to patent an invention

***Vermont Historical Society:*** **vermonthistory.org**
A large collection of models of Vermont inventions is housed here