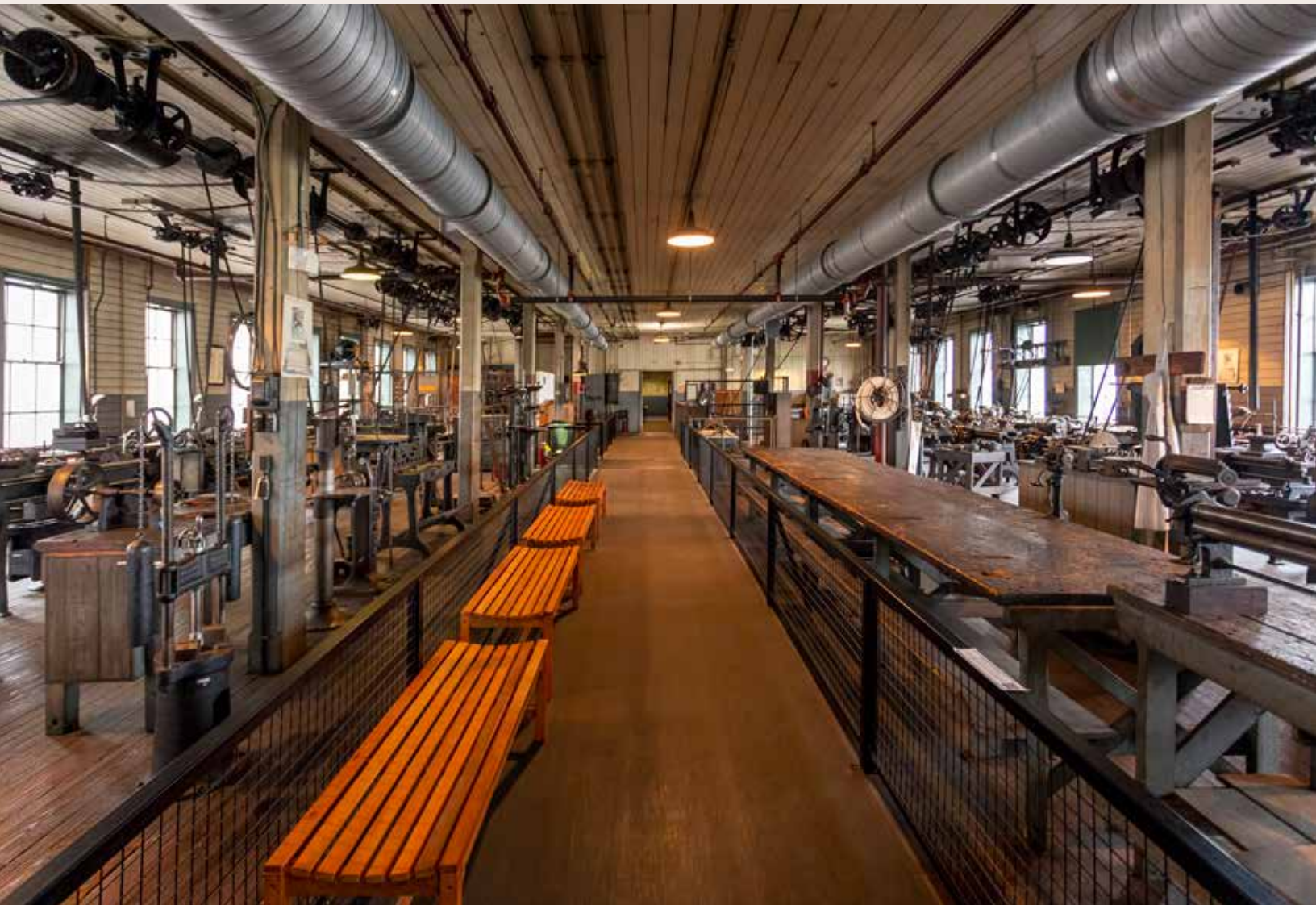
Thomas Edison Information and Activities Book

by
Harry T. Roman



Author Harry Roman is a regular ITEEA contributor and author of the long-time "Classroom Challenge" feature in *Technology and Engineering Teacher*. As a retired engineer and inventor, Harry likes teaching teachers, students, and school leaders about STEM and its applicability.

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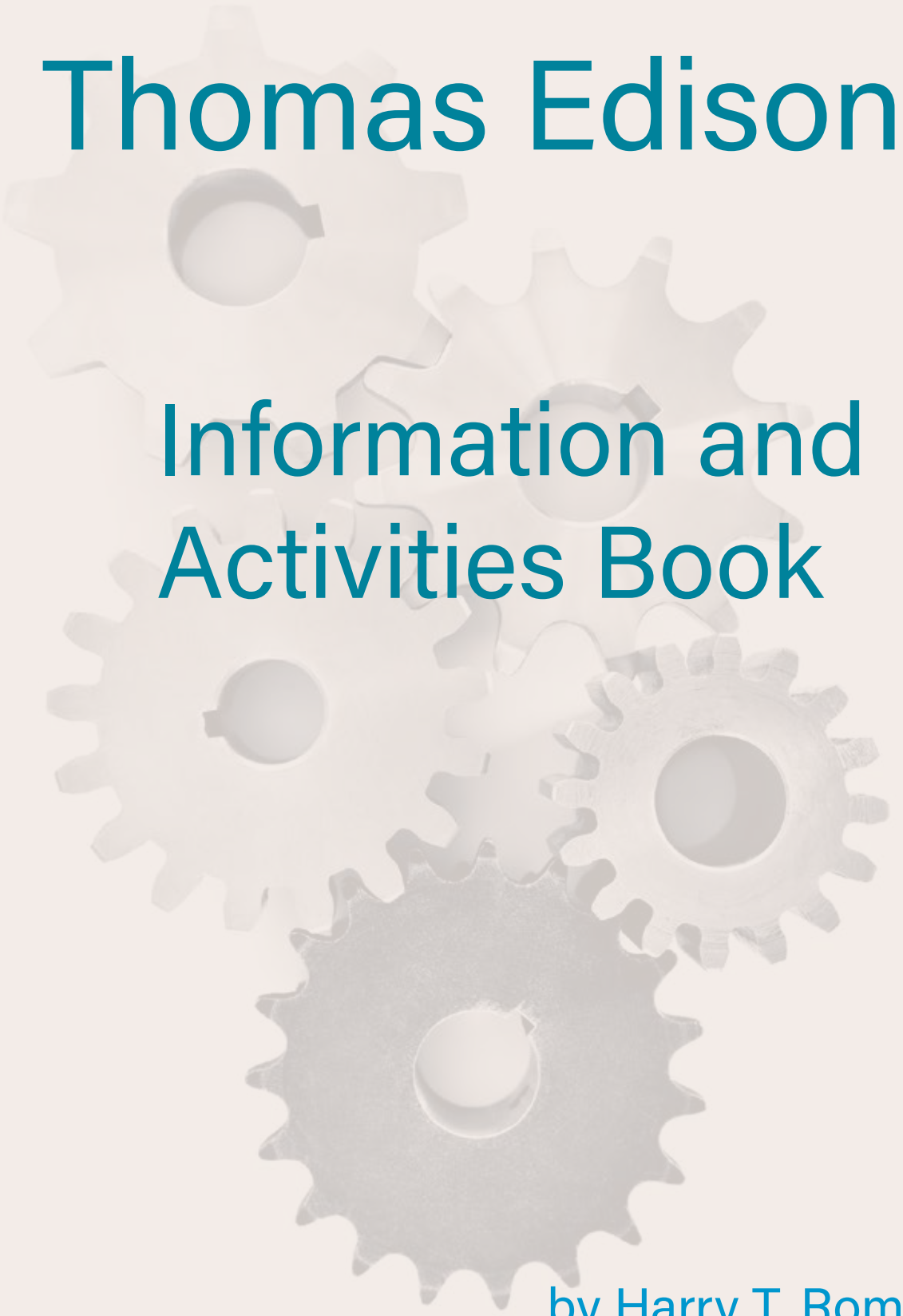

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Thomas Edison

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Introduction

"I never perfected an invention that I did not think about in terms of the service it might give others... I find out what the world needs, then I proceed to invent."

Thomas Edison

Without a doubt, Thomas Edison is the world's greatest inventor, even now influencing legions of new inventors and entrepreneurs. Many excellent books, articles, and teacher resources exist for students to consult, as well as internet sites galore. Edison significantly impacted our world and boosted the ability to innovate and increase the standards of living for its citizens. Much can be gained from having students learn about this great man. His connection to what we study today as STEM is astonishing, as you will see in the pages that follow.

Much of this publication is comprised of information synthesized and extended from many of my previous writings, lectures, and formal presentations about Mr. Edison. He was my boyhood hero, and since I continue to write and lecture about him on behalf of the Edison Innovation Foundation in Newark, NJ and the Thomas Edison National Historical Park site in West Orange, NJ, I can become a bit zealous about my favorite inventor.

It was when I read a book about him way back in 1957/58 that I became an engineer and inventor...so I think my enthusiasm is understandable. Also, I happen to have married the niece of the man who ran Mr. Edison's battery manufacturing operation. I am a true Edison apostle. Sometimes I think Mr. Edison and I were destined to become friends through time.

First, let's take an overall look at what he accomplished in the 30-year time frame of 1870 to 1900, just as a capsule summary of his work. This should get your imagination going.

- 1870 – Stock Ticker
- 1874 – Quadruplex Telegraph (multiple messages on a line)
- 1875 – Electric Pen and Document Duplication Systems
- 1876 – Menlo Park Labs (the Wizard of Menlo Park)
- 1877 – Phonograph and Greatly Improved Telephone
- 1879 – Light Bulb
- 1880 – Edison Effect (foundation of modern electronics)
- 1882 – First Central Station Power Plant/Utility System in New York City
- 1887 – West Orange Labs Established (emergence of R&D Labs)
- 1887 – 1888 Magnetic Ore Separation
- 1889 – Motion Pictures
- 1890 – Establishes Edison General Electric (GE today)
- 1899 – Edison Portland Cement Company
- 1900 – Alkaline Storage Battery Work Begins (for electric vehicles and other applications)

These are the major inventions only. Many other things were developed in his labs by his omnipresent teams of inventors—after all, the man had 1093 domestic patents and several hundred more international patents. Where appropriate, I shall suggest some classroom activities for you to lead.

At the end of this volume I will present additional interesting and challenging activities for students to undertake to expand their understanding of Thomas Edison.

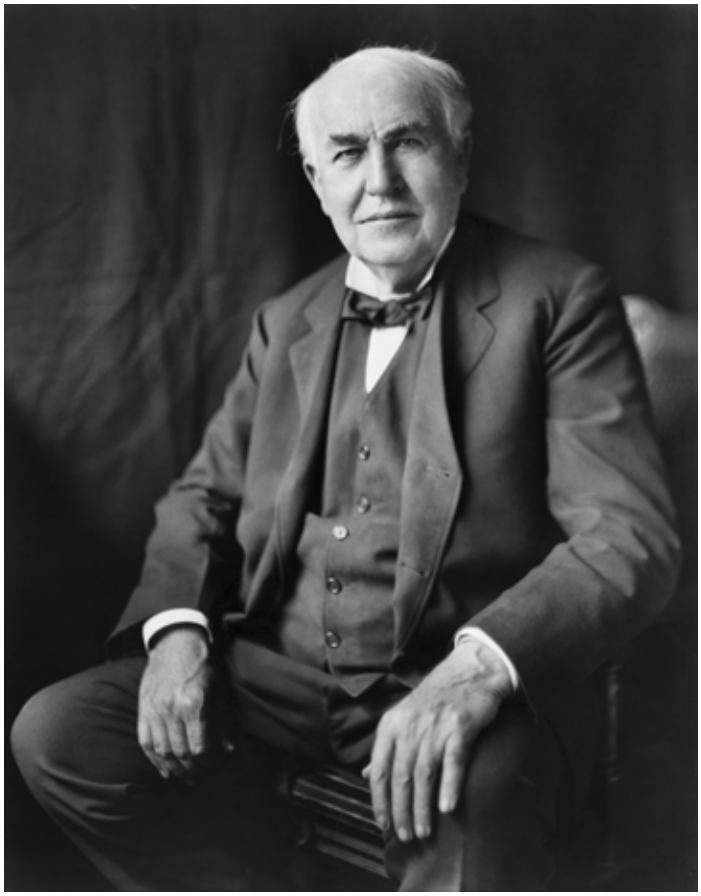
As another way to stimulate your thinking about Edison, consider this:

- *Life Magazine* in 1996 proclaimed him "The Man of the Millennium" (not the man of the century…the man of the millennium…1,000 years!).
- Economists believe his accomplishments have been responsible for one-fourth of all the jobs that exist on the planet today.
- The world economy today is about $80 trillion dollars. Edison's work and accomplishments generate today about $8-$12 trillion of that world economy.

Edison was very particular about who he hired for his invention-development activities. He even gave potential new hires extensive written and often laboratory-like tests. Here is a boiled-down set of characteristics he prized in new hires:

- Ability to see a problem clearly and cut to the heart of the matter.
- Creativity!
- Simple, effective methods to analyze and solve problems.
- Able to work well with others.
- Wide knowledge about technology, materials, and how things are made.

Ready to take the big ride through history and see what Mr. Edison means to us today? Read on.



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Some Suggested Activities:

- Compare Edison's phonograph and motion pictures—how similar and different were they?
- What did the electric light bulb do for society?
- How did squeezing more messages onto a telegraph line benefit the telegraph companies?
- What was important about alkaline storage batteries compared to what was available then?
- How is the electric pen similar to a tattoo pen?
- What is a disruptive technology? Can you name several modern ones? Which of Edison's inventions were disruptive…and why?
- One of the early applications for movies in Edison's mind was for education. How is this being realized today?
- Edison had three great facilities in New Jersey: Newark, Menlo Park, and West Orange. What transpired at these famous facilities, and what did it mean for the progress of our nation and its impact on the world?

The STEM Connection

If you are teaching STEM, you are teaching about how Thomas Edison changed the world with his codification of the invention process, soon to be named the invention factory. Later it became known as the commercial R&D lab; and so useful was this concept that every major company (what we today call the Fortune 500 companies) created its own R&D lab—all of which was done before Edison's death in 1931.

The invention of R&D labs stands out as the incredible process that keeps the industrial revolution of the 1880s vibrant and alive to this day. It is the centerpiece of what we refer to as technology-driven growth—the very foundation of what we mean when we say "progress." General Electric Company, an inspiration of Thomas A. Edison, adopted a most apropos tagline in the 1950s: "Progress is our most important product." Keep in mind that 70% of the annual economic growth of our nation is driven by advances in technology.

Let's drive this point home with an economic example. If you look at all the R&D investments every year for the recent past, you will find that when you sum up the R&D invested in the academic, governmental, and business sectors for 2019, you arrive at a figure somewhere in the neighborhood of $550 billion. The budget for the U.S. Department of Defense in 2019 was $686 billion. R&D is a very important aspect of our economy.

So closely allied are Edison's R&D labs with what we teach today under the STEM taxonomy, that I playfully refer to Edison as the "STEM-meister." Edison and his invention factory concept was all about interdisciplinary, team-based, head-and-hands, new-product development—way back in 1876. When your students grow up and graduate, they will be working for companies doing exactly what Edison did with his teams of inventors over 140 years ago. Edison is as relevant today as he was back at his legendary West Orange, NJ Labs.

Below is a detailed identification of the value of STEM for the classroom.

Working in STEM team settings promotes:

- Combining process and content.
- Integration of the curriculum.
- Solving problems in an interdisciplinary and multidimensional manner.
- More complete, higher-quality solutions to meaningful problems.
- Better overall problem-solving skills.
- Increased student confidence and self-esteem.
- Mastery of a lifelong method/process for solving any kind of problem.
- Planning, researching, organizing, and executing project activities.
- Learning how to ask meaningful questions and draw conclusions.
- Evaluating problems from multiple viewpoints—360-degree problem solving.
- Better understanding of collaboration among students.
- Engendering multiple potential solutions/selecting the best solution.
- Ownership and leadership of the problems being addressed.
- Creativity and new idea generation.

- Improved written and oral presentation skills.
- Reductions in "math-phobia."
- Diversity in thinking and ideas.
- Respect for others and their thoughts.
- Self-actualization and leadership.
- A drive for self-learning.
- Relevance in the classroom.

"I always invented to obtain money to go on inventing."

Thomas Edison

Some Suggested Activities:

- Examine how modern businesses value STEM education for their new hires.
- How does STEM help us become competitive in the global economy?
- Do other countries have STEM education in their schools like the U.S.?
- How might the "Arts" fit into the STEM paradigm?
- How would having a facility with math fit into STEM learning? Why is math important?
- Why is lifelong learning so valuable in a STEM-based economy?
- How did the spirit of Edison greatly contribute to America's inventive culture?
- How did Edison keep track of his discoveries, inventions, and progress in the labs?
- How have the R&D expenditures for this country changed over time? Develop a chart or graph that shows R&D spending growth over the last 10-20 years. How have other competitive countries fared with their R&D expenditures?
- Back in Edison's day, what things do you think he was spending R&D monies on? What might today's R&D managers and directors spend R&D funds on?

"Hell, there are no rules here—we're trying to accomplish something."

Thomas Edison

As Edison forged his invention factory concept at Menlo Park and perfected it at West Orange, he employed experts in teams, members of which possessed the multidisciplinary skills needed to develop specific new products. These experts were chosen because of their ability to solve problems from a multidimensional perspective; able to see the various important aspects of the problem; and reach a mediated solution that was both practical and economic. They were designing within socioeconomic constraints. Or as I like to say, solving the problem from a 360-degree perspective, not just the science, technology, engineering, and math, taking into account the environmental, social, regulatory, legal, and cultural aspects of the problem. Envision the problem solved from the perspective of the user of the new product or service you are designing and how it will be used in their world.

The invention process you encounter in STEM literature is basically the one Edison used to codify the invention process in his invention factory. Here he managed maybe 30-40 project teams at once—all of which were working on individual new products or perhaps revising existing products and improving them. As a quick refresher, below are the steps to this iterative and deeply inquisitive invention process:

1. Identify a problem worth solving.
2. Evaluate the economics/market needs.
3. Identify constraints, impacts, challenges.
4. Identify/test potential solutions—invent!
5. Validate invention against 1, 2, and 3 (repeat 1 thru 5 as necessary—redesign/reevaluate original problem).
6. Market the invention.
7. Grow and improve the invention.

You will recognize this as a form of the engineering design process so prevalent in STEM literature and taxonomy.

The interior of the main laboratories, Thomas Edison National Historical Park, New Jersey, USA. *Wikimedia Commons: Edison_laboratories_NJ2.jpg, by Acroterion - Own work, CC BY-SA. https://commons.wikimedia.org/wiki/File:Edison_laboratories_NJ2.jpg.*

Challenge your students as often as possible to work in teams using this process as a fundamental guideline, and empower them to ask questions. The quality of solutions is dependent upon the quality of the questions asked. Teach them how to ask tough questions! Let your students be like "hard boiled" detectives when they have problems to solve—get in there and turn every problem inside out, learning as much as possible about the problem and how proposed solutions could be used. Sanction

and champion your students to always ask questions—be relentless about this.

Study other great inventors throughout history (and maybe within your own state as well). How did they solve tough problems? Were their approaches to problem solving similar? What characterized these inventors (e.g., their behaviors and distinguishing traits)?

Take the time to teach how the economy works, for our modern understanding of how potential new products are envisioned and brought to market derives directly from what Edison taught us at Menlo Park/West Orange. At West Orange, he put his invention factory on steroids, with about 250 technical experts and craftsmen developing prototypes for new/improved products. Then he had over 10,000 workers in surrounding buildings making the new products and shipping them around the world. All this occurred on about 23 acres of land (a veritable beehive of activity).

His company, Thomas A. Edison Industries, was the Silicon Valley of its time, composed of about 30 separate businesses. Before he died in 1931, most of the great companies of that era duplicated his invention factory in their own business models. Today we know these corporate entities as R&D departments.

Edison sets in stone for us our modern conception of team-based, technology-driven economic growth; or what we euphemistically refer to as progress. General Electric of the 1950s had a wonderful corporate tagline they used ubiquitously…"Progress is our most important product"…precisely summing up the power of the innovation process.

By studying how the economy works, students will gain a powerful insight about how STEM-based academic pursuits are a direct link to economic growth; and technology-driven growth is a force for good in the world, helping to raise the standards of living for everyone. Think of all this as a school-to-work paradigm.

Edison understood how the economy worked. He had to—otherwise his inventions and innovations would never have had the impact described above or been so useful during his time. He had to meet a payroll regularly for his 10,000 employees. Profits come after all the costs, including payroll, are met; and profits are what make new jobs and new products possible.

"To invent, you need a good imagination and a pile of junk."

Thomas Edison

Some Suggested Activities:

- Have your class discover what other inventors have done to impact the world's economy. What about Bill Gates, Steve Jobs, and Steve Wozniak?
- How about other classic entrepreneurs/inventors like Henry Ford and Harvey Firestone?
- Look at the many sectors of the economy where growth is technologically driven and study inventors and their links to the economy. (Hint: 70% of the annual growth of our economy is technology-driven!)
- Examine the following modern-day technologies and evaluate them from the multidisciplinary categories (the 360-degree look) mentioned at the beginning of this chapter:
  - Electric vehicles
  - Wind energy
  - Nuclear power
  - Nanotechnology
  - Artificial intelligence
  - Batteries
- How similar are today's project managers to Thomas Edison and his teams?
- Would you like to work on a modern project team developing a new product? Why/why not? Would it matter what kind of product you were working on? Why? How about leading the team?

The Power of the Invention Notebook

"To have a great idea, have a lot of them."

Thomas Edison

One of the great lessons one can learn from studying Thomas Edison is his persistent keeping of notes and records of many experiments and inventions. Over his lifetime he produced about 4,000 notebooks detailing his work in text, mathematical formulations, and pictorial formats—forming the basis for his 1093 patents. Think of the great benefits of teaching students to keep meticulous records, a kind of scientific diary similar to a scientist's laboratory notebook. Let's examine the benefits.

Say your students form teams to develop ideas into possible inventions. By carefully recording their work in a chronological fashion, they benefit by:

- Developing the important discipline of working toward a solution—the commitment over time of achieving the goal of a new invention/product and commitment to the team—something highly valued in the business world.
- Gaining special insights about the invention as it changes and morphs over time, which can produce some very interesting options later—empowering them to continually seek answers to well-asked questions.
- Regularly practicing concise descriptive writing (teachers: take no prisoners here…make students write, write, write).
- Expressing their ideas in a graphic, pictorial manner—another way to explain their concepts. Use graphs, charts, tables of data, experimental results, and record these in the notebook—fusing intellectual and graphical portrayals of information.
- Gain appreciation of how math is used to explain their ideas and quantify its impact (teachers: math is the coin of the realm in the work-a-day world—make students use math in all aspects of their invention's design and evaluation).

- Blend together in their writings the input of the entire team—all team members should sign each entry to make sure they have read and understood it.
- Preparing students for the workplace, where organizing and managing projects is a top priority (corporate positions can pay exceptionally well).

It is vital that any invention notebook also document the thinking of the team. Insist that all invention notebooks also ask:

- What are the marketing aspects of the invention—why is it needed, who will buy it, what is its sales potential, etc.?
- What could be a logical selling price for the invention/product?
- How will this new technology impact the world and society?
- Does it have a potential impact on the environment, and how will this be minimized?
- What about the safety of the invention/product?
- Does it need to meet regulatory statutes?
- Will there be cultural/religious impacts associated with selling the invention/product overseas?
- What legal implications might arise?

Everyone on a team has a chance to participate in the project and provide input to the team's invention notebook. Most of all, this close interaction and verbalization of the problem, as exemplified by the descriptions of the group's progress in the notebook, will help students get comfortable with working with people. In the work world, everyone works in teams; and invention notebooks are legal documents, proving ownership or the right to assign intellectual property to people and companies—i.e., patent rights. These rights can result in hundreds of millions of dollars in sales over the life of the new product or problem solution. Students need to understand how fundamental the documentation of ideas and inventions is to our economy.

Some Suggested Activities:

- Try this out with your class. Have students design an invention notebook format that all teams can use. Research the literature and sample notebook formats, urging your students to implement a format for all teams to use.
- Often, in disagreements over who invented what at what time, inventors must present their notebooks for lawyers and judges to examine. Can students find a recent legal case where this happened?
- Why would excellent written communications skills be so important for keeping invention notebooks?

The Legendary West Orange Labs

The entrance to the main complex at Thomas Edison National Historical Park, West Orange, New Jersey, USA. *Wikimedia Commons, Thomas_Edison_NHP_entrance_NJ1 - Author =Acroterion.* https://commons.wikimedia.org/wiki/File:Thomas_Edison_NHP_entrance_NJ1.jpg

One of the main reasons Edison established the West Orange Labs was to add manufacturing into his business plans. This would bring in more revenue and allow him to expand his inventive output.

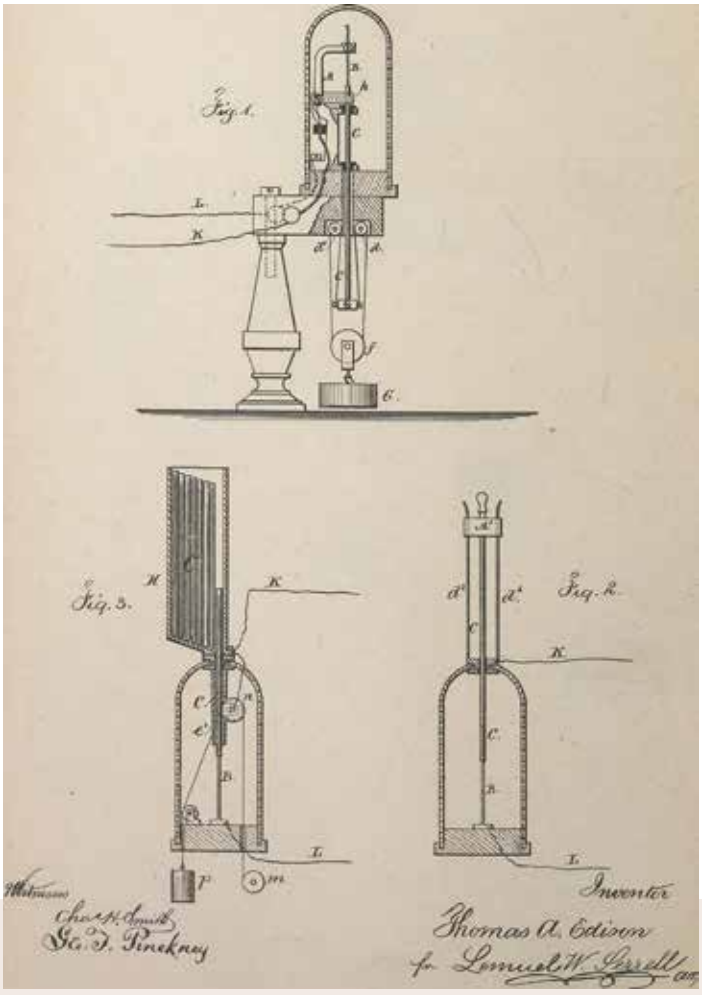
Businesses and inventors from around the world came to visit Edison and learn the new techniques he was forging. West Orange is possibly the first vertically integrated manufacturing facility—from raw materials to finished products. He often boasted that his premier invention factory could make anything from a women's watch to a locomotive. His good friend Henry Ford spent a great deal of time learning from Edison before he built his own River Rouge plant to make a Model T car every 7-8 minutes. This he did around 1918. Edison's West Orange plant was using railroads to deliver his raw materials and take away his finished products in 1910 or so. Just down the railroad tracks from his West Orange facility was his Silver Lake chemical works where he made all the chemicals he needed and had easily delivered to West Orange.

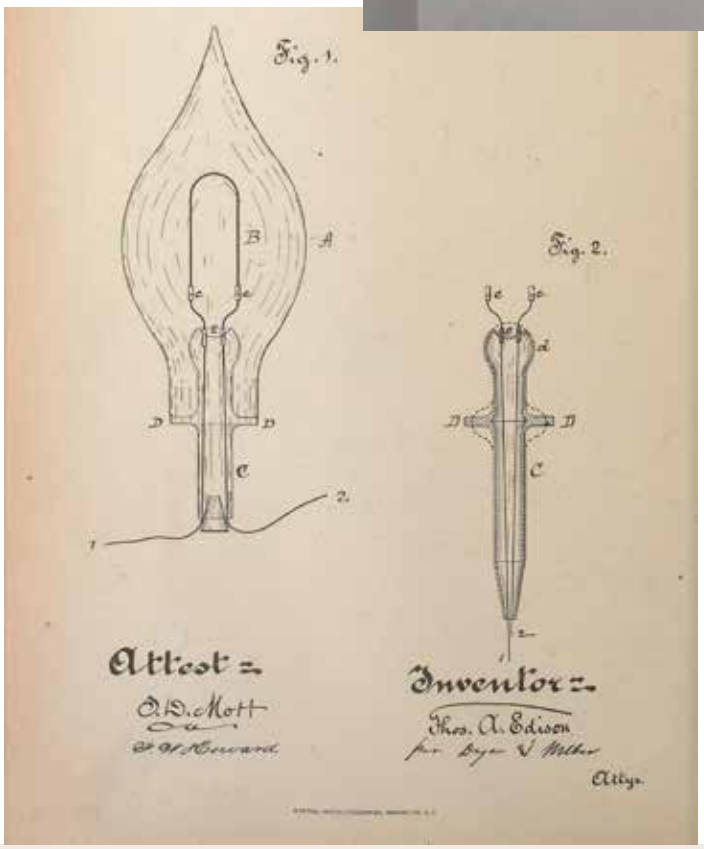
About 65% of all his patents originated at West Orange. Here he basically took many of his previous patents and turbocharged them, as well as pioneering whole new industries. Many economists think of West Orange as the nation's first "Silicon Valley," a model if you will. The original invention factory workshop can be seen as the first "maker lab," an analog version, later to be superseded by digital-based maker labs, including 3D printers and such.

Not often appreciated is what also happened at West Orange that would later influence corporate facilities, such as amenities for employees like:

- Savings banks
- Infirmaries
- Industrial sports teams
- Professional organizations
- Training
- Flexible work hours for R&D staff
- Ability to share in patent recognition

Another fascinating aspect of West Orange is that Edison used the special cement he invented to build his large factories and buildings. That cement proved vital in protecting his capital investment in the great fire of 1914, where the buildings survived the fire to be rebuilt on the inside and used again within a few months.





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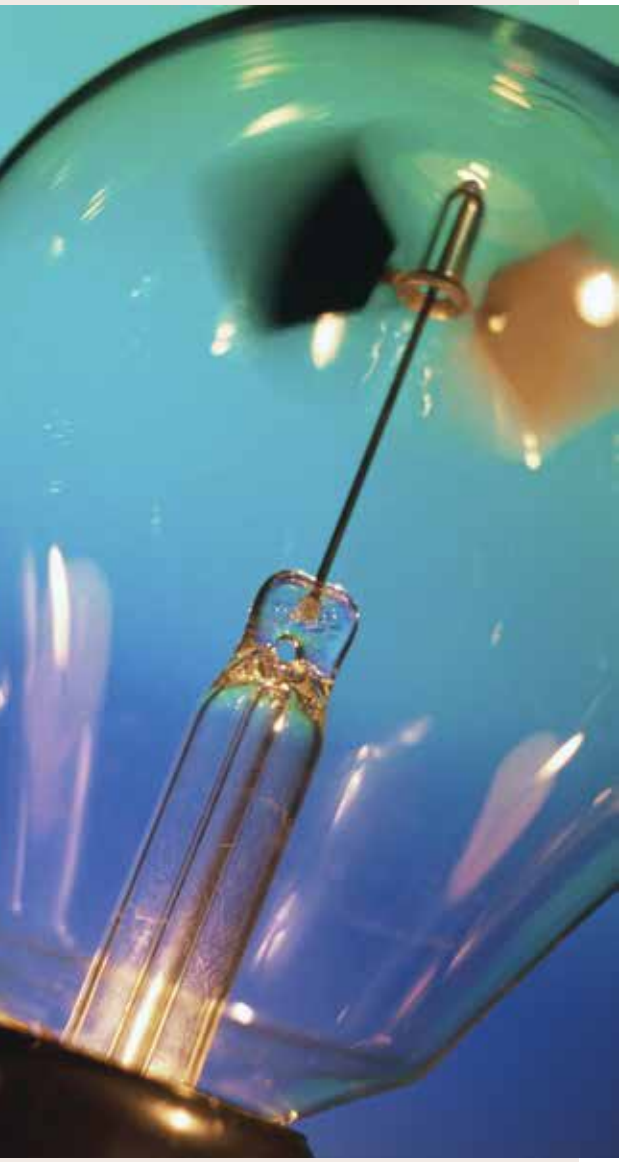
Classroom Activities

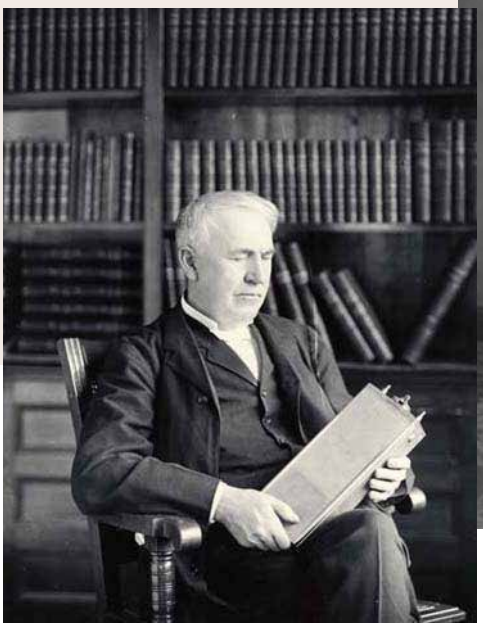


The questions and activities below are a way to promote the natural inquisitiveness of middle and high schoolers, perhaps even making them future devotees of the famous inventor. Encourage your students to dig deep into the many resources available to try to answer these. Have fun—and learn plenty!

- Edison created four really major inventions—the electric light and power industry, recorded sound, motion pictures, and R&D labs. Together, these big four have changed the face of society, practically defining our modern standards of living. The questions for you to address are:
  - Which of these innovations do you think was the most valuable and why? Support your position with facts and discussion.
  - What do you think it was like in the minds of citizens in the late 1800s when these inventions burst upon the scene?
  - Just looking at the electric light bulb, identify the benefits of this innovation; do a pro/con analysis of this incredible invention.
  - What invention/innovation of the last 20 years rivals one of the big four here? Why? Present your discussion with details.

- An integral part of Edison's creativity and inventive power stems from having an invention factory and workshop to rapidly prototype his ideas and those creations of his famed project teams.
  - Identify why a creative genius like Edison would use the invention factory concept?
  - What does this remind you of today? (hint: maker labs)
  - Discuss how Edison's project teams were so valuable to his new product development.
  - How do you think rapid prototyping capability assisted Edison in his business practices?
  - Is there a place in STEM classes and technology education curriculum that mimics what Edison did to prototype new products? (hint: be specific)

- Without a doubt, Thomas Edison is an inspiration for the ages with his incredible record of patents. His inventions were both broad and deep—and created whole new industries. Consider these questions, which may require some reading and investigation:
  - What is a patent and why are they valuable?
  - How many U.S. patents did Edison amass during his life?
  - Did he have patents overseas as well? How many?
  - With so many patents, what do you think he had to continuously defend against?
  - In what area of technical competence do you think he had the most patents?



Left: Edison with his battery.
Center: Edison with his early phonograph.
Below: Edison with his electric car.
Image credit: Wikimedia Commons.

By the way, where did the concept of patents come from... and why?

- Elon Musk recently built a large battery-manufacturing facility in Nevada for his Tesla electric car and for his solar photovoltaic business. Edison built a battery-manufacturing facility at his West Orange lab in 1912.
  - Why do you think Edison built his battery facility?
  - Two simple metals were used in his batteries. What were they?
  - The creation of his batteries ushered in a whole new class of batteries that we use today in our mobile phones. What is the name of this class of batteries?
  - Edison's batteries were so versatile, they found uses in many areas and applications. What were some of those applications?

- During his lifetime, Edison kept important lab and experimental notes in his many notebooks.
  - How many of his notebooks were there; and why did he consider them so important?
  - Scientists also keep notebooks. Are these similar to what you would find in Edison's notebooks? Why/why not?
  - Have you kept notebooks in any of your school projects or STEM classes? What did you think about all the documentation required, and what might the benefits be?
  - Can you try designing a notebook that you and your classmates can use when doing team projects?

- Edison's first formal invention was a vote-recording device, and it was not successful. This activity had a profound effect on the business acumen of the then young inventor. What did he learn from this effort that guided his inventive activities for the rest of his life?
  - He even had a famous quote about the experience. Can you find it?
  - Do you believe his experience and the quote is still relevant today? Why/why not?

- Edison made two important discoveries. One was called the Etheric Force (1875) and the other the Edison Effect (1880).
  - What did each of these lead to?
  - Where did he first apply the Edison Effect?
  - Why is the Edison Effect referred to as the world's first electronic patent?
  - Later, the Edison Effect was referred to as what?

- Edison first successfully demonstrated the concept of a central station DC utility system in 1882 to distribute electricity for light and power.
  - Where did he first demonstrate it?
  - Is this system concept still used today?
  - Is there anything different about it?

- His invention of concrete homes and the improved efficiencies of concrete making actually stemmed from an earlier project that had failed.
  - What was Edison originally trying to do that was unsuccessful?

- Why did he switch to making concrete and concrete products?
- What successful New York City landmark was built with Edison concrete?

- The Black Maria is the first motion picture studio ever created. The first movies were shown in special peephole viewers and were shown in nickelodeon parlors. Full-length movies came later.
  - What was unique about the design of the Black Maria?
  - What were some of the first movies he created? What did he film?
  - When he created his movies, how did he see them being used in schools and why?

- The first cylinders Edison used on his phonographs were made of an unusual natural material…what was it?

- How did Edison's work on the telephone, originally invented by Alexander Graham Bell, greatly improve it?

- A great deal of Edison's early work involved telegraph technology and modifications to it. How did Edison get involved in telegraphy in the first place?

- It is said that Edison's greatest talent was to assemble teams of people to solve problems and create new prototypes. Why are teams working on problems so important?

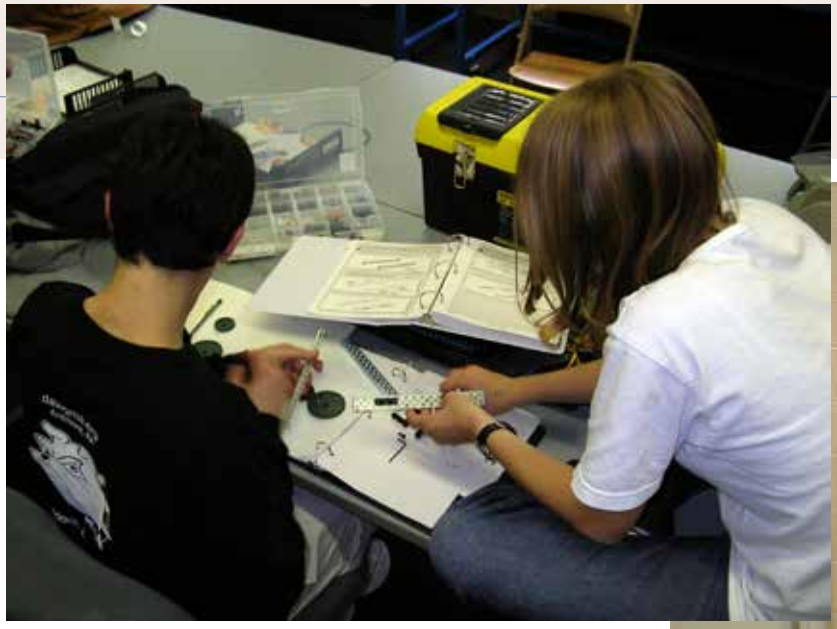
- Working in teams and rapid prototyping at West Orange, Edison is responsible for the establishment of what would come to be commercial R&D labs. How important is R&D to business today?

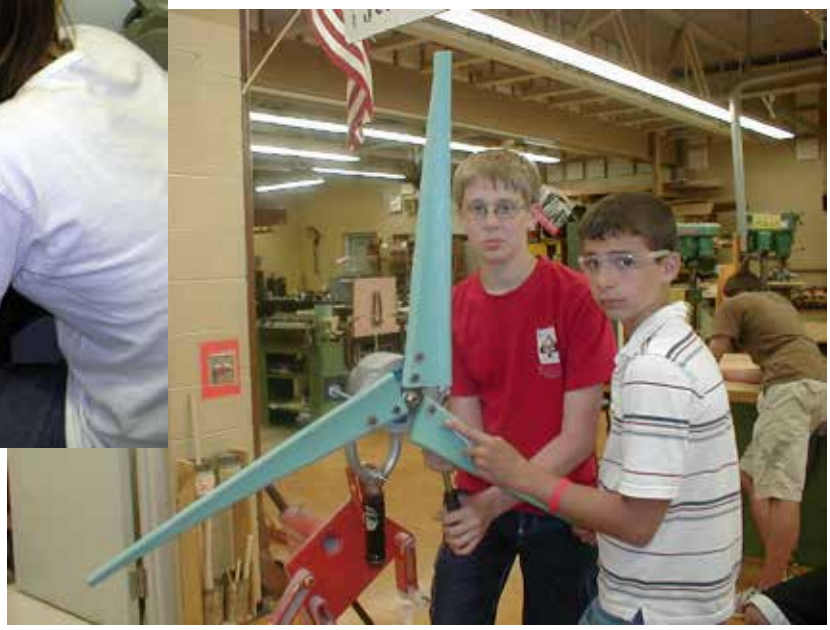
- Why was the creation of R&D labs considered his most important invention? Quote some hard facts and economics.

- Edison was involved in researching and experimenting in areas outside of the earth's atmosphere, i.e., space. What were those activities, and what did some of those activities help lead to today?

- During WWI, Edison was asked to assist the U.S. Navy with problems concerning German U-boats. He established a national team of inventors, scientists, and engineers to address these issues. After the war these efforts resulted in a very important organization, first at the U.S. Navy and later throughout government. It is

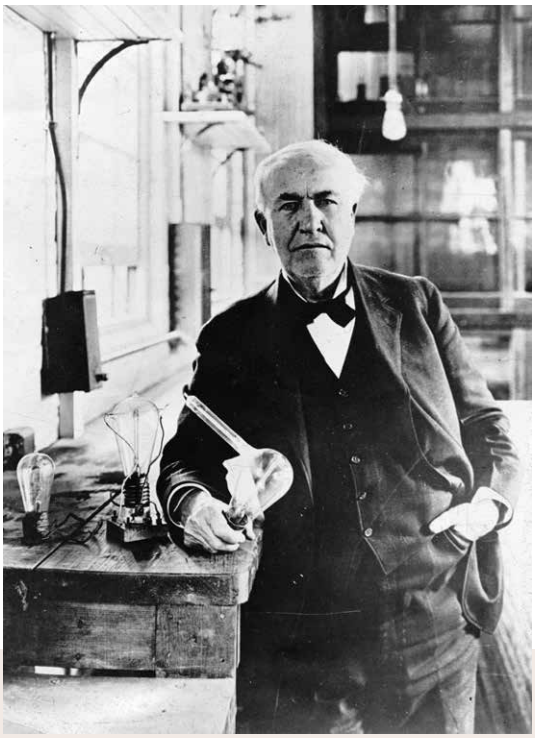
Thomas Edison's Black Maria motion picture studio, Thomas Edison National Historical Park, New Jersey, USA. *Wikimedia Commons: Edison_Black_Maria_NJ1. https://commons.wikimedia.org/wiki/File:Edison_Black_Maria_NJ1.jpg.*





an integral part of the government's scientific/ engineering apparatus today. What was it, and why is it so important?

- What historical figures did Edison admire and why?
- Why did his mother take him out of school and educate him at home?
- What motivated Edison to locate his large West Orange business office inside his grand corporate library? Would you do this today? Why/why not?
- What did Edison think of solar and wind energy....and why?
- Identify five famous quotes by Edison.
- There were three famous facilities/labs that Edison established in NJ. Where were they? Why were they always along rail lines?
- How did Ford and Edison first meet, and what did they talk about that led to their lifelong friendship?
- When Edison thought about hiring employees, what skills and characteristics did he highly prize in them? Did he also have a formal test he gave prospective employees? What things were in the test?
- How did Edison obtain the funds he needed to develop his new inventions? Identify the possible sources of these funds.



Thomas Edison (1847–1931) with his invented white light bulbs from 1883. *Wikimedia Commons – Thomas_edison_glühbirne.* https://commons.wikimedia.org/wiki/File:Thomas_edison_gl%C3%BChbirne.jpg.

- Research these people and discuss their relationship to Thomas Edison:
  - Henry Ford
  - Harvey Firestone
  - John Burroughs
  - Alexander Graham Bell
  - Nikola Tesla
  - George Westinghouse
  - George Eastman
  - J. P. Morgan
  - Charles Steinmetz
  - Reginald Fessenden
  - Marconi
  - John and Fred Ott
  - W. K. L. Dickson

The Thomas Edison Battery

Here is a fun thing to do that exemplifies Edison's major work on batteries; and it will also get the students involved in scientifically recording data.

Using a simple electrolyte like salt and water, make a wet-cell battery featuring two electrodes, one of iron and one of nickel. The iron electrode can be a simple nail, and the nickel electrode can be a 5-cent piece (a nickel). Measure the voltage across the two electrodes using a simple voltmeter.

Now try a series of different electrolytes and measure the voltage across the electrodes. It will be different as you try different electrolytes. Consider using for an electrolyte (which should be an ionic solution) solutions such as:

- Lemon juice and water
- Bleach and water
- Gatorade
- Soda
- Windex
- Detergent and water
- Other?

You can, as a surprise, use Play Doh as an electrolyte and get a very nice little battery with no chance of spillage...and you will get a nice voltage as well.

Once Edison settled on his battery design, he then arranged the cells in both series and parallel to increase the voltage and current delivery capability of them. You might want to try and demonstrate this in class.

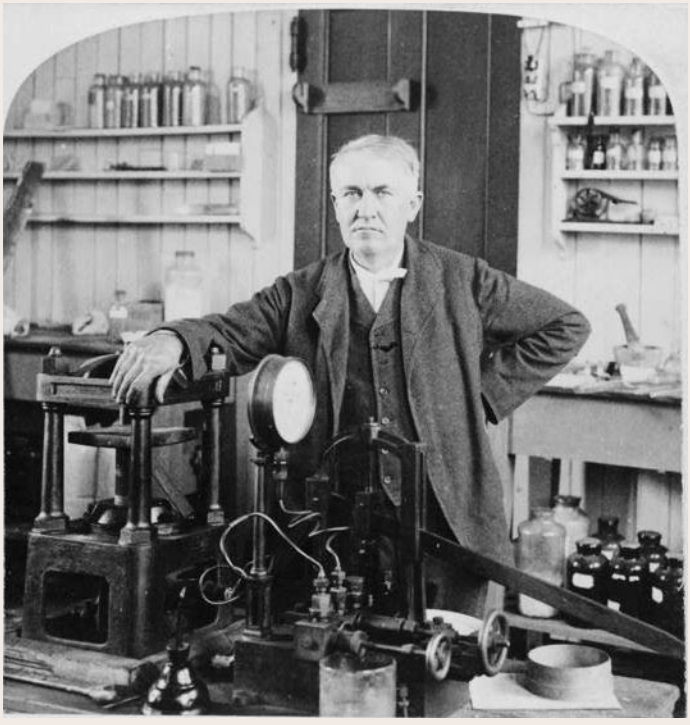
By the way, the electrolyte Edison used for his nickel-iron storage battery was Potassium Hydroxide (the chemical formula of which is KOH).

Now have some more fun. Use the same electrolytes used above, but change the metal electrode pairs using common metals like:

- Copper-Zinc
- Nickel-Copper
- Tin-Zinc
- Other?

As a way to drive this battery discussion home for your students, examine how the ubiquitous 1.5-volt dry cell works; what are the two metals that are used? Also discuss the typical 9-volt battery as well.

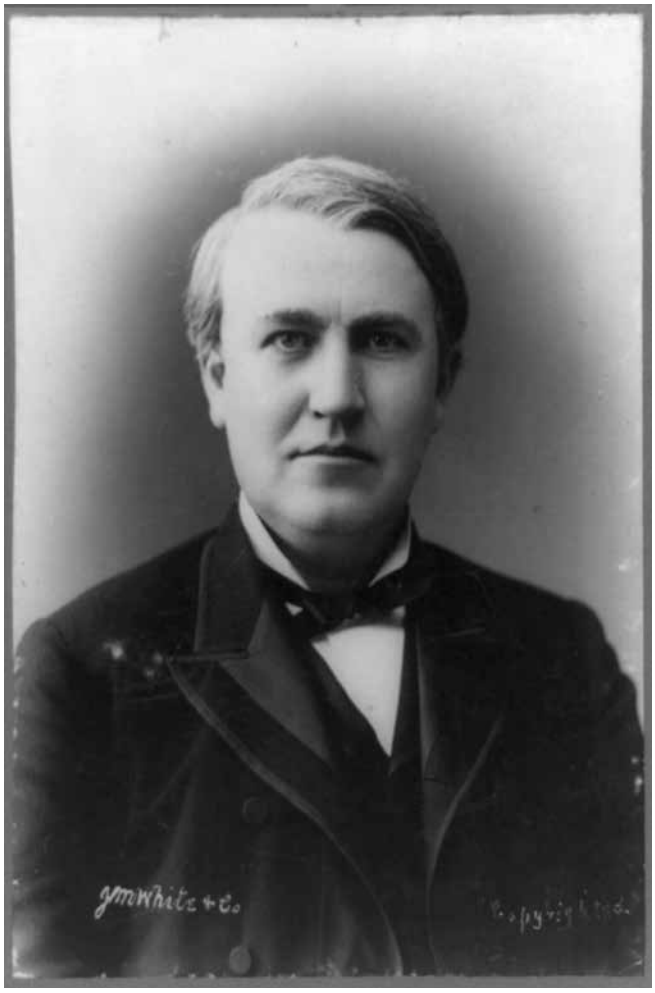
Designing batteries is not easy. It took many experiments to make the Edison batteries work properly...legend had it, about 10 years and 10,000-15,000 experiments!



Edison in his NJ laboratory, 1901.

Some Fun Facts About Thomas Edison

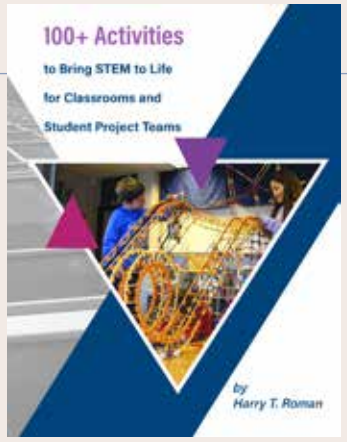
Enjoy these fun facts about the world's greatest inventor!

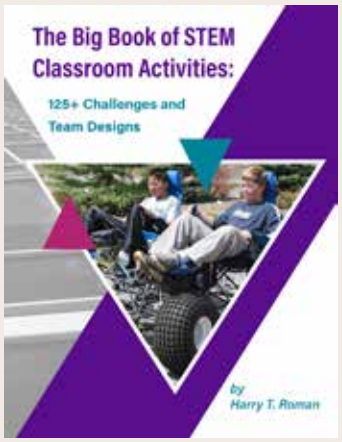


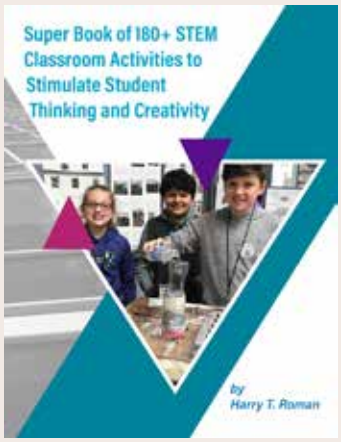
- Thomas Edison's favorite holiday was 4th of July, and he made his own fireworks to celebrate the day—with some really loud boomers!
- Edison was a big fan of American Revolution writer Thomas Paine.
- Edison was a big proponent of solar energy way back in the early 1900s. His famous quote about it was: "I'd put my money on the sun and solar energy. What a source of power! I hope we don't have to wait until oil and coal run out before we tackle that."
- Edison was responsible for the words "Hello" on the telephone and "bugs" in unproven inventions and new systems.
- Edison and his son Charles played very important roles in the U.S. Navy in both WWI and WWII.
- Edison had the most recognizable face in the world when newspapers and magazines were the chief means of communicating news.
- Edison was quite fond of pie, which friends joked that he ate by the yard—especially rhubarb and apple pie.
- Edison had a tattoo on his forearm, a quincunx, like the face of the number "five" on a dice cube.
- A practical joker was Edison, and he gave as good as he got.
- His first two children were nicknamed "Dot" and "Dash" in honor of his early telegraph days.
- He taught his second wife, Mina, Morse Code and proposed to her by tapping it out on her palm. She tapped back, "Yes."
- Regular bathing was not a big deal for Edison, and he often went several days without it.

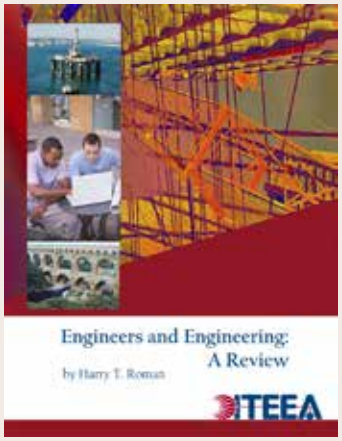
Image credit:
Left: Wikimedia Commons, Edison in his NJ laboratory 1901.jpg.
https://commons.wikimedia.org/wiki/File:Edison_in_his_NJ_laboratory_1901.jpg

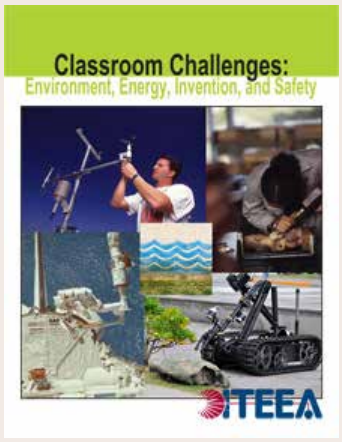
Above: Wikimedia Commons, Thomas Edison 1.png.
https://commons.wikimedia.org/wiki/File:Thomas_Edison_1.png

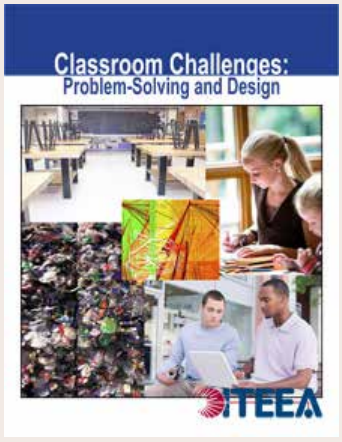


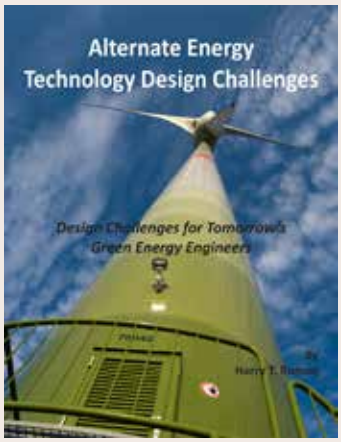












Suggested Reading

In addition to his extensive article writing for ITEEA, here are the books Harry Roman has published under the ITEEA imprint. These books also contain classroom activities.

100+ Activities to Bring STEM to Life for Classrooms and Student Project Teams. International Technology and Engineering Educators Association (ITEEA e-book), 2019. Free with donation of any size to ITEEA's Foundation: www.iteea.org/File.aspx?id=156460

The Big Book of STEM Classroom Activities: 125+ Challenges and Team Designs
International Technology and Engineering Educators Association (ITEEA e-book), 2019. Free with donation of any size to ITEEA's Foundation: www.iteea.org/File.aspx?id=162611

Super Book of 180+ STEM Classroom Activities to Stimulate Student Thinking and Creativity
International Technology and Engineering Educators Association (ITEEA e-book), 2020. Free with donation of any size to ITEEA's Foundation: www.iteea.org/File.aspx?id=156460

Engineers and Engineering: A Review
International Technology and Engineering Educators Association (ITEEA e-book), 2014.
Purchase online at:
https://portal.iteea.org/Shop/Product-Catalog

Classroom Challenges: Environment, Energy, Invention, and Safety
International Technology and Engineering Educators Association (ITEEA e-book), 2012.
Purchase online at:
https://portal.iteea.org/Shop/Product-Catalog

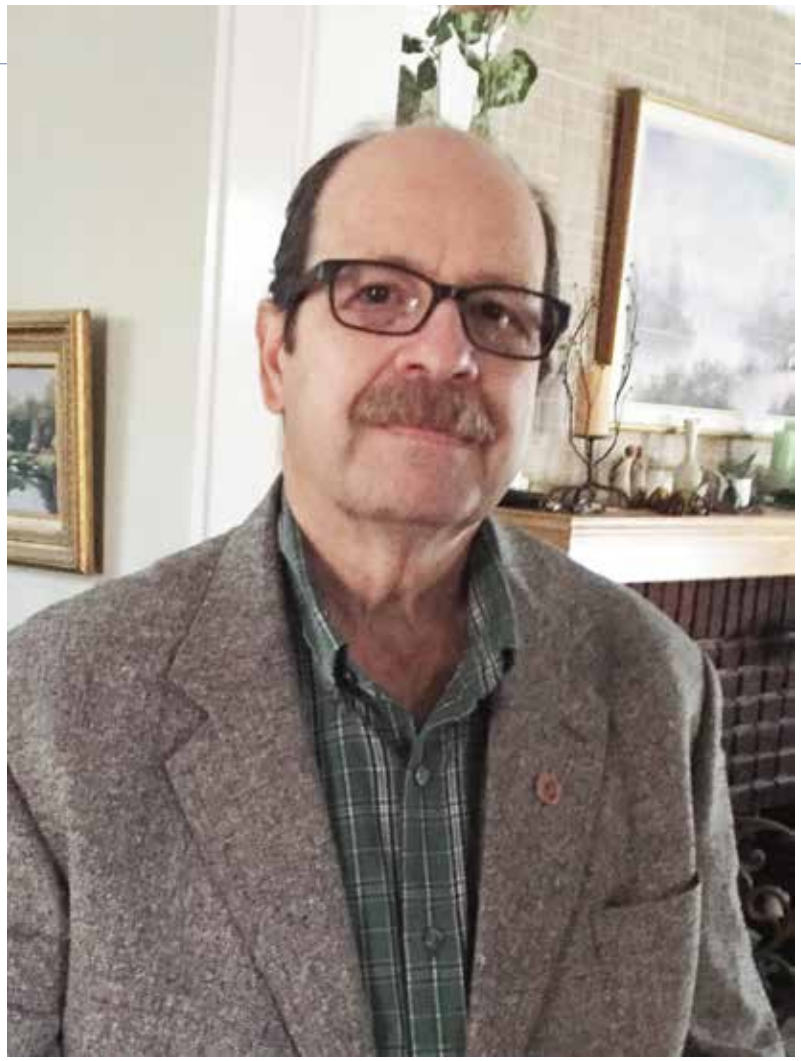
Classroom Challenges: Problem-Solving and Design
International Technology and Engineering Educators Association (ITEEA e-book), 2012.
Purchase online at:
https://portal.iteea.org/Shop/Product-Catalog

Alternate Energy Design Challenges: Design Challenges for Tomorrow's Green Energy Engineers
International Technology and Engineering Educators Association (ITEEA e-book), 2010.
Purchase online at:
https://portal.iteea.org/Shop/Product-Catalog

About the Author

Harry T. Roman

has been an ITEEA book and article author for about 20 years; and for the last 13 years has been the author of the "Classroom Challenge" feature that appears in every issue of the *Technology and Engineering Teacher* (*TET*) journal.



As a retired engineer and inventor, Harry likes teaching teachers, students, and school leaders about STEM and its applicability. Between 2012 and 2016, he created and co-taught graduate courses in iSTEM at Montclair State University's teaching college.

Harry also is an educational author and advisor to the Edison Innovation Foundation and writes many articles and books about the great inventor. Often, he lectures at the Thomas Edison National Historical Park in West Orange, NJ.

Prior to being involved in modern STEM activities, Harry was involved in the launching of Technology Education in NJ schools in the 1980s and is considered a leader in technology education in that state, accumulating many awards and top honors during his 30+ years of service.

He has received numerous industry awards and professional recognition during his 37-year engineering, invention, and patent career; and was instrumental in establishing the NJ Inventors Hall of Fame to celebrate the state's many inventors. Harry holds 12 U.S. Patents.

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