

Fourth through Sixth Grade Tour –

Hydroelectricity and the Inventions of Hearthstone

Key:

Red Bold – Location in Hearthstone

Orange Underline - Discussion Questions

Green – Interpretive Tools

List of vocabulary terms and concepts used during the presentation.

- Magnet
- Coil of wire
- Mechanical means
- Generator
- Dynamo
- Mechanical energy
- Henry Rogers
- Velocipede
- Thomas Edison
- Hydroelectricity
- Green energy
- Paper industry (or paper business)
- Paper mill
- Invention process or method
- Electric lights / incandescent bulbs
- Phonograph
- “Turn on the lights”
- Digital music
- Central heat
- Annunciator
- Silicon Valley
- Suffrage
- Running water
- Flush toilets

Foyer / Grand Hall (or other starting point)

Introduction and welcome to students

Introduction

Hello and welcome to Hearthstone

My name is _____. I am a guide here at this beautiful museum.

If you are not familiar with Hearthstone. This stunning mansion was built in 1882... that's 140 years ago... and it is absolutely stunning inside and out.

It is also very important in terms of

- Its role in the history of electricity and the history of Appleton.
- But also for the inventions that it contains that date from the 1880s.
- Many of these inventions we take for granted today.
- But they were utterly revolutionary 140 years ago.
- In many ways Hearthstone was a house of the future when it was built because we still use most of these inventions today in one form or another.

I am delighted that I get to share that with you today.

We are going to begin in the lower level exhibit area. So follow me!

Lower Level Learning Center Hydro Room

Introduction

- Here we are in our lower level learning center.
- On today's tour we are going to learn about
 - Hydroelectricity
 - Green energy
 - Invention method

Location

First... let's review how to make electricity.

Original Dynamo



Does anyone know what are the three things needed to make electricity?

- Magnet
- Coil of Copper Wire
- Movement

Yes, yes, and yes! Those are the three things that you need *every* time you try to make electricity through mechanical means.

You need at least one coil of wire and at least one magnet.

Together the coil and magnet are called with either a

- Generator
- Dynamo

Plus you need movement. You have to spin either the magnet or the copper wire.

It makes no difference whether we move the magnet around the coils or move the coils around the magnets!

You still make electricity!

And here is one of the very first dynamos.

It is a real dynamo that was used in 1886 in one of the first power plants in Appleton.

Can you identify the parts? It actually is a bit tricky.

- Magnet (there is a top piece and a bottom piece but those are used to create an electromagnet using the big coils you see here)
- Coil of Wire on the axle
- Movement (axle here rotates very quickly)

You can see in the photo from 1886, the same type of dynamo is being used to make electricity right her in Appleton!

Velocipede

This funny looking contraption is an old-fashion bicycle.

It was called a “velocipede.”

Can you imagine riding down the street on this? I can't.

This type of bicycle was needed before streets were paved. The streets were basically made of dirt and mud (when it rained) and



there were always big ruts. A big front wheel like this was needed to climb over the ruts.

When streets were paved, first with wood planks or blocks, then bricks, these bicycles were still popular but they soon gave way to the bicycles we see today with two wheels of the same size.

The new type of bikes was called “safety bicycles.” I think we can imagine why!

This velocipede is set up to demonstrate how we can make electricity using mechanical energy.

Its big wheel is hooked up to a dynamo (magnet and coils).

Want to see how it works?

Ok, I will climb on and starting pedaling. It will be noisy!

(DEMONSTRATE)

Now we are lighting all kinds of lights using our leg muscles.

We have a bigger dynamo and we are using our leg muscles to provide mechanical energy.

“Mechanical energy” is the energy that is possessed by an object due to its motion or due to its position. Mechanical energy can be either kinetic energy (energy of motion) or potential energy (stored energy of position).

So think of it as the ability to perform tasks (work) because of you’re moving something.

Here we are making lots of electricity! Because my legs are moving the wheel and, in turn, the generator. Cool.

Ok... Here’s another question...

Would this be a good way to light our homes? Why not?

- Get tired!
- Oh yeah. Trust me. It wouldn’t take long.

So we need to find a source of movement that never gets tired.
What do you think would work?

Possible suggestions could include...

- Engine (but you still need to add coal or gasoline or some other fuel – even in nuclear power plants)
- Wind might work. But it isn't always windy. What is like wind but never stops moving?
- Water! A big river that flows all year round would be a perfect source!

Water Wheel



Let's go over here...

What would happen if you linked a dynamo to constantly moving water?

- Constantly make electricity (unlimited!)

Here we have a wheel that is just like the big wheel on the velocipede.

Would you like to see it work? It's is going to be noisy again.

(DEMONSTRATE)

Here we are just pumping water over the top of the wheel.

The wheel turns solely because of the weight of the falling water and gravity.

When the wheel turns it provides movement.

When we connect that movement of the water wheel to a dynamo (like we have right here), what do we get?

Electricity! That's right!

Look at this indicator here. We are making electricity.

And we can use that electricity to light lights!

(DEMONSTRATE)

Falling water generates a great deal of power – that is mechanical

energy.

Seems like a good system, right?

Does the river ever get tired?

- No! It never stops.
- You can replace your legs and have unlimited “muscle” power of water!

Print of Paper Mills



The gentleman who built this beautiful mansion was named Henry Rogers.

He controlled all the dams along the river.

Here's a copy of a painting we have upstairs that shows...

- One of the dams that Henry Rogers controlled
(POINT OUT THE DAM)
- Henry Rogers' first paper mill which was located just down the hill from Hearthstone on the river

(POINT OUT THE MILL)

The mill already was using water power from water wheels – just like the one we just saw - that was used to grind wood into pulp to make paper.

- A paper mill owned by Kimberly and Clark

Their mill is this one right here.

(POINT OUT THE MILL)

In fact, Henry Rogers, along with other men named Kimberly and Clark created the paper industry along the Fox River.

That's why this area is called the “Paper Valley!”

(POINT OUT APPLETON PAPER AND PULP MILL and VULCAN MILL)

If you were Henry Rogers and you wanted to

1) make electricity

2) you controlled a dam

3) you had a mill equipped with water wheels

What would you do?

- Exactly! Hook up your dynamo (magnet and coils) to the same water wheel as your paper mill!
- That's exactly what Henry Rogers did!

Now the river, which never stops flowing, replaces our muscles. It is making electricity all day and all night every day of the year. It never gets tired!

So 140 years ago, Henry Rogers used water power and lights invented by Thomas Edison (more on that in a bit) to light...

- His beautiful new home Hearthstone (this building we are in)
- One of his paper mills and
- Kimberly and Clark mill

It was the first time ever, anywhere in the world, where this happened to make enough electricity for everyone!

Henry Rogers invents the idea of hydroelectricity (using water power to make electricity) and in doing so invents the idea of green energy.

Green energy is any energy type that is generated from natural resources, such as sunlight, wind or water that are naturally renewable

The major types or sources of renewable energy are:

- Solar energy from the sun.
- Geothermal energy from heat inside the earth.
- Wind energy.
- Biomass from plants and of course...
- Hydropower from flowing water.

Renewable energy is also called "clean energy" or "green power" because it doesn't pollute the air or the water.

Right here in Appleton! Wow!

Invention Process



Let's move over here.

Here is the first power plant – anywhere in the world! - to light more than one building using Thomas Edison's lighting and hydroelectricity. Henry Rogers built it at his paper mill.

But Henry runs in to a problem.

He has hooked up his generator to the same water wheel that he uses to make paper. The water wheel is used to grind wood into chips that can be turned into pulp (fibers) to make paper.

Henry discovers that every time his employees add wood to be ground, the wheel slows way down and the lights get very dim.

But when there is no pulp being ground at all, the water wheel spins so fast that his generator makes so much electricity that it burns out all the light bulbs!

He has to find a solution to fix the problem.

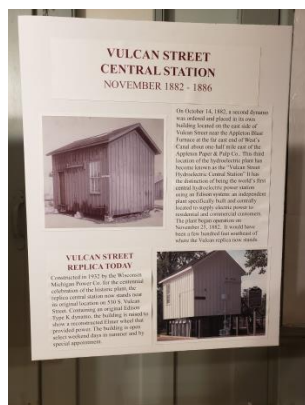


What would you do?

Exactly! Hook up your dynamo (magnet and coils) to its *own* water wheel!

Two weeks later, the dynamo was moved to its own waterwheel.

Here is a photo of the small building that housed the water wheel and the generator for the first dedicated hydroelectric system.



Then, two weeks after that, Henry built another building to do the same thing at the other end of downtown Appleton.

It is the Vulcan Street plant.

A replica still stands today in Appleton! You can go visit it!

All of this illustrates something called the invention process.

It is what inventors do all the time. In fact, it is what *all of us* can do *all the time* because every one of us can be inventors too!

There are the steps...

First, come up with an idea (called “ideate”) that is all your own.

Second, test the idea to see if does what you think it should or if there are problems.

Third, “problem solve”.

- If there are problems, figure out why there are problems.
- Then work hard to come up with new ideas that either
 - o fix the problems or
 - o eliminate the problems all together.

Fourth, test the new ideas to see if *they* work.

Fifth, repeat until you come up with the best method possible.

Now you are an inventor!

Can you see this process in how Henry invents hydroelectricity?

Sure! Let’s give some examples.

Library (tour moves to first floor)

Location

Let me start with a question...

What do you do when you enter a dark room?

- Turn on the lights!
- Of course!

And what happens?

- Power comes from somewhere else
- Lights the lights in your room.
- Exactly!

Hearthstone was the first house *anywhere in the world* where this happened. Yes, it was right here! In this house! In Appleton!

It was the first time someone could

- Walk into a room in their home
- Turn a switch
- Instant light
- First time ever!



He used this light fixture. It is 140years old and is original to this house. I know right?

In fact, ALMOST ALL of the light fixtures are the original ones used when the house was lit on Sep 30 1882.

This was revolutionary!! Here's why this is so important.

Do you know what kind of lighting electric lights replaced?

There are some examples in this room. Let's look around. Can you find them?.

- Candles
- Kerosene lamps
- Gas lights
- Fireplace



What are the problems with these kinds of lights?

- Takes time to light them
- Flicker
- Smoke
- Soot
- Bad smells
- Dangerous!! They are all on fire!

Does electric lighting solve all of these problems? Yes!

- On demand – they turn on as soon as you turn the switch
- Steady, even light
- No smoke or soot
- No smell
- No open flames so much safer!

So you can see how Thomas Edison, who invented the light bulbs we will use today used the invention method to invent one of his greatest inventions.

In fact, he tested over 10,000 things to use create the filament, that's

the part of the lights that glows when electricity runs through it before he found the one that worked!

Sometimes inventing can be hard work. Edison once said...

“Invention is 1% inspiration and 99% perspiration!”

He also said...

“I haven’t failed. I have just found 10,000 things that don’t work!”

Phonograph



Ok... Here is another question...

Do you know what else Thomas Edison invented?

- 1093 patents! That’s a lot!!
- Invented (among other things)
 - Electric lights
 - Movies
 - Phonograph and... here is one of the first ones!!!

Thomas Edison invented the light bulb with the help of others.

But he invented the phonograph – wholly from his own imagination.

The music recorded on wax cylinders ([show one](#)). Each holds about 2 minutes of music.

Can you believe it? This is a recording. This makes music!

Would you like to hear it play?

(DEMONSTRATE and explain how it works)

It runs entirely by springs. There is no volume control. The volume depends on the length of the horn... until people discovered they could do this...

(DEMONSTRATE)

And that’s where we get the phrase “Put a sock in it” when we want others to be quiet!

The phonograph was revolutionary too! Just like the light bulb.

- First time on-demand music

- First time you could hear a human voice or an instrument.
- Didn't need someone to play an instrument
- Now music was available to everyone!!!

Parlor

Central electrolier



Here is another original light fixture.

Henry used that first night. WOW! Here's a question...

Have you ever wondered why we say "turn on the lights" when we are actually flipping a switch?

Well, the phase actually started with these light switches! (point out)

Do they look like our current light switches?

No!

They were designed to work like a water faucet (which everyone was familiar with that turned to open). They work like this.

(DEMONSTRATE motion but don't actually turn the handle)

They "turn."

So these lights switches started it all. They are the original switches used 140 years ago.

They are very rare now. There are only 13 in the world and Hearthstone has 11 of them! The other two are in other museums!

But this is where we get the phrase "Turn on the lights." Amazing!

Throughout our tour we will talk about other phrases that live on in our everyday speech but that we might not know where they came from!



Check this out. Here is another invention that starts something we still use today.

Do you know what digital music is?

It is music that's played on our phones and computers. It is stored as digits. This simply means that it is stored as ones and zeros in computer programs, computer files, and on CDs that can use read by our phones

and computers to produce music.

So it's all just stored as one of two digits... either ones or zeros.

(PULL OUT A DISK FROM THE STELLA)

Well here is the first digital music!

Does it look like digital music? No?

But it is! It records music using ones and zeros but here the ones and zeros are holes and spaces.

The holes flick little tines (pieces of metal that vibrate) to produce the music. It is a big music box!

Should we play it?

Sure!

Sounds good doesn't it.

But the important thing to remember is that sometimes we can get inspiration for new inventions from past inventions.

They might work a different way but they can teach to think differently.

Cool.

Dining Room



Here is another invention in Hearthstone.

Do you know that this is?

It is a radiator! It is called that because it radiates (or gives off) heat!

It uses very hot steam, which flows through the pipes and through the radiator, to heat the rooms here.

It is 140 years old too! And it, along with all of the other ones that are 140 years old, are still used to heat the museum.

It is called a central heating system because there is one centrally located furnace to heat the whole house.

Hearthstone was one of the first houses in the state to have central heat! You didn't have to build a fire in every fireplace to heat the house.

Central systems are how we heat our houses today... and it starts at Hearthstone 140 years ago!

Now let's go into the Kitchen.

Kitchen

Kitchen lights

There are three inventions we want to talk about in this room...

This first are these electric lights.

Are they fancy ones like in the rest of the house?

No. They are very simple. But they are really important.

Remember when we were talking in the Library about how important electric lights were. They were safer because there was no open flame. They were healthier because they didn't produce smoke and soot for people to breathe in.

These are important attributes of electric lights.

But electric lights changed people lives in other ways. Here is a great example.

The cook who worked for Henry Rogers loved these lights. They literally changed her life. She worked from 4:30 in the morning to 10:00 at night in this kitchen.

Can you imagine having to do all that work by candle light? How do you think that would work?

Not well!

People's eyes would wear out by the time they were 30. They would have to have other people read to them.

Imagine working here and not being able to read your own recipe books!

Electric lights meant being able to do your job well and to keep your job (job security). This was very important to workers like the servants who worked here.

Speaking of the servants in this house...

Annunciator



This was the high tech way to call your servants to help you. It ran on electricity too. It is original to the house.

These buttons were scattered throughout the house and you would do this.

(DEMONSTRATE)

Here is an interesting idea. Things like the annunciator were being invented here in Appleton 130 years ago.

Appleton was center of invention because it had electricity!

People were flocking to Appleton in the 1880s and 1890s because Appleton had more buildings with electricity than any other city *in the world!*

That's right! More than New York or Chicago or Paris or London. All because of Henry Rogers. So people came here to use this new technology and invent new things.

Appleton became the "Silicon Valley" of America!

Have you heard of the Silicon Valley in California? It is the center of the computer industry. It has grown by leaps and bounds over the past 40 years because people flocked to the area – where companies like Apple were founded – to use the new technology of computers.

The same thing happened here 140 years ago with the new technology of electricity! Amazing!

Hmmm... maybe this area should have been called the "Electric Valley"!

Toaster

And there is another invention.

Do you know what it is? Any guesses?

It's a toaster!

It doesn't look like a toaster. But it is!



First...

- Notice that the toaster is plugged into the light fixture.
- There were no outlets in this house originally! Outlets hadn't been invented yet.
- Harvey Hubbell invents the outlet we use today in 1895 though not standard until 1926!
- Can you imagine an entire house with a single outlet!

This toaster is as revolutionary as the electric light and the phonograph. Do you want to know why?

Do you know what huge change in America is directly related to the toaster and other small appliances?

- Women finally getting the right to vote!!
- That's right!!!
- How? Electric appliances (like the toaster, coffee makers, vacuum cleaners, etc.) made the lives of women easier and gave them sometime they never had before... free time.
- Free time for middle class women turned suffrage into a mass movement. Meaning that hundreds and thousands of women could join in the fight to get them their rights.
- 19th amendment recognizing women's right to vote was passed in 1920.
- Wisconsin was the first state to pass the amendment!

I told you the toaster was revolutionary!! How cool!

This shows another important aspect of inventing. Sometimes you don't know...

- where a new invention will lead
- what it will make possible, or
- what the end results will be.

Here, it is really interesting and important that the invention of the electric light, in an indirect but important way, leads to everyone

getting the right to vote! WOW!

Servants Hall

Telephone



Here is our last invention on the first floor.

Do you know what this is?

It is a telephone! Does it look like our telephones today? No!

What is different?

Ok... just about everything but specifically...

- Huge!
- Attached (wired) to the wall
- Separate ear piece and transmitter
- No dial or buttons in fact no numbers at all
- Only for talking to people! (No camera, messaging, music, internet, etc. I know, how did people live this way?!)

So how did it work?

(DEMONSTRATE)

Do you know who invented the telephone?

It was Alexander Graham Bell 150 years ago.

Do you know who helped him get his patent on the phone?

A famous African-American inventor named Lewis Latimer. We have a display on Mr. Latimer that you can see in the lower level after our tour.



Lewis Latimer drafted the technical drawings for Bell that explained his invention and helped Bell with the language of his patent. Both are absolutely critical to Bell getting his patent.

In fact, Lewis Latimer works with three giants of American invention...

- Alexander Graham Bell
- Hiram Maxim who invents the machine gun and works on airplanes before the Wright Brothers, and also

- Thomas Edison!

Lewis Latimer invents a new way to make filaments (remember, the part that glows in a light bulb) that makes light bulbs cheaper and easier to make! How marvelous!

He is a giant of American invention in his own right!

Lewis Latimer was self-educated. His mother and father were enslaved in Virginia, escaped North, fought for their freedom with the help of very famous people like Frederick Douglass.

It shows us that we can all be inventors.

- It does not make a difference what our backgrounds are or
- Where we went to school.
- We all possess the spark of genius!

Second Floor Bathroom



Here we have four bedrooms and a sitting room in the middle where the Rogers family could relax.

But maybe the coolest part of the upstairs is this room... The bathroom!

In bathroom describe

- Tub
 - Made out of zinc because zinc doesn't rust
 - If it looks like a horse trough... there is a reason!
 - The Kolher Company originally made farm implements and just put little legs on their horse trough and called it a bathtub!
 - Sometimes inventions come from truly unexpected sources!
- Sink
- Toilet which was one of the first flush toilets in the state!

These all illustrate another innovation at Hearthstone... running water! You could just open the tap and water would flow out.

Today that happens because we have city water. But not 140 years ago.

Henry Rogers had big tanks installed in the attic just above the bathroom and water from the pump behind the house would be pumped up to fill the tanks.

When you wanted water, all you had to do was open the tap and gravity would let it flow back down!

All designed to make life easier but, importantly, this room also helped stop people from getting sick.

Again, simple inventions can have important benefits!