

<b>Instructor:</b> John M. Berner	<b>Unit Title:</b> History of Fluid Power
<b>Course:</b> Power and Energy	<b>Lesson Number:</b> 002
<b>Grade Level:</b> 11 <sup>th</sup> and 12 <sup>th</sup> Grade	<b>Time Allotted:</b> 50 – 55 min
<b>WI Standards:</b> A.12.1	<b>STL:</b> 4, 5, 6, 7,
<b>Rigor/Relevance:</b> A B C D	

Contrast the increasing complexities of technology with its ease of use.

Students will develop an understanding of the cultural, social, economic, and political effects of technology.

Students will develop an understanding of the effects of technology on the environment.

Students will develop an understanding of the role of society in the development and use of technology.

Students will develop an understanding of the influence of technology on history.

**Objectives and/or Purpose:**

On a written matching exam students will be able to identify the accomplishments associated with Galilei, Toricelli, and Pascal with no more than one error.

Given a barometric meter and a tub of water, students will be able to calculate the force acting on the surface of the water with no more than 10 % error.

**Terms to Know:**

Pressure  
Force  
Barometer  
Mass

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**Method/Procedure:**

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<b>Materials</b>	<b>Time Estimate</b>	<b>Activity</b>
Ruler String Two Balloons Tape	5 – 10 min.	Prove that air has mass by comparing weights of filled balloons.
Tub of Water Water Glass Container	5 – 10 min.	Build a barometer.

Peeled Hard Boiled Egg Gatorade Bottle Paper Towel Matches	5 – 10 min.	Let the air in the atmosphere push an egg into a bottle by removing the air that applies an upward force.
Balloon	1 – 2 min.	Blow up a balloon and press on one side to see that forces act equally on all sides.

### Formative Assessment

### Summative Assessment

#### Quiz 1

**Directions:** Read each of the following statements and fill in the blank by writing a capital letter that corresponds to correct person.

- A. Galileo Galilei
- B. Evangelista Toricelli
- C. Blaise Pascal

1.   B   ocean of air that surrounds us all
2.   C   his discovery led to measurement in PSI
3.   A   discovered that objects accelerate at the same rate.
4.   B   invented the first barometer.
5.   A   discovered that air has mass.
6.   A   from the top of the leaning tower of Pisa, he proved Aristotle wrong

## **Method/Procedure:**

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### **Pre-assessment**

#### **Overview**

Today, we are going to have fun with history. The first three scientists that we will be discussing have discovered physical properties that will affect pneumatics. Not only will we talk about each of these scientist, we will perform easy experiments that will prove or disprove their theories.

#### **Introduction/Motivation/ Set Induction:**

Imagine going to a fast food restaurant and ordering a soda in a world where air doesn't have any mass or weight. You sit down at your table and rip the paper off of your straw. You wad the paper up in the end of the straw and proceed to blow the wad through the straw towards your friend sitting across the table? The problem you come to find out is that without air having mass, how would you generate any force to shoot that paper wad? If air doesn't have weight, you also wouldn't be able to sip through a straw. I will show you why that is.

#### **Content Presentation**

##### **Galileo Galilei 1564-1642**

Galilei was the first scientist to unintentionally prove that air has mass. Dropping objects off of the Leaning Tower of Pisa proved Aristotle wrong, who thought that objects that were bigger fell faster. Galileo observed that large objects accelerated at the same rate and that air applied a frictional force on the objects. In order for air to apply a force it would have to have mass.

##### **Evangelista Toricelli 1608-1647**

Toricelli was a scientist who worked with Galilei and continued out his experiments. He is remembered for inventing the first barometer which is used today to measure pressure in the ocean of air that surrounds us.

##### **Blaise Pascal 1623-1662**

Pascal continued the work of Toricelli carrying a barometer up to different land elevations. Using Toricelli's experiment, he pointed out that air pressure affects an entire surface equally, so in order to take a measurement, the force applied needs to be divided by surface area countering the pressure of the air.  $\text{Pressure} = \text{Force} / \text{Area}$ .

#### **Repetition & Review – Feedback**

## **Application & Practice/Learning Activities:**

Experiment #1– Hanging scale weighs the difference between an air filled balloon and a popped balloon.

Experiment #2- Toricelli filled half a container of water and tipped it up side down in a tub of water. A vacuum of trapped air was still in the jar. Lifting and mounting the jar so that the rim of it never came above the water level of the tub showed that the water inside of the jar raised as well to fill the empty space that the air didn't. The amazing discovery he found was that over time the water level raised and lowered proving that the air around us was exerting a force on the water in the tub fighting the air pressure in the jar. He repeated the experiment with mercury which is a much heavier fluid. The rising and lowering fluid in the jar can be measured, and with that information so can air pressure. This is how a barometer works.

Experiment #3– If we took a hard boiled egg, peeled it and set it on the lip of a jar that has a diameter slightly less than the diameter of the egg, what would happen to the egg if a burning sheet of paper towel inside of the jar do? Fire consumes oxygen. What you will find is that the air around us will exert a force on the egg that cannot be counter acted with any air that is inside the jar; so the egg should be pushed into the jar.

Experiment #4– By pressing on a blown up balloon, the balloon will stretch in all directions with equal force.

## **Closure/Summary**

History is full of well known people who have made discoveries. You and I easily understand that the earth is round. Christopher Columbus once had to prove it to the world who thought the earth was flat. Think about how the knowledge of the world being round affects us today. Galilei, Toricelli, and Pascal made similar discoveries that allow us to harness nature into something useful, such as Toricelli's barometer. Because of them, we also know the answers to simple everyday routines like sipping soda through a straw.

## **Reflection/Self Evaluation**

### **Resources**

#### **Elements of a Basic Pneumatic System:**

<http://ranier.oact.hq.nasa.gov/team116/2003/lessons/Lesson7-Pneumatics.pdf>

NASA.Gov

Updated 12/17/2002

#### **Wikipedia, *Blaise Pascal***

[http://en.wikipedia.org/wiki/Pneumatic\\_actuator](http://en.wikipedia.org/wiki/Pneumatic_actuator)

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Dawson, Brett. *Team DaVinci's Understanding Pneumatics*

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