

## Lesson Plan

### Laura Bassi's School of Experimental Physics



*Bassi, Laura Maria Caterina by Haid, Johann Jakob - 1741 - Österreichische Nationalbibliothek (Austrian National Library), Public Domain.<sup>1</sup>*

**Grade Level(s): 3-5**

**Subject(s): Physics, History**

**Supplements: Physics**

**In-Class Time: 70-95 Minutes**

**Prep Time: 20-30 Minutes**

#### **Materials**

- *Bassi Laboratory Guide*
- *Bassi Laboratory Notebook*

<sup>1</sup> [https://www.europeana.eu/en/item/92062/BibliographicResource\\_1000126179172?q=Laura%20Bassi](https://www.europeana.eu/en/item/92062/BibliographicResource_1000126179172?q=Laura%20Bassi)

- *Experimental Physics School of Laura Bassi Diplomas*

For the experiments:

- An empty can
- A balloon
- A piece of cloth or clothing
- Faucet with running water
- Bubble solution
- Straws
- Surface that can be wet (e.g. a tray)
- Water
- Spray bottle
- Clear cup of water
- Pencil that can be placed in cup
- Small mirror to fit in cup
- Flashlight

### Objective

Students will be immersed in the state-of-the-art lab of Laura Bassi, an 18<sup>th</sup> century experimental physicist. They will learn about Bassi and perform simple experiments on subjects Bassi and other scientists were exploring at the time, including static electricity, surface tension, and light refraction. They will record their observations in lab notebooks and graduate from the “Laura Bassi Experimental Physics School” with diplomas.

### Introduction

Laura Bassi (1711-1778) defied the gender norms of her time by becoming the second woman in Europe to receive a university degree and the first woman to receive an official teaching position in physics at a European university. She grew up in Bologna, Italy, and was known as an intellectual across the continent with notable fans including the famous author and philosopher Voltaire as well as Pope Benedict XIV.<sup>2</sup> The daughter of a modest lawyer, Bassi was taught by the family physician and became adept in Latin, mathematics, writing, and the physical sciences, at the time called “natural philosophy.”<sup>3</sup> Although she did not come from nobility, Bassi achieved notoriety and general renown by publicly performing her knowledge. On April 17<sup>th</sup>, 1732, at age 20, Bassi defended 49 theses on topics ranging from mathematics to philosophy to achieve a doctorate in philosophy and a lecturer position from the University of Bologna, as well as membership in Bologna’s Institute for Sciences.<sup>4</sup> She went on to pursue

<sup>2</sup> Findlen, Paula. “Science as a Career in Enlightenment Italy: The Strategies of Laura Bassi.” *Isis* 84, no. 3 (September 1993): 441–69.

<sup>3</sup> Frize, Monique. *Laura Bassi and Science in the 18th Century Europe* (Berlin: Springer, 2013). 39.

<sup>4</sup>Frize, *Laura Bassi*, 1-3.

an extraordinary scientific career of teaching, conducting her own experiments, popularizing experimental physics, and performing her intellect for the entertainment of the nobility.

It was fortunate that Bassi lived in 18<sup>th</sup> century Italy, where the scientific establishment and nobility largely celebrated her and her achievements. At the time, the ideal of an “exceptional woman,” one who was intelligent, was highly celebrated.<sup>5</sup> In addition, Bologna was on a mission to reclaim its scientific profile, which was slipping.<sup>6</sup> Because of this, Bassi was embraced, particularly in Bologna where she received patronage of the local Cardinal Prospero Lambertini who would later become Pope Benedict XIV.<sup>7</sup>

Despite her recognition, Bassi still faced numerous barriers because of her gender. After obtaining her degree and lecturer position, she was expected to fill an honorary role. Bassi, however, wanted to teach and pursue experimental physics, not write poetry and host public debates.<sup>8</sup> Moreover, as a single woman, people gossiped about her participation in scientific community of men. She married fellow scientist Giuseppe Veratti. Although this quieted the gossip about her virtue, it was also itself a controversial decision because women dedicated to knowledge were expected to remain single, and women who married were expected to dedicate themselves to their families. Nevertheless, Bassi and Veratti worked together to perform experiments, teach, and publish works.<sup>9</sup> Though she faced sexism, Bassi was also a strong advocate for herself and her accomplishments, petitioning for the positions, credit, and salary she deserved.<sup>10</sup>

Bassi’s academic career was hugely influential in Europe, not because of her gender but because of the quality of her work. At this time, the methodologies of experimental physics were not widely adopted, and many academics favored thought experiments in the tradition of Aristotelianism. Bassi’s honorary lectureship at the University of Bologna did not allow her to teach experimental physics to students on a regular basis. However, she was not deterred, and Bassi and her husband opened her own school operating from their home, where students could learn experimental physics. This school quickly became internationally renowned as Bassi and Veratti purchased state of the art equipment. Through her school and correspondences, Bassi was also hugely influential in spreading Isaac Newton’s physics and the importance of calculus and mathematical physics within Europe.<sup>11</sup>

In addition to teaching, Bassi conducted her own experiments ranging from studying electricity, to the nature of bubbles, air-pressure, the water cycle, and the nature of fluids. She did not publish many papers and records of her work are mainly found in correspondences.<sup>12</sup> Two years before she

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<sup>5</sup> Frize, *Laura Bassi*, 9-11.

<sup>6</sup> Frize, *Laura Bassi*, 2-3.

<sup>7</sup> Frize, *Laura Bassi*, 58.

<sup>8</sup> Frize, *Laura Bassi*, 48-50

<sup>9</sup> Frize, *Laura Bassi*, 42-44

<sup>10</sup> Frize, *Laura Bassi*, 4, 42.

<sup>11</sup> Frize, *Laura Bassi*, 51-53.

<sup>12</sup> Frize, *Laura Bassi*, 71-75.

died, the University of Bologna created a Chair position for experimental physics and appointed her. At the time of her passing, she was internationally regarded as one of the best scientific minds of her generation.<sup>13</sup>

### Instructions/Activities

#### Engage: 5-10 Minutes

Laura Bassi and her experimental physics school is introduced to the students, and they will learn about her and physics of the 18<sup>th</sup> century. The teacher will introduce Bassi and the classroom and together they will “travel” to Bassi’s classroom.

#### What is the teacher doing?

The teacher explains who Laura Bassi is and that they are transported to 1700’s Italy where Laura Bassi is letting them use her classroom to learn about science. Key facts to mention about Laura Bassi include:

- She was the second woman in Europe to receive a university degree
- She was the first female physics professor in Europe
- She was interested in studying the science herself by making experiments
- She started her own school doing cutting-edge experiments because the university she worked at did not completely support her experimental physics
- People would travel from all across Europe to learn from Bassi, which is what this class is doing!

#### What are the students doing?

The students are listening to the teacher and learning about Bassi and the school they are going to.

#### Explore: 50-60 Minutes

The teacher will lead the students conducting the simple experiments found in *Bassi’s Experiments in Supplemental Materials*.

#### What is the teacher doing?

The teacher will hand out the *Bassi Lab Notebooks* found in *Supplemental Materials* and explain that Bassi’s new science relied on making observations of experiments so they will take notes and draw what they see to become a scientist like Bassi. The pages of the notebook can be stapled together to make it more like a book and less like a printout.

#### What are the students doing?

The students will receive the lab notebooks. They should make sure to put their name on their notebook.

<sup>13</sup> Frize, *Laura Bassi*, 82-83.

<p>The teacher will then perform the experiments for the class, using students to help. During the experiments the students are writing in their notebooks.</p> <p>The teacher will reinforce the scientific process, encouraging students to:</p> <ol style="list-style-type: none"> <li>1. Observe and ask a question to test</li> <li>2. Hypothesize</li> <li>3. Perform the experiment</li> <li>4. Analyze results</li> <li>5. Make conclusions</li> <li>6. Based on new information ask questions</li> </ol>	<p>The students will then participate in the experiments as the teacher requests and make notes and draw in the notebook as instructed.</p> <p>Students will participate in the scientific process actively through the lab notebooks and in-class participation.</p>
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**Explain: 10-15 Minutes**

<p>They will reflect on the lab experiments and discuss the lab discussion questions (found in <i>Supplemental Materials</i> and below).</p>	
<p><b>What is the teacher doing?</b> The teacher is facilitating the discussion and calling on students to participate.</p> <p>Discussion questions:</p> <ol style="list-style-type: none"> <li>1. What was your favorite experiment?</li> <li>2. What was something that surprised you?</li> <li>3. What did you learn from the experiments today?</li> <li>4. Would you want to be a scientist like Laura Bassi?</li> </ol>	<p><b>What are the students doing?</b> The students are participating in the discussion.</p>

**Elaborate: 5-10 Minutes**

<p>The students “graduate” from Laura Bassi’s school and receive diplomas similar to what someone might have received if they did learn from Bassi.</p>	
<p><b>What is the teacher doing?</b> The teacher is passing out the diplomas and congratulating the class.</p>	<p><b>What are the students doing?</b> The class is receiving the diplomas.</p>

**Evaluate:**

<p>The teaching can collect and evaluate the lab notebooks.</p>
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**Discussion Questions**

1. What was your favorite experiment?

2. What was something that surprised you?
3. What did you learn from the experiments today?
4. Would you want to be a scientist like Laura Bassi?

### Further Reading and Additional Resources

1. Frize, Monique. *Laura Bassi and Science in the 18th Century Europe*. Berlin: Springer, 2013.
2. Findlen, Paula. "Science as a Career in Enlightenment Italy: The Strategies of Laura Bassi." *Isis* 84, no. 3 (1993): 441-469.

### Extensions

Related AIP Teacher's Guides on the History of the Physical Sciences:

On the Shoulders of Giants: Inertia from Ibn Sīnā to Newton

The Night Sky by Another Name Grades 4-5

### Common Core Standards

For more information on Common Core Standards, visit <http://www.corestandards.org/>.

Writing	
<a href="#">CCSS.ELA-LITERACY.W.3.3</a>	Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.
<a href="#">CCSS.ELA-LITERACY.W.3.7</a>	Conduct short research projects that build knowledge about a topic.
<a href="#">CCSS.ELA-LITERACY.W.4.3</a>	Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.
<a href="#">CCSS.ELA-LITERACY.W.4.7</a>	Conduct short research projects that build knowledge through investigation of different aspects of a topic.
<a href="#">CCSS.ELA-LITERACY.W.5.3</a>	Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.
<a href="#">CCSS.ELA-LITERACY.W.5.7</a>	Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.

### Next Generation Science Standards

For more information on the Next Generation Science Standards, visit <http://www.nextgenscience.org/>.

Physical Sciences

<b><u>3-PS2-2 Motion and Stability: Forces and Interactions</u></b>	Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. Grade: 3-5
<b><u>3-PS2-3 Motion and Stability: Forces and Interactions</u></b>	Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. Grade: 3-5

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