

Make an analog calculator. The Pascaline.

Respective blueprint	Pascaline
Description	<p>This sequence will introduce students to the Pascaline, also called the Arithmetic Machine, and teach them about the use of gears. They will learn appropriate vocabulary and relate it to their everyday lives, as well as putting all this knowledge into practice by creating a simple calculator system using gears.</p>

Learning Objectives

The purpose of this lesson is to give students an understanding of gears and how they work in a simple calculator system.

Afterward,

1. The student will be able to explain what a gear is and how it makes work easier.
2. The student will be able to give examples of everyday items that use gears.
3. The student will be able to create a simple calculator system with gears.

Related curricular
subject(s)

- Shop class: Using appropriate tools strategically.
- Physics: The relationship between energy and forces. When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.
- Mathematics, and its relationship to the movement of gears.

<p>Prerequisites / preparatory actions for teachers</p>	<p>To prepare the session well, we recommend seeing these videos about simple machines and gears.</p> <p>Video: Gears and simple machines https://www.youtube.com/watch?v=-m3Er8Zcb_A</p> <p>This is a silly project, but it clarifies the use of Lego gears and their combinations. https://www.youtube.com/watch?v=QwXK4e4uqXY</p>
<p>Prerequisites / preparatory actions for students</p>	<p>Knowing and being confident with the Lego system.</p>
<p>Age of students</p>	<p>10 – 15 years old</p>
<p>Duration</p>	<p>50 minutes</p>



Level of difficulty	Medium
Resources	<p>If you don't have all the necessary Lego gears, you can download the files for 3D printing them at thingiverse:</p> <p>https://www.thingiverse.com/thing:4258996</p>

Step by step description of the tasks

1. Introduce the concept and history of the Pascaline.

The Pasacaline, or the Arithmetic Machine, was the first calculator or adding machine to be produced in any quantity and actually used. The Pascaline was designed and built by the French mathematician-philosopher [Blaise Pascal](#) between 1642 and 1644. It could only do addition and subtraction, with numbers being entered by manipulating its dials. Pascal invented the machine for his father, a tax collector, so it was the first business machine, too (if one does not count the abacus). He built 50 of them over the next 10 years.

2. Go over key vocabulary learned during the video provided above (Silly project) – gears, gear ratio, rotation. Discuss what they mean and give real-world examples of them.

3. Introduce the “Gears at Work” science kits. Go through the parts so students are aware of what they will be working with and know what each piece is.

4. Encourage students to take notes as they explore and learn about gears.

5. Divide students into small groups or pairs (depending on class size) and give each group a kit.

6. Display the blueprint of the Pascaline on the board. Tell students that by the end of class they will have to explain to you where the gears and pulley are located on the calculator and how they work.

Assessment activities

1. Review the notes taken during the viewing of the videos and how they apply to the Pascaline.

2. Give students the class period to complete the Pascaline activity and explore within their groups. Make sure all students participate, as all students will be responsible for knowing the information at the end of the class period.

3. Reflect on:

- Preparation
- Planning
- Teaching
- Student Engagement and Participation
- Evidence of Student Learning

4. Have students complete the following quiz, and later discuss the answers:

What Are Gears? What Do They Do? Post-Quiz and Answer Keys.

1- What is a gear?

A gear is a wheel with teeth that meshes with other gears. It is usually made of metal or plastic.

2- How do we select the gear ratio for a particular application?

Some applications (machines) may need to be fast, while other machines may need to be strong. When designing gears for a machine, it's important to know whether speed or torque (strength) is more important. Remember that $\text{power} = \text{torque} \times \text{speed}$. In general, if you need to have more torque, select a large gear ratio. If you need to move fast, then use a smaller gear ratio.