

## Oxygen Analyzer Lesson Plan

**Beckman Center Collection Area:** Oxygen Analyzer

**Grade:** Middle School, recommended 7<sup>th</sup>-8th Grade

**Subject Area:** Science, English Language Arts

**Duration:** 1 hour

### Objectives:

#### Goals:

1. Students will understand that oxygen can be influenced by magnetic forces and that by measuring the effect of magnetism on a sample of air, one can determine the concentration of oxygen in the sample.
2. Students will understand that there are different types of magnetic properties, ferromagnetism and paramagnetism.
3. Students will use knowledge of the different types of magnetism to identify metal samples.

### Next Generation Science Standards:

MS-PS2-3 Ask questions about data to determine the factors that affect the strength of electric and magnetic forces

MS-PS2-5 Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact

### Common Core State Standards English Language Arts

CCSS.ELA-LITERACY.RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

CCSS.ELA-LITERACY.W.8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

CCSS.ELA-LITERACY.RST.6-8.8 Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.

### Materials:

- Iron Samples
- Aluminum Samples
- Bar Magnets
- Paperclips

### Classroom Activities:

1. Warm-up Discussion: What is oxygen? What is air and how are they different? Why might it be important to measure the concentration of oxygen in the air? Are there negative consequences to too little oxygen? Too much oxygen?

2. Pass out the student activity hand out on magnetism and ensure all groups have the required materials. Work through the activity in small groups or a class.  
Suggested comprehension and discussion questions following the activity:
  - o *What is the difference between paramagnetism and ferromagnetism?*
  - o *How might we take advantage of the fact that oxygen is magnetic to measure the concentration of oxygen in a sample of air.*
2. Watch this short video on the Beckman Oxygen Analyzer:
  - o [Oxygen analyzer - YouTube](#)
3. Discuss the invention of the oxygen analyzer and some popular applications, namely use in submarines and incubation chambers.
4. As a whole class, discuss results and share as a class:
  - *What surprised you today?*
  - *What is something new you learned?*

### **Extension Activities:**

- Have students split up into groups to research explore some important chemical reactions which require oxygen.
  - o Combustion (fire)
  - o Oxidation (rust)
  - o Cellular Respiration, have another group look up anaerobic respiration to see how cells produce energy when not enough oxygen is present.
- Students divide into groups and explore at a deeper level applications of the oxygen analyzer and scenarios where oxygen concentration is critical
  - o Submarines
  - o Spaceships
  - o Incubation Chambers
  - o SCUBA Tanks

### **Additional Beckman Center Resources:**

[About the Foundation | Beckman Foundation \(beckman-foundation.org\)](#)

[Impact Videos | Beckman Foundation \(beckman-foundation.org\)](#)

#### **Other things to explore:**

This video is a short demonstration which demonstrates turning an iron nail into a temporary magnet:

[Iron nail as a temporary magnet | Magnetism | Physics - YouTube](#)

This video is a demonstration of the magnetic properties of oxygen. Oxygen is cooled down to a low temperature until it liquifies, this way we can observe its magnetic properties.

[Paramagnetism of Oxygen - YouTube](#)