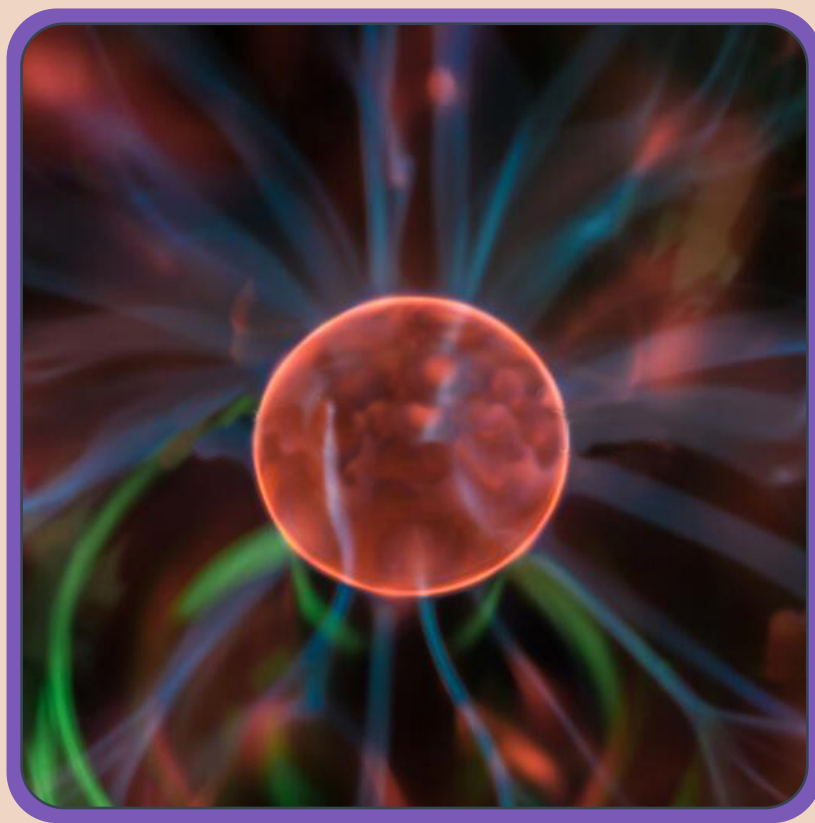


STEM *Sims*™

# Inside Atoms

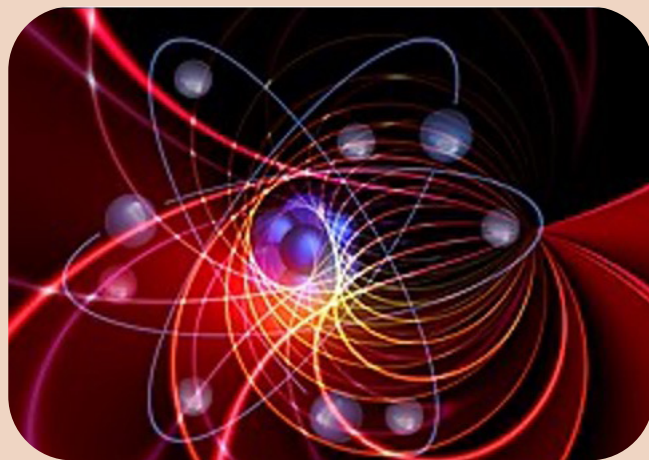


# Inside Atoms

**Do you need an idea for a scientific study?  
Try out one of our ideas or make one of your own.**

Atoms make up everything that has mass and takes up space. Finding the nature of atoms was hard work and required much thinking outside the norm. Take the following brief quiz to see how much you already know about the atom. See the bottom of page 4 to check your answers.

1. What percentage of an atom is empty space?
  - a. 10%
  - b. 33%
  - c. 75%
  - d. 99%
2. What was the first non-natural atom “created” by humans in the laboratory?
  - a. technetium
  - b. argon
  - c. plutonium
  - d. uranium
3. The Greek word for the term “atom” means:
  - a. very small.
  - b. hard.
  - c. uncuttable.
  - d. charged.
4. What is the most abundant atom in the universe?
  - a. oxygen
  - b. hydrogen
  - c. nitrogen
  - d. carbon
5. The force that holds protons and neutrons in the nucleus is:
  - a. much weaker than gravity.
  - b. about the same strength as gravity.
  - c. much stronger than gravity.



# I Don't Have a Ruler!

If someone asked you to find the area of a penny, most people would grab a ruler and quickly get to work. However, what happens if you don't have a ruler? Can you still find the penny's area? Get started measuring without direct measurements.

## Materials Required

1 – sheet of copy paper

1 – sheet of carbon paper  
1 - marble  
safety glasses

1 – penny

## Procedure

1. Make sure that you get permission before conducting this experiment.
2. Place your safety glasses on your eyes!
3. Use a pen or pencil to outline the penny on the sheet of copy paper. Repeat this process until you have about 20 penny circles spread out evenly on the sheet of paper.
4. Place the sheet of copy paper with the penny circles flat on the ground with the penny circle side up.
5. Lay the sheet of carbon paper face down on top of the copy paper.
6. Close your eyes, hold the marble away from your body and over the copy paper. Release the marble so it makes a mark on the paper.
7. Repeat this step until you have dropped the marble on the paper a total of 50 times. Remove the carbon paper from the copy paper.
8. If a marble mark is inside a penny circle, count this as a hit. If a marble mark is outside the penny circle count this as a miss. Record your data in Table 1.
9. Use the equation below to find the area of all the pennies and then the area of one penny.

$$\text{Total area of all penny circles} = (616 \text{ cm}^2) \times \text{hits inside penny circles}/50$$

**Table 1. Investigation Results**

	Results
Number of hits inside the penny circles	
Number of hits outside the penny circle, but on the copy paper	
Total area of all penny circles (square centimeters)	
Number of penny circles inside the rectangle	
Area of a penny (in square centimeters)	

## Questions

1. Describe the difference between a direct and indirect measurement.
2. Do you think the original measurement of the size of an atom was made using direct or indirect measurements? Provide a reason to support your answer.

# Inside Atoms

## Looking Inside Your Body

One outcome of the Covid-19 epidemic was people's increased awareness of the oxygen saturation level in their blood. One symptom of the virus was a significant drop in the  $O_2$  saturation below the normal reading of about 95% saturation. Many people purchased oxygen meters to measure their saturation levels to make sure they stayed healthy.

The pulse oximeter is a non-invasive device that uses red light and infrared (IR) light to measure the peripheral  $O_2$  saturation levels in a person's bloodstream. The device clips onto a person's fingertip or earlobe where the skin on the body is slightly more translucent. Hemoglobin with oxygen absorbs more IR than hemoglobin molecules without oxygen. The oxygenated hemoglobin allows red light to pass through the bloodstream more than deoxygenated hemoglobin. A detector on the backside of the device measures the amount of red light and IR that passes through the person's fingertip. This ratio is then used to determine the relative amounts of oxygenated and deoxygenated hemoglobin in the person's body. The higher the percentage of red light that is detected, the greater the person's oxygen saturation in their bloodstream and the healthier the person.

The pulse oximeter is another example of a device that can look inside something without having to actually be inside. The development of new technologies that enable looks inside without surgery or trauma to the body is of high interest to scientists and medical personnel alike.



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**Answers: Page 2 Answers:** 1) d, 2) a, 3) c, 4) b, 5) c. **Page 3 Answers:** 1) Don't Have a Ruler! The total area of the pennies/the number of penny circles = area of one penny. 2) Direct uses a measuring device, indirect does not use a device. 3) Indirect since an atom is too small to see.

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