"The Treachery of Images" by Magritte

- It's not a real pipe. It's a picture of a pipe! A model, not the real thing.
- Type I: 3 sentences, 2 minutes – give an example of how a model can be useful. Go!

Cycle 2 Chemistry I Lesson 2

Evidence for Atoms: Thomson's Cathode Rays and Rutherford's Gold Foil Experiment

Agenda:

Warmup: How can a model be useful?

Vocab: Subatomic Particles, Electron, Nucleus, Proton, Neutron

Sketch: Dalton's Atom

Thomson's "Plum Pudding" atom

Rutherfords "Nuclear" atom

Dalton's Atom

- Dalton's model of the atom was a tiny, indivisible particle which could not be created, destroyed, or broken down into smaller particles.

  Kind of like little billiard balls.

End Of Slide

Subatomic Particles

- Experiments by several scientists in the mid-1800s led to the first change to Dalton's atomic theory. Scientists discovered that atoms can be broken into pieces after all.
- The smaller parts that make up atoms are called *subatomic particles.*
- The three subatomic particles that are most important for chemistry are the electron, the proton, and the neutron.

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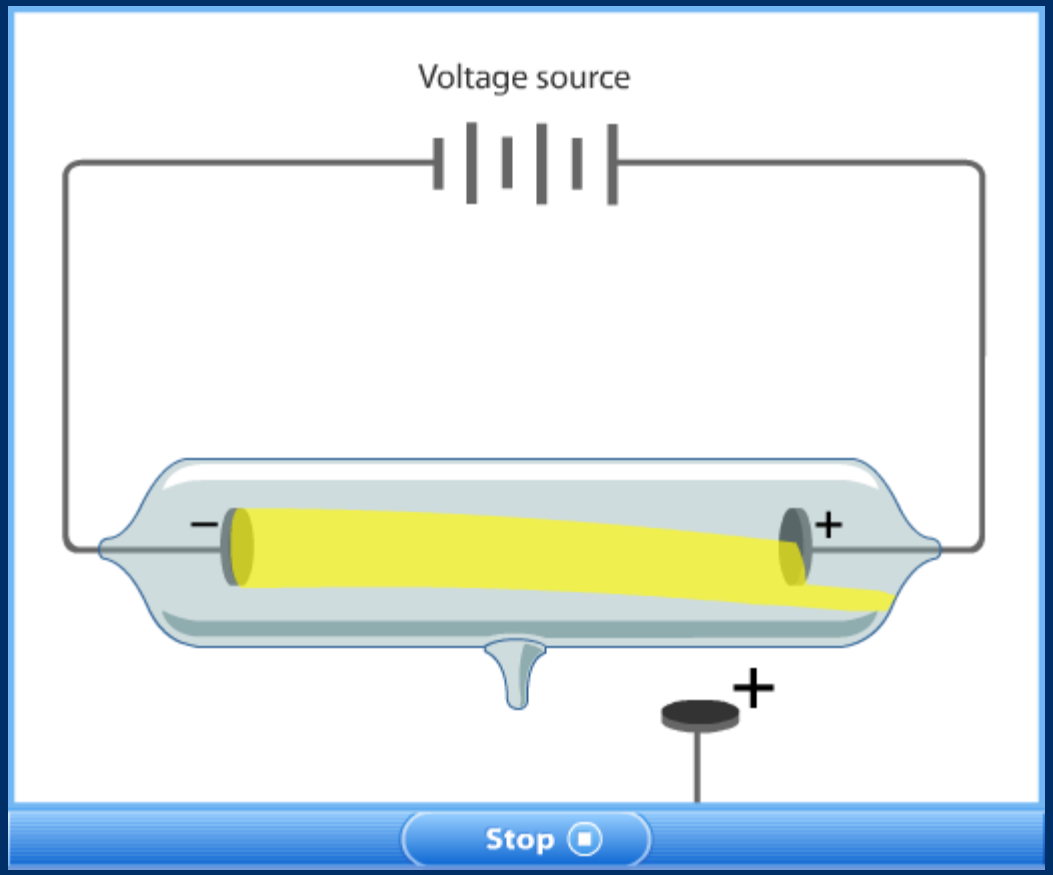
Thompson's Cathode Ray Tube Experiment



Subatomic Particles, *continued*

An Electron Has a Negative Charge, *continued*

- Thomson's experiments showed that a cathode ray consists of particles that have mass and a negative charge.
- These particles are called electrons.
- An **electron** is a subatomic particle that has a negative electric charge.
- Electrons are negatively charged, but atoms have no charge.
  - Atoms contain some positive charges that balance the negative charges of the electrons.

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Subatomic Particles, *continued*

An Electron Has a Negative Charge, *continued*

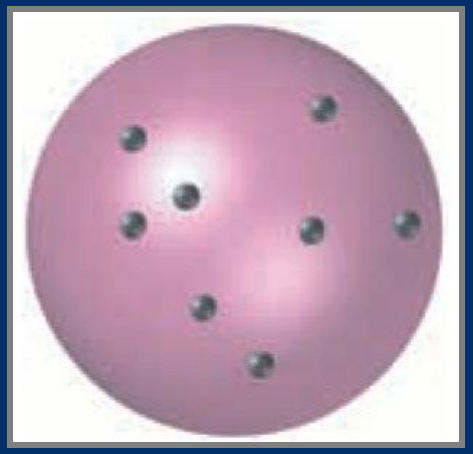
- Properties of Electrons

Name	Symbol	As shown in figures	Charge	Common charge notation	Mass (kg)
Electron	e, e^-, or ${}^{0}_{-1}e$		-1.602×10^{-19} C	−1	9.109×10^{-31} kg

Subatomic Particles, *continued*

Rutherford Discovered the Nucleus

- Thomson proposed that the electrons of an atom were embedded in a positively charged ball of matter. His model of an atom was named the *plum-pudding model.*



Subatomic Particles, *continued*

Rutherford Discovers the Nucleus, *continued*

- Ernest Rutherford performed the gold foil experiment, which disproved the plum-pudding model of the atom.
  - A beam of small, positively charged particles, called *alpha particles*, was directed at a thin gold foil.
  - Rutherford's team measured the angles at which the particles were deflected from their former straight-line paths as they came out of the foil.
- Rutherford found that most of the alpha particles shot at the foil passed straight through the foil. But very few were deflected, in some cases backward.

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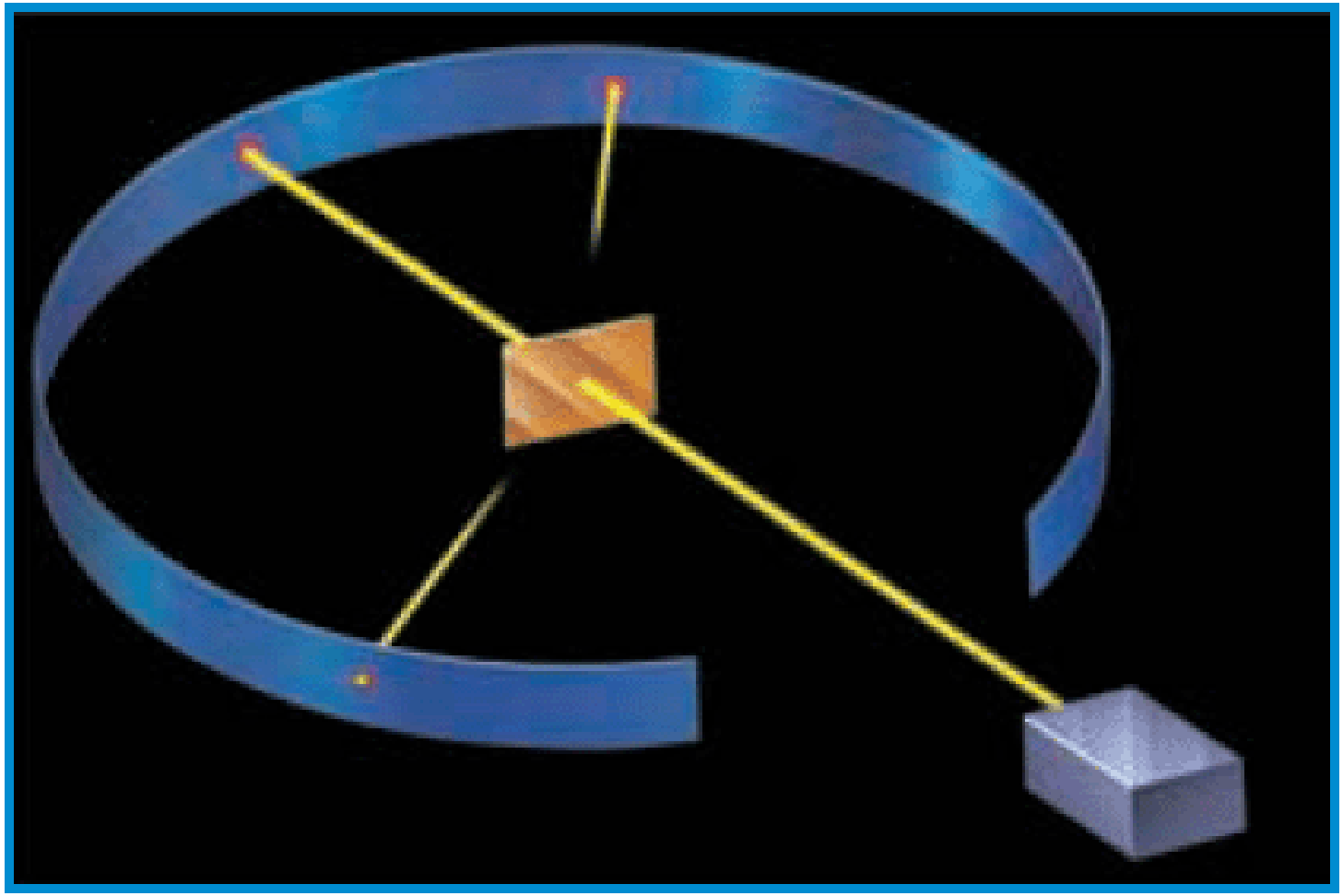
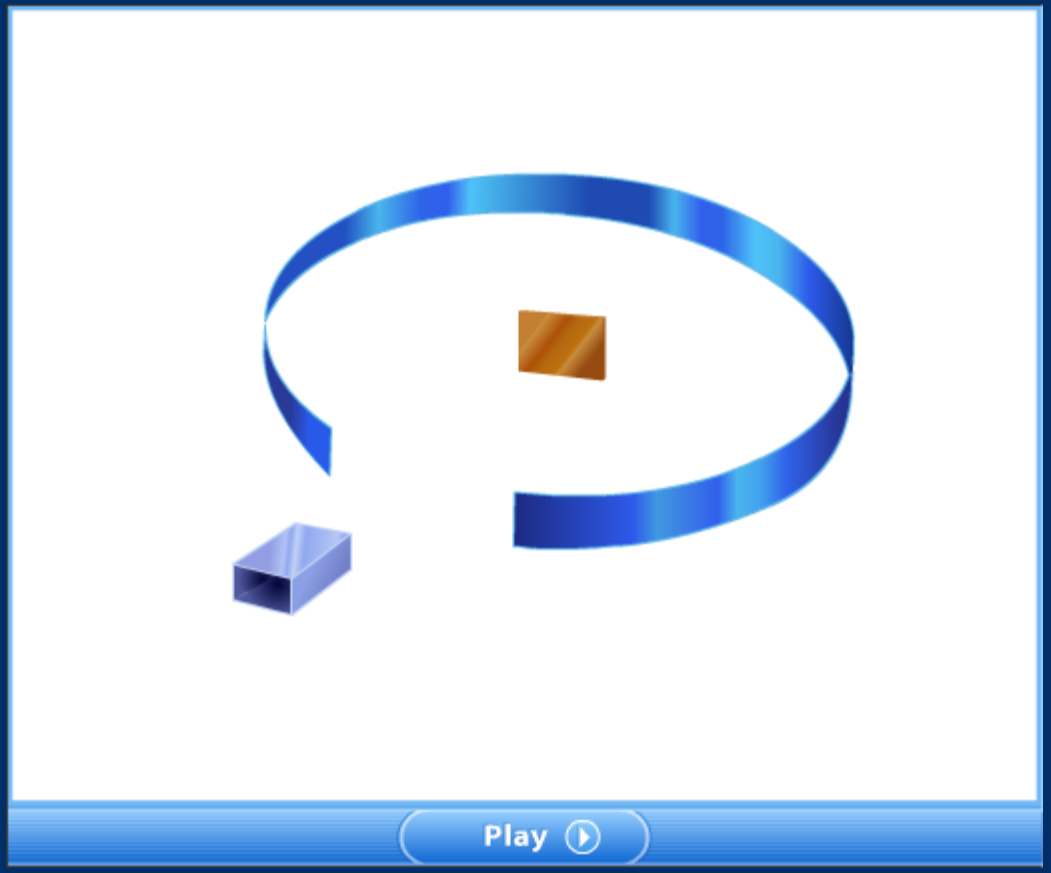
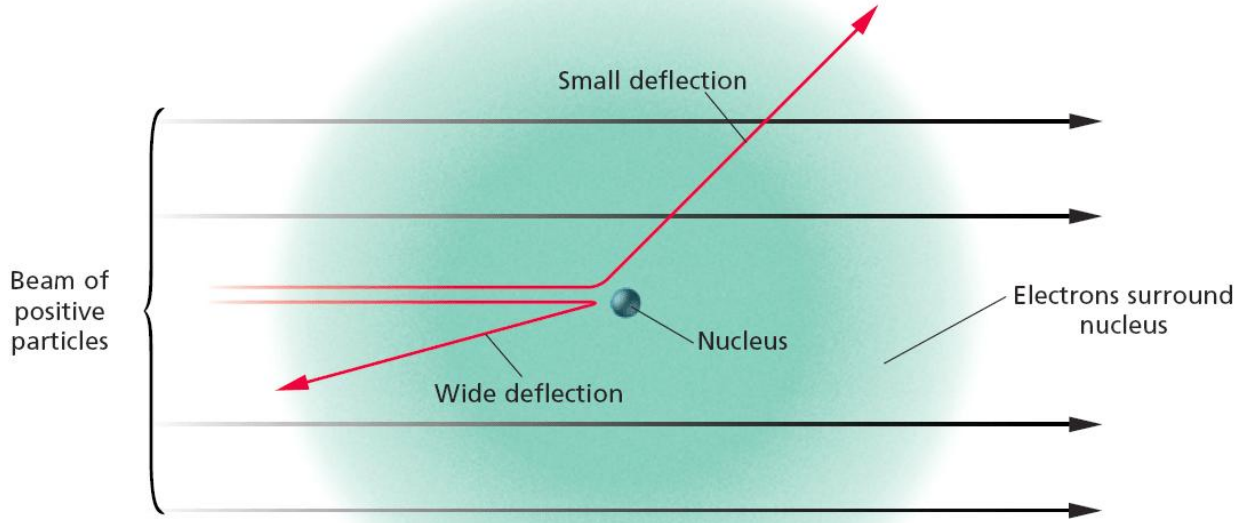
Gold Foil Experiment



Rutherford's Gold Foil Experiment



Gold Foil Experiment on the Atomic Level



Rutherford reasoned that each atom in the gold foil contained a small, dense, positively charged nucleus surrounded by electrons. A small number of the alpha particles directed toward the foil were deflected by the tiny nucleus (red arrows). Most of the particles passed through undisturbed (black arrows).

Subatomic Particles, *continued*

Rutherford Discovers the Nucleus, *continued*

- The **nucleus** is the dense, central portion of the atom.
- The nucleus is made up of protons and neutrons.
- The nucleus has all of the positive charge, nearly all of the mass, but only a very small fraction of the volume of the atom.

End Of Slide

Subatomic Particles, *continued*

Rutherford Discovers the Nucleus, *continued*

- Rutherford's Model of the Atom
- Electrons orbit like planets around a sun

Subatomic Particles, *continued*

Proton and Neutrons Compose the Nucleus

- **Protons** are the subatomic particles that have a positive charge and are found in the nucleus of an atom.
  - The number of protons of the nucleus is the atomic number, which determines the identity of an element.
  - Because protons and electrons have equal but opposite charges, a neutral atom must contain equal numbers of protons and electrons.
- **Neutrons** are subatomic particles that have no charge and are also found in the nucleus of an atom.

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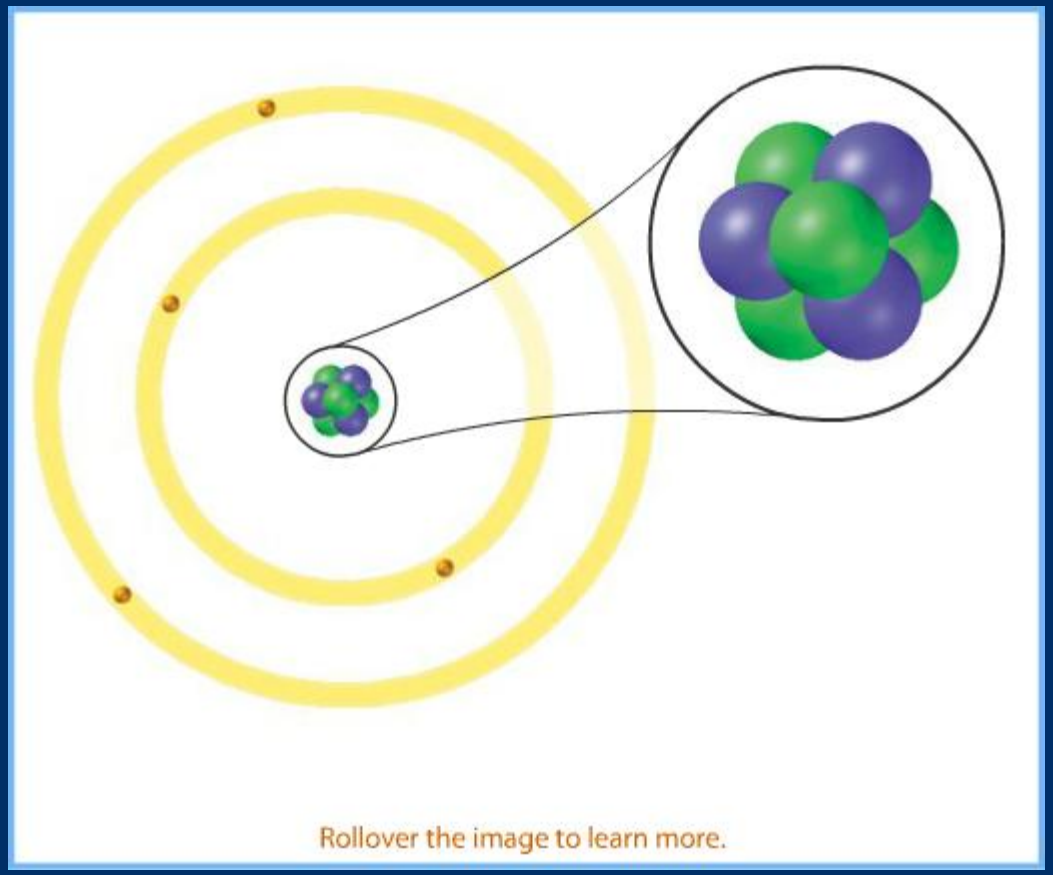
Parts of an Atom



Subatomic Particles, *continued*

Proton and Neutrons Compose the Nucleus, *continued*

Name	Symbol	As shown in figures	Charge	Common charge notation	Mass (kg)
Proton	p, p^+, or ${}_{+1}^{1}p$		$+1.602 \times 10^{-19}$ C	+1	1.673×10^{-27} kg
Neutron	n or ${}_{0}^{1}n$		0 C	0	1.675×10^{-27} kg

Name	Symbol	As shown in figures	Charge	Common charge notation	Mass (kg)
Electron	e, e^-, or ${}_{-1}^{0}e$		-1.602×10^{-19} C	−1	9.109×10^{-31} kg

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