ATOMIC MODEL MOVIE TRANSCRIPT

Text reads: The Mysteries of Life with Tim and Moby
A robot, Moby, is shaking a wrapped present. A boy, Tim, walks over to Moby.

TIM: Ooh, a present!

A letter falls from the present, and Tim reads from the typed letter.
TIM: Dear Tim & Moby, How do we know what atoms look like if we can't see them? From, Darren.
TIM: Yeah, atoms are small, real small; too small to be seen in any detail! Still, scientists can do experiments that tell them things about what makes up an atom.

MOBY: Beep! *Moby holds the present to his ear and starts shaking it.*

TIM: Right you are, my robot pal. You can't see what's inside the box, but shaking it can give you clues as to what's inside. It's the same with atoms. Using indirect means, scientists have been able to construct different models of the atom.

An animation shows large transparent spheres moving across the screen behind Tim. Each sphere is different from the last.
TIM: This atomic model has taken years and years to build, and people still tweak it now and again, hopefully making it more and more accurate.

Text reads: Back in the year…, as an animation below it shows a digital device counting backwards to the number 1802.
TIM: At the beginning of the 19th century, Englishman John Dalton built an atomic model called the "atomic theory of matter."

An image shows John Dalton standing in front of a blackboard.
TIM: According to his theory, each type of matter is made of only one type of atom.
An image shows a gold bar and a piece of iron.

TIM: Also, each type of atom could be put into a group called an element, and every atom of a given element was identical. For example, gold atoms make gold, iron atoms make iron, and so on.
An animation shows the atoms of the gold and the iron, as per Dalton's theory.
TIM: These atoms were way too small to see. Dalton also believed atoms could not be created, divided into smaller parts, or destroyed. So far, so good.
MOBY: Beep.

Text reads: Back in the year…, as the animation of the digital device counts backwards to the number 1897.
TIM: About 100 years after Dalton, British scientist J. J. Thomson discovered the electron.

An image shows J.J. Thomson standing in front of a unique device.
TIM: Thompson used a vacuum tube with metal plates at both ends and an electrical source for his experiment. He found that a beam would form between the two plates; the cathode and the anode.

An animation shows two metal plates. An oscillating dotted line is traveling from one plate to the other.
TIM: Putting a magnet near the beam caused it to bend, which meant that the particles of the beam were electrically charged.
A U-shaped magnet drops into screen. The oscillating dotted line bends upward at one end and is no longer connecting the two metal plates.
TIM: Thomson discovered that the cathode rays were made of negatively charged particles, later called electrons. Because matter is mostly neutral — with no net charge —atoms must contain both positive and negative charges that cancel each other out.

An animation shows spheres representing positive and negative charges behind Tim. The two combine to form one sphere that is labeled with a crossed-out zero.
TIM: Thompson stated that negatively charged electrons must be stuck all throughout a positively charged area.

An image of a large sphere representing an atom is shown. It is surrounded by smaller spheres representing electrons.
TIM: Think of it like the atom is cookie dough, and the electrons are chocolate chips.

An animation shows a ball of chocolate chip cookie dough falling into screen. Moby's hand quickly enters the screen and grabs the dough.
TIM: The discovery of electrons was a big deal.

An animation shows Moby eating the cookie dough behind Tim while Tim is speaking.
TIM: But it left some questions to be answered — what were those positive particles holding those electrons in place?

Text reads: Back in the year…, as the animation of the digital device counts backwards to the number 1909.
TIM: In 1909, a New-Zealand-born British scientist named Ernest Rutherford and his team set out to answer some of these questions.

An image shows Ernest Rutherford stands in front of a device.

TIM: They beamed positively charged alpha particles at a sheet of really thin gold foil. Because so many particles could pass right through the thin gold foil, Rutherford hypothesized that the gold atoms must be made of mostly empty space. But some of the particles did bounce off, so Rutherford revised his hypothesis to say that a gold atom must have some very small, positively charged mass.

An animation shows the side view of the device shooting very small, yellow, cylinder-like particles at the gold foil sheet. Some of the shapes are bouncing off the sheet while others are passing through it.
TIM: He named this mass the nucleus. He called the positively charged nucleus particles protons, and said that the electrons were scattered in empty space around the nucleus.

An animation shows a large, transparent sphere representing an atom. At its center, a smaller, gray sphere representing the nucleus is shown. An orange sphere representing a proton is shown entering the smaller gray sphere.
TIM: James Chadwick, a student of Rutherford's, found new particles in the nucleus that weren't affected by an electric field at all.
An image shows James Chadwick.

TIM: Alpha particles in the experiment had knocked them loose.

An animation shows the side view of a device shooting very small, yellow, cylinder-like particles at a gold sheet. Some of the particles are bouncing off while others are passing through the sheet. At the point where the particles are hitting the sheet, small spheres representing neutrons are shooting off.

TIM: Chadwick called these uncharged particles neutrons. Also in the early 20th century, a Danish physicist named Niels Bohr discovered that electrons are arranged in energy levels.

An animation shows a cluster of spheres representing the atom surrounded by concentric rings representing the energy levels. Traveling on each ring are small spheres representing electrons.
TIM: The lower energy levels are closer to the nucleus and can hold just a few electrons. The higher energy levels are farther away and can hold more electrons.
The rings begin to spin around the cluster of spheres.

TIM: Since then, scientists have refined the so-called Bohr model. Electrons have levels, but they don't orbit the nucleus in neat little circles. Instead, they exist in a region called the electron cloud.

The rings disappear and the cluster of spheres is surrounded by three large transparent spheres of various sizes, which now represent the energy levels. Small spheres representing electrons are traveling throughout these transparent spheres.

TIM: The atomic model is constantly evolving as scientists discover more and more about what makes the universe tick.
MOBY: Beep.

An image shows Moby holding the present up to his ear.
TIM: Oh, okay. Go ahead and open it.

The unwrapping of paper is heard.
An animation shows the lid of the present being removed, revealing plastic pieces and a pamphlet. The pamphlet text reads: Atomic Model.

TIM: Hey, it's an atomic model!
MOBY: Beep.
TIM: Well, you have to put it together.

An animation shows Moby holding the present in one hand and a piece of the model in the other.
TIM: That's not right!
An image shows that Moby has used the pieces from the atomic model to make a figure resembling his own head. A bottle of glue is sitting next to the figure.