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Intro to Physics Video – 100 Greatest Discoveries

Period \_\_\_\_\_\_\_\_\_\_\_\_\_ Mrs. Nadworny

100 Greatest Discoveries - Physics

**Discovery #1. The Law of Falling Bodies (1604)** Galileo Galilei overturns nearly 2,000 years of belief in Aristotle’s idea that heavier bodies fall faster than lighter ones by proving that all bodies fall at the same rate.

1. What did Aristotle believe about the rate of falling objects?
2. How is air resistance a factor when testing the rate of falling objects?
3. Why was Galileo’s challenge to Aristotle’s law a turning point in science?
4. What happened when the feather and hammer were dropped on the moon where there is no air resistance?

**Discovery #2. Universal Gravitation (1666)** Isaac Newton comes to the conclusion that all objects in the universe, from apples to planets, exert gravitational attraction on each other.

1. What is the legend of Isaac Newton and the apple?
2. What is the law of universal gravitation?
3. How are tides created on Earth?

**Discovery #3. Laws of Motion (1687)** Isaac Newton changes our understanding of the universe by formulating three laws to describe the movement of objects.

1. What is Newton’s 1st law of motion?
2. What is Newton’s 2nd law of motion?
3. What is Newton’s 3rd law of motion?

**Discovery #4. The Second Law of Thermodynamics (1824 –1850)** Scientists working to improve the efficiency of steam engines develop an understanding of the conversion of heat into work. They learn that the flow of heat from higher to lower temperatures is what drives a steam engine, likening the process to the flow of water that turns a mill wheel. Their work leads to three principles: heat flows spontaneously from a hot to a cold body; heat cannot be completely converted into other forms of energy; and systems become more disorganized over time.

1. \_\_\_\_\_\_\_\_\_\_\_\_\_ energy can be turned into the energy of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
2. What is the second law of thermodynamics?
3. How much of the energy from gasoline is actually used to move the car and passengers? Where does the rest of it go?

**Discovery #5. Electromagnetism (1807 –1873)** Pioneering experiments uncover the relationship between electricity and magnetism and lead to a set of equations that express the basic laws governing them.

1. What did Michael Faraday do in 1831 that is now the basis of all generators? He used a moving magnetic field to create electricity.
2. Why was Bill Nye safe inside the cage when it was hit by a lightning bolt?
3. How would the world be different without the work of Faraday and James Maxwell?

**Discovery #6. Special Relativity (1905)** Albert Einstein overthrows basic assumptions about time and space by describing how clocks tick slower and distances appear to stretch as objects approach the speed of light.

1. How was Einstein’s view of time and space different than Newton’s view of time and space?
2. Describe the “twin paradox.”
3. The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ you move, the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ time beats.

**Discovery #7. E = mc2 (1905)** Energy is equal to mass times the speed of light squared. Albert Einstein's famous formula proves that mass and energy are different manifestations of the same thing, and that a very small amount of mass can be converted into a very large amount of energy. One profound implication of his discovery is that no object with mass can ever go faster than the speed of light.

1. The \_\_\_\_\_\_\_\_\_\_ you move, the \_\_\_\_\_\_\_\_\_\_\_\_ you get.
2. Why was this discovery so important in science?

**Discovery #8. Quantum Theory (1900 –1935)** To describe the behavior of subatomic particles, a new set of natural laws is developed by Max Planck, Albert Einstein, Werner Heisenberg and Erwin Schrodinger. A quantum leap is defined as the change of an electron within an atom from one energy state to another. This change happens all at once, not gradually.

1. Why was there a crisis in physics around 1900?
2. What are “quanta”?
3. Atoms are \_\_\_\_\_\_\_\_\_\_\_\_; atoms are \_\_\_\_\_\_\_\_\_\_\_\_\_\_; and there are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ involved in them.

**Discovery #9. The Nature of Light (1704 –1905)** Thought and experimentation by Isaac Newton, Thomas Young and Albert Einstein lead to an understanding of what light is, how it behaves, and how it is transmitted. Newton uses a prism to split white light into its constituent colors and another prism to mix the colors into white light, proving that colored light mixed together makes white light. Young establishes that light is a wave and that wavelength determines color. Finally, Einstein recognizes that light always travels at a constant speed, no matter the speed of the measurer.

1. What did the ancient people think the universe was made of?
2. What was Newton’s main contribution to the understanding of light?
3. How did Thomas Young understand light?
4. How did Einstein contribute to the understanding of light?

**Discovery #10. The Neutron (1935)** James Chadwick discovers neutrons, which, together with protons and electrons comprise the atom. This finding dramatically changes the atomic model and accelerates discoveries in atomic physics.

1. How many atoms fit into a single grain of sand?
2. What is the “plum-pudding” model of the atom?
3. What happened when Ernest Rutherford shot alpha particles at a sheet of gold? How did this discovery change the understanding of the structure of the atom?
4. Why was James Chadwick’s discovery of the neutron so important?

**Discovery #11. Superconductors (1911 – 1986)** The unexpected discovery that some materials have no resistance to the flow of electricity promises to revolutionize industry and technology. Superconductivity occurs in a wide variety of materials, including simple elements like tin and aluminum, various metallic alloys and certain ceramic compounds.

1. What happens in a particle accelerator?
2. What happens to the electrical resistance of a metal when it is at very low temperatures?
3. What is the “holy grail” of superconductors, and why would this discovery be so important?

**Discovery #12. Quarks (1962)** Murray Gell-Mann proposes the existence of fundamental particles that combine to form composite objects such as protons and neutrons. A quark has both an electric and a "strong" charge. Protons and neutrons each contain three quarks.

1. What did Murray Gell-Mann propose that protons and neutrons are made of?
2. How did scientists first “see” quarks?

**Discovery #13. Nuclear Forces (1666 – 1957)** Discoveries of the basic forces at work on the subatomic level lead to the realization that all interactions in the universe are the result of four fundamental forces of nature — the strong and weak nuclear forces, the electromagnetic force and gravitation.

1. What are the 4 fundamental forces of nature?
2. What does the strong nuclear force do? The weak nuclear force?
3. What is the “theory of everything”? Has anyone developed a successful “theory of everything”?