Name: _____ Teacher: _____ Pd. ___ Date: _____

STAAR Science Tutorial 02
TEKS 8.3B, C: Scientific Models, Laws & Theories

TEKS 8.3B,C: The student is expected to use models to represent aspects of the natural world such as an atom, a molecule, space or a geologic feature; and identify advantages and limitations of models such as size, scale, properties, and materials.

Scientific Models

- A **scientific model** is a physical, conceptual or computer-generated representation of reality, used to test a hypothesis or demonstrate a theory. Models are used when the reality they represent is too big, small, complex or even unknown to be actually seen and tested. Models can take the place of a controlled experiment.
- For example, a globe is a model of Earth, which allows us to see the very large sphere of Earth as a whole—something we cannot do sitting on Earth. Maps are two-dimensional models of the three-dimensional surface of Earth, reduced in size to allow viewing of a larger area. A diagram of a cell enlarges a reality too small to see.
- Computer simulations allow scientists to test the outcome of events they cannot actually perform: What would happen if a 10 km diameter asteroid hit the Earth? What will the orientation of planets in our solar system be in a thousand years? What will the path of a hurricane be over the next three days?
- All models are less-than-perfect, because they cannot include all of the detail and structure of the reality they test and represent. A food web is a model that represents the predator-prey relationships in a community, but it cannot possibly show all the relationships, just some of the main ones. A model of the solar system can either show the relative distance between planets, or the relative size of each planet, but not both at the same time. Weather models cannot show all the small variations in temperature and wind that actually exist, and thus are not very accurate in the predictions they make.
- Over time, scientists improve the accuracy of computer models by comparing the predictions they make with the actual outcome, and correcting the mathematical algorithms used in the model. As computers become more powerful, and more detailed data can be included in a model, the accuracy of the computer model should further improve.

Scientific Laws and Theories

- Scientists do not easily accept newly proposed hypotheses or models. When a hypothesis or model has been tested many times by different scientists, and has become generally accepted by the scientific community, it may eventually become a scientific law, principle or theory. Even then, all scientific knowledge is subject to

revision or rejection, as new scientific discoveries are made. Scientists can never be 100% certain that any law or theory is absolutely true.

- A **scientific law** is a statement that describes how some specific part of nature behaves generally or under defined conditions. For example, the law of universal gravity states that all objects with mass exert an attractive force on all other objects with mass. Scientific laws describe <u>what</u> will happen under certain circumstances, not why it will happen. Laws are often stated as mathematical equations. For example, Newton's Second Law of Motion can be stated as F=ma: Force = mass times acceleration. Scientific laws are useful to scientists and engineers, because they can be used to predict future behavior. As new scientific discoveries are made, scientific laws may need to be limited, modified or even discarded, as exceptions to the law are found. For example, Einstein discovered that Newton's Laws of Motion do not accurately describe the motion of objects when they travel at near the speed of light.
- A **scientific principle** is similar to a scientific law, but usually narrower in scope. Examples are Archimedes' Principle (describing buoyancy) and the Copernican Principle (the Earth is not the center of the Universe).
- A **scientific theory** is a general description of <u>how</u> and <u>why</u> some part of the natural world behaves as it does. Theories typically make predictions that can be tested over a wide range of conditions. In science, a theory is generally accepted as true by scientists working in that field. (In common English use, the word "theory" has a meaning closer to a scientific hypothesis, as in the expression "it is just a theory".) An example of a scientific theory is the Plate Tectonic Theory, which describes how and why crustal plates on Earth move as they do, why earthquakes and volcanic eruptions occur, and how the Earth's surface features were created. This theory was created when substantial evidence supporting the earlier continental drift and seafloor spreading hypotheses were accepted.

<u>Practice Questions</u>

1. What is a scientific model? _____

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2. What are the limitations of scientific models? _____

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3. What is a scientific law? _____

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4. What is a scientific theory? _____

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