Name _____

Please circle, underline or make notes anywhere on the sheet that will help you! This is your copy.

Scientific Law: This is a statement of fact meant to describe an action or set of actions. It is generally accepted to be true and universal, and can sometimes be expressed in terms of a single mathematical equation. They are accepted at face value based upon the fact that they have always been observed to be true.

Specifically, scientific laws must be simple, true, universal, and absolute. They represent the cornerstone of scientific discovery, because if a law ever did not apply, then all science based upon that law would collapse.

Some scientific laws, or laws of nature, include the law of gravity, Newton's laws of motion, the laws of thermodynamics, Boyle's law of gases, the law of conservation of mass and energy, and Hook's law of elasticity.

Hypothesis: This is an educated answer (guess) based upon observation and inferences. It is a rational explanation of a single event or phenomenon based upon what is observed, but which has not been proved. Most hypotheses can be ***supported or rejected*** by experimentation or continued observation.

Theory: A theory is an explanation of a set of related observations or events based upon proven hypotheses and verified multiple times by separate groups of researchers.

**One scientist cannot create a theory; she can only create a hypothesis.

In general, **both** a scientific theory and a scientific law are:

1. accepted to be true by the scientific community
2. are used to make predictions of events
3. are used to advance technology

The biggest difference between a law and a theory is that a theory is much more complex and changing. A law describes a single action, whereas a theory explains an entire group of related actions.

Examples:

(1) An analogy can be made using a slingshot and an automobile.

A scientific law is like a slingshot. **A slingshot has but one moving part--the rubber band. If you put a rock in it and draw it back, the rock will fly out at a predictable speed, depending upon the distance the band is drawn back.**

An automobile has many moving parts, all working in unison to perform the chore of transporting someone from one point to another point. An automobile is a complex piece of machinery. Sometimes, improvements are made to one or more component parts. A new set of spark plugs that are composed of a better alloy that can withstand heat better, for example, might replace the existing set. But the function of the automobile as a whole remains unchanged.

A theory is like the automobile. Components of it can be changed or improved upon, without changing the overall truth of the theory as a whole.

(2) In fact, some laws, such as the law of gravity, can also be theories when taken more generally. The law of gravity is expressed as a single mathematical expression and is presumed to be true all over the universe and all through time. Without such an assumption, we can do no science based on gravity's effects. But from the law, we derived the theory of gravity which describes how gravity works, what causes it, and how it behaves. We also use that to develop another theory, Einstein's General Theory of Relativity, in which gravity plays a crucial role. The basic law is intact, but the theory expands it to include various and complex situations involving space and time.

Some scientific theories include the theory of evolution, the theory of relativity, the atomic theory, and the quantum theory. All of these theories are well documented and proved beyond reasonable doubt. Yet scientists continue to tinker with the component hypotheses of each theory in an attempt to make them more elegant and concise, or to make them more all-encompassing. Theories can be tweaked, but they are seldom, if ever, entirely replaced.

A theory is developed only through the scientific inquiry (scientific method), meaning it is the final result of a series of rigorous processes.

*****Note that theories do not become laws. Scientific laws must exist prior to the start of using the scientific method because, as stated earlier, laws are the foundation for all science.

IN SUMMARY:

A scientific law is a description of an observed phenomenon. Kepler's Laws of Planetary Motion are a good example. Those laws describe the motions of planets. But they do not explain why they are that way. If all scientists ever did was to formulate scientific laws, then the universe would be very well-described, but still unexplained and very mysterious.

A theory is a scientific explanation of an observed phenomenon. Unlike laws, theories actually explain why things are the way they are. Theories are what science is for.

Name _____ Hour **6th / 7th / 8th** Date _____

Label each of the following as:

Hypothesis
Scientific Theory
Scientific Law

Pre-reading ***Post-reading***

1. _____ A one time explanation of one observation. _____
2. _____ The cornerstone of scientific discovery. _____
3. _____ Well-proven explanation for a set of observations/ actions. _____
4. _____ An explanation that has not been proven. _____
5. _____ Explanation of WHY things are the way they are. _____
6. _____ A proven description of HOW things are, but does not give a reason why. _____
7. _____ Can be supported or rejected by a single experiment. _____
8. _____ Conservation of mass & energy _____
9. _____ (***fill in the blank***) of Evolution _____
10. _____ Atomic (***fill in the blank***) _____
11. _____ Einstein's General (***fill in the blank***) of Relativity _____
12. _____ Newton's (***fill in the blank***) of motion _____
13. _____ (***fill in the blank***) of Gravity _____
14. _____ Based on proven hypotheses by many different scientists. _____
15. _____ DEVELOPED through scientific inquiry process. _____
16. _____ TESTED through scientific inquiry process. _____
17. _____ Simple, true, universal, and absolute _____
18. _____ Can be created by a <u>single</u> scientist _____