Scientific Method

The key components of the scientific method are set forth below.

Asking Questions and Defining Problems
- Asking questions and defining specifying relationships between variables, and clarifying arguments and models.
- Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information; identify and/or clarify evidence and/or the premises of an argument; determine relationships between independent and dependent variables and relationships in models; clarify and/or refine a model, an explanation or an engineering problem.
- Ask questions that require sufficient and appropriate empirical evidence to answer.
- Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources, and when appropriate, frame a hypothesis based on observations and scientific principles.
- Ask questions that challenge the premises of an argument or the interpretation of a data set.

Planning and Carrying out Investigations
-Use multiple variables and provide evidence to support explanations or solutions.
- Plan an investigation individually and collaboratively; identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.
- Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation.
- Evaluate the accuracy of various methods for collecting data.

Analyzing and Interpreting Data
-Extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
- Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships.
- Use graphical displays (map, charts, graphs, and/or tables) of large data sets to identify temporal and spatial relationships.
- Distinguish between causal and correlational relationships in data.
- Analyze and interpret data to provide evidence for phenomena.
- Apply concepts of statistics and probability to analyze and characterize data, using digital tools when feasible.
- Consider limitations of data analysis (measurement error) and/or seek to improve precision and accuracy of data with better tools and methods (multiple trials).
- Analyze and interpret data to determine similarities and differences in findings.

Constructing Explanations and Designing Solutions
-Constructing explanations supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.
- Construct an explanation that includes qualitative or quantitative relationships between variables that predicts and/or describes phenomena.
- Construct an explanation using models or representations.
- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including experiments) and the assumption that theories and laws that describe the natural world operate today as they

did in the past and will continue to do so in the future.
- Apply scientific ideas, principles, and/or evidence to construct, revise, and/or use an explanation for real-world phenomena, or events.
- Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion.

MAIN CONCEPTS (You MUST cover at least five of these in your game)

- The scientific method is a process that scientists follow in order to learn about the world around us.
- The scientific method allows other scientists to repeat an experiment and confirm the results.
- The first step in the scientific method is asking a scientific question based on observations of phenomena in the world.
- Scientific questions are questions that can be answered with appropriate empirical evidence.
- Empirical evidence is data gathered from measurements in an experiment.
- The second step in the scientific method is developing a hypothesis.
- A hypothesis is an educated guess about the answer to a scientific question based on observations and scientific principles.
- The third step in the scientific method is planning and carrying out an investigation to test a hypothesis.
- A variable is a part of an experiment that is observed and/or changed.
- A controlled variable is something that remains the same in each trial of an experiment.
- An independent variable is something that the scientist modifies in the experiment.
- A dependent variable is something that the scientist measures in response to a change in an independent variable.
- A trial is a single test of the variables that occurs during an experiment.
- Many experiments have multiple trials.
- When planning an experiment, scientists determine what tools are needed to gather data.
- When planning an experiment, scientists determine how measurements will be recorded.
- When planning an experiment, scientists determine a specific procedure to follow.
- Qualitative data are descriptions that can be observed but not measured precisely.
- Quantitative data can be measured precisely using standard units.
- During an investigation, data are measured and recorded.
- Scientists may need to revise an experimental design to produce data that meet the goals of the investigation.
- Data can be represented in tables or graphical displays.
- The fourth step in the scientific method is analyzing data from the experiment.
- Data can be analyzed to determine relationships between variables.
- A linear relationship occurs when data show a pattern with a constant rate of change.
- A non-linear relationship occurs when data do not show a pattern with a constant rate of change.
- A correlation means that there is a relationship or pattern between two variables.
- Causation means that one variable causes the other to occur.
- Just because data are correlated does not mean that they share a causal relationship.
- The last step in the scientific method is to draw a conclusion supported by evidence, scientific ideas, and theories.
- A conclusion is a summary statement that compares the hypothesis in an investigation with the actual results.
- Scientists can communicate the results of their work in many ways, such as oral presentations, written reports, graphs, and charts.