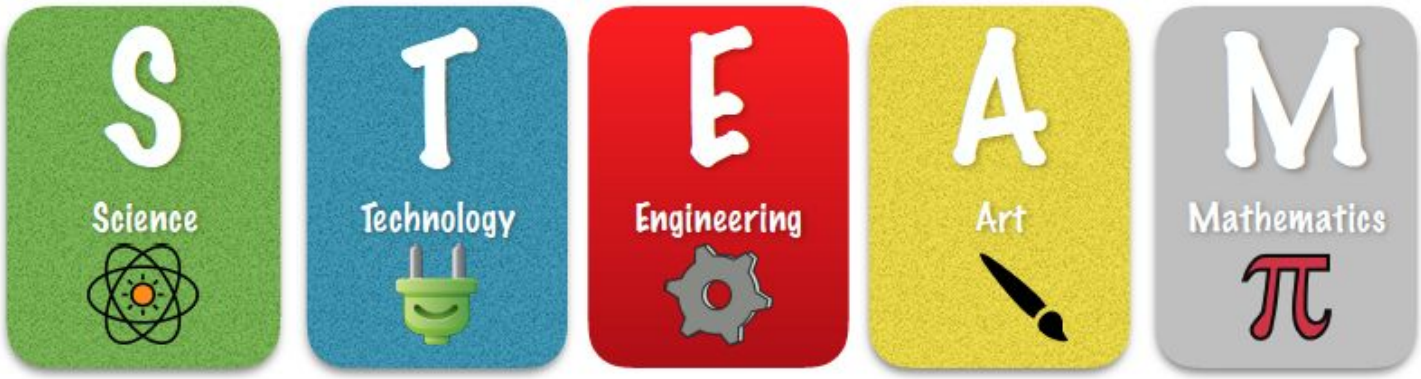
TUSD STEAM Fair



Project Specifications:

4th/5th Grade - Scientific Problem Solving/Experimental Design

(Focus: Science, Technology, Engineering, Art, Math)

Example Question: How can I improve the design?

Scientific STEAM Process-

1. **Wonderings**- What do you wonder about? (Ex: erosion, potholes, earthquakes, landslide, etc)

2. **Research** - Several different expository texts should be used to obtain general information about the topic. This allows the student to make an informed claim and to formulate a procedure for testing the claim.

3. **Claim** - A scientific claim is an attempted answer to the question being investigated. Also called the hypothesis, the claim attempts to predict the outcome of the experiment and suggests a possible reason for this outcome. "Using the evidence of what I've observed and reasoning, how can I solve this problem?"

4. **Materials** - Materials need to be listed in specific amounts and sizes. This allows people to replicate the experiment exactly to see if they get the same results. This is called verification.

5. **Procedure** - The procedure used in an experiment must be written in a clear, sequential manner in order to allow someone else to follow the same steps to replicate the experiment. The procedure should repeat the investigation a minimum of five times, or trials. In determining the procedure that will be used in the investigation, the variables must be identified and controlled. Variables are the factors that will affect the outcome of the experiment. There are three types of variables that must be considered:
    a. Manipulated variable (independent variable) - the factor that will be intentionally changed during the experimental procedure in order to find out what effect it has on something else. An example of a manipulated (independent) variable is using different lengths of

string to construct a pendulum in order to observe the effect the length of the string has on the swing of the pendulum.

b. Responding variable (dependent variable) - the factor that is observed and measured to see if it is affected by the change made in the manipulated (independent) variable. An example of a responding (dependent) variable is the number of swings the pendulum makes when the length of its string is changed.
c. Variables that are controlled - the factors in the experiment that must be kept exactly the same to make sure that they are not having any effect on the responding (dependent) variable. Variables that would need to be controlled in the pendulum experiment would be the mass of the pendulum, the type of string, and the release height of the pendulum.

6. **Evidence** - Conducting the experiment or investigation produces evidence, which includes the measurements taken and observations made as well as a written explanation of the outcome. Evidence (data) that are observed or measured during the experiment should be recorded as the experiment is conducted. The best format to collect evidence (data) is a data collection table. When constructing a data collection table, it should be remembered that repeated trials (minimum of five) of the experiment must be conducted to obtain valid results. Data can then be analyzed and graphed. A statistical analysis of the collected data to include the median, or measure of central tendency, should be completed where appropriate. It is helpful to present the evidence (data) in the form of a graph so that the evidence (data) illustrated can easily be interpreted. The two most commonly used types of graphs for science experiments are detailed below.

   Bar Graphs are used to display discrete data, or data that is distinct and separate from other information. Data shown on a bar graph often reflect measured or counted amounts. For example, the average number of drops of plain water versus the average number of drops of soapy water that will fit on a penny would best be shown on a bar graph. The bars drawn on a bar graph should all be the same width and are separated by spaces in between them. This is the most common type of graph used by fourth and fifth grade students to show relationships with data. Line graphs are used to display continuous data or data that goes on without a stop or break. Experiments that have dependent (responding) variables involving Student Packet Office of Science, PreK-12 6 temperature, time, or distance will usually yield data that should be graphed as a line graph. Line graphs are useful to analyze relationships among collected data. In particular, line graphs can show trends in data - increasing, decreasing, or staying the same. The dissolving time of a solid in a range of different temperatures would be an example of data best displayed on a line graph. Line graphs are used less frequently by fourth and fifth grade students, but may be used when appropriate.

   The manipulated (independent) variable is usually represented on the horizontal (x) axis of a graph, and the responding (dependent) variable is represented on the vertical axis of a graph. The graph should also have:
   - Numbers in even intervals (1's, 2's, 5's, 10's, 100's, etc.).
   - Labels for both the horizontal (x) and vertical (y) axes.
   - A title that reflects the information that is being represented on the graph.

   Students should make use of appropriate software to complete the graph.

   The data chart and/or graph are followed by a paragraph describing the results. The paragraph should

- Note highs and lows of data collected.
- Include the calculated median as appropriate for the grade level.
- Describe trends in the data.
- Restate the number of trials completed.
- State any inferences and/or observations evidenced by the data.

7. Scientific Reasoning:
   - Should reflect back on the original claim (hypothesis) and state whether it was supported or not supported by evidence (data or observations).
   - Should answer the original question that started the investigation and include evidence used to support the reasoning (conclusion).
   - Should include specific evidence from the investigation.
   - Should include inferences that can be made from the evidence of the experiment.
   - Should include any additional questions that could be investigated or information that could be researched in the future. In addition, any problems that were experienced during the experiment can be discussed.

Experimental Design Presentation Requirements:

The experimental design may only occupy a space the size of a student's desktop (24" long and 15" deep). Experimental designs may be mounted on a display board, cardboard/tagboard, or any reasonable manner that fulfills the size display requirements.

Oral Presentation:

Must be 1-2 minutes and explains the purpose of the project and what was discovered. Presentations can be via video, but the student has to be the one explaining in the video, and student must be prepared to answer questions during the presentation.