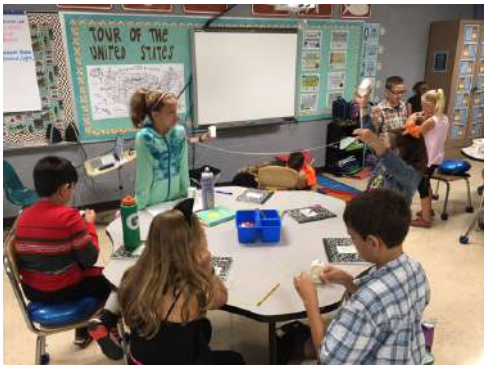
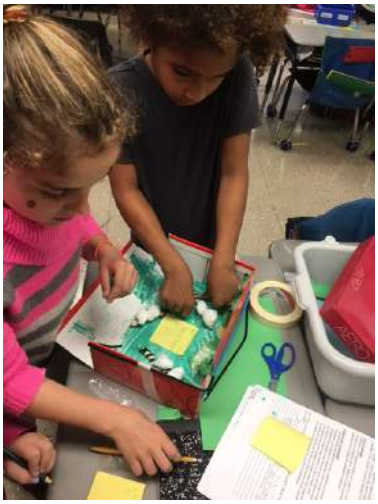
SCIENCE PRACTICES & ENGINEERING CONCEPTS

BETHEL PUBLIC SCHOOLS



STEM

Science • Technology • Engineering • Math



CONSTRUCTING SCIENTIFIC EXPLANATIONS & ARGUMENT

The goal of science is to construct explanations for the causes of phenomena.

A scientific explanation has the following components:

- **Claim:** An assertion or conclusion that answers the original question
- **Evidence:** Scientific data that supports the student's claim that must beappropriate and sufficient. Can come from an investigation or other source such as observations, reading material, archived data, or other
- **Reasoning:** Justification that links the claim and evidence. Shows why the data counts as evidence to support the claim, using appropriate scientific principles.

Students are expected to construct their own explanations as a result of an investigation.

CONDUCTING SCIENTIFIC INVESTIGATIONS

Scientific investigations may be undertaken to describe a phenomenon, or to test a theory or model for how the world works.

Students learn to state the goal of an investigation, predict outcomes, and plan a course of action that will provide the best evidence to support their conclusions. Students will conduct investigations that generate data to provide evidence to support claims they make about phenomena. Data are not evidence until used in the process of supporting a claim. Students should use reasoning and scientific ideas, principles, and theories to show why data can be considered evidence.

Over time, students are expected to become more systematic and careful in their methods. Planning and carrying out investigations may include elements of all of the other practices.

EXPECTATION FOR SCIENTIFIC EXPLANATIONS & ARGUMENT

- Make an accurate and complete claim.
- Provide two or more accurate pieces of evidence, use labels, and address variables (when appropriate).
- Connect evidence is to the claim and use scientific principles and vocabulary.

EXPECTATION FOR CONDUCTING INVESTIGATIONS

- The student implements the stated plan with only minor deviations.
- Student (oral and written) observations are mostly accurate. They are mostly relevant to the purpose of the communication.

The emphasis in the Grade 5 STEM classroom is on developing the student's ability make sense of science and engineering concepts through thinking, writing and talking about the hands-on activities. Students develop their ability to express their ideas and evidence through their writing, drawings and discourse with their classmates.

DEVELOPING AND USING MODELS

Models include diagrams, physical replicas, mathematical representations, analogies, and computer simulations. Although models do not correspond exactly to the real world, they bring certain features into focus while obscuring others..

In science, models are used to represent a system (or parts of a system) under study, to aid in the development of questions and explanations, to generate data that can be used to make predictions, and to communicate ideas to others.

Students learn to evaluate and refine models through an iterative cycle of comparing their predictions with the real world and then adjusting them to gain insights into the phenomenon being modeled. As such, models are based upon evidence. When new evidence is uncovered that the models can't explain, models are modified.

EXPECTATION FOR DEVELOPING & USING MODELS

- The model addresses the major components of the purpose of the assignment.
- Compares the model to the "real thing" and accurately identifies the features that are the same and different. Identifies some possible ways to use the model.

USES MATHEMATICS, ANALYZES & INTERPRETS DATA

Once collected, data must be presented in a form that can reveal any patterns and relationships and that allows results to be communicated to others. Because raw data as such have little meaning, a major practice of scientists is to organize and interpret data through tabulating, graphing, or statistical analysis. Such analysis can bring out the meaning of data—and their relevance—so that they may be used as evidence.

Students learn to expand their capabilities to use a range of tools for tabulation and graphical representation Students are also expected to improve their abilities to interpret data by identifying significant features and patterns, use mathematics to represent relationships between variables, and take into account sources of error.

EXPECTATION FOR USES MATHEMATICS, ANALYZES & INTERPRETS DATA

- Constructs accurate data tables and/or graphs (e.g., bar graphs, pictographs) and presents data to identify patterns among variables.
- Generate an interpretation of the data without major errors in logic.
- Identifies similarities/differences in their data compared with other groups' results or "expert" results.
- Uses counting and numbers to accurately identify and

ENGINEERING CONCEPTS & PRACTICES

Students are learning the concepts of engineering design:

Defining the problem involves the specifying criteria and constraints. Criteria are requirements for a successful solution and usually specify the function that a design is expected to perform and qualities that would make it possible to choose one design over another. Constraints are the limitations that must be taken into account when creating the designed solution. In the classroom constraints are often the materials that are available and the amount of time students have to work.

Developing possible solutions the discipline of generating several alternative solutions and comparing them systematically to see which best meet the criteria and constraints of the problem.

Improving designs involves building and testing models or prototypes using controlled experiments or "fair tests" in which only one variable is changed from trial to trial while all other variables are kept the same. This is the same practice as in science inquiry, except the goal is to achieve the best possible design rather than to answer a question about the natural world. Another means for improving designs is to build a structure and subject it to tests until it fails; noting where the failure

EXPECTATIONS FOR ENGINEERING PRACTICES

- Defines a problem or design statement that is realistic, possible, or practical. Matches the intent of the problem and satisfies constraints. It may fail, slightly, to address minor issues.
- Written design plan identifies the criteria, constraints, and intent of the problem. It may fail, slightly, to address minor issues
- The final build follows the intended design with only minor deviations
- Generates and compares multiple solutions to a problem based on how well they meet the criteria and constraints of the solution. Recommends the "best" solution