# Vertical Alignment of Scientific and Engineering Practice: Collecting and Organizing Observations and Measurements

TEKS in Focus highlights key concepts and student expectations to support educators in implementing the Texas Essential Knowledge and Skills (TEKS). The vertical progression of a concept within the science TEKS is presented alongside detailed explanations from the TEKS Guide. The scientific and engineering practices are the first strand of the science TEKS. Educators should integrate these practices with content, providing students with the context to ask questions, develop models, and analyze data, thereby creating a cohesive learning experience. This approach ensures that students develop critical thinking and problem-solving skills by applying scientific and engineering practices to real-world scenarios as they learn the content.

Detailed explanations are provided for specific underlined terms and phrases in a student expectation. These explanations clarify what students should know and be able to do in relation to a specific word or phrase within the context of that student expectation. Some detailed explanations include a Tier 1 instructional boundary, which describes the baseline instructional expectations for all students. Educators are expected to differentiate for students who exceed Tier 1 proficiency by providing instruction that extends beyond the TEKS Guide's boundaries.

**Scientific and Engineering Practice 1F**

| Science TEKS | Term or Phrase | Detailed Explanations from TEKS Guide |
|---|---|---|
| *K.1.F, 1.1.F, 2.1.F record and organize data using pictures, numbers, words, symbols, and* ***simple graphs****; and* | **simple graphs** | In Kindergarten, students should record data in simple graphs, such as real-object and picture graphs.<br><br>Students in grade 1 should record data in simple graphs, such as bar-type graphs.<br><br>Students in grade 2 should record data in simple graphs, such as bar graphs or pictographs. |

| Science TEKS | Term or Phrase | Detailed Explanations from TEKS Guide |
|---|---|---|
| *3.1.F, 4.1.F, 5.1.F construct **appropriate graphic organizers** to collect data, including tables, bar graphs, line graphs, tree maps, concept maps, Venn diagrams, flow charts or sequence maps, and input-output tables that show cause and effect; and* | **appropriate graphic organizers** | Students should construct a variety of graphic organizers and graphs.<br><br>In grade 3, students will construct tables and bar graphs, building on prior learning from kindergarten–grade 2. Grade 3 students have not had prior experience constructing line graphs and input-output tables, so educators should co-construct them with students.<br><br>In grades 4 and 5, students will construct tables and bar graphs, and grade 5 students will construct input-output tables and line graphs. Grades 4 and 5 students may not have prior experience constructing input-output tables. Grade 5 students may not have prior experience with constructing line graphs. Educators should co-construct these tables and graphs with students. |
| *6.1.F, 7.1.F, 8.1.F **construct appropriate tables, graphs, maps, and charts** using repeated trials and means to organize data;* | **construct appropriate tables, graphs, maps, and charts** | Students should construct and complete tables, graphs, and charts to fit the data collected in an investigation.<br><br>At the beginning of grade 6, students can create and use bar graphs, frequency tables, scatter plots, dot plots, and histograms. By the end of grade 6, students can use and create circle graphs (pie charts) and bar graphs with percentages, and are expected to do so through grades 7 and 8. Students should gather data from a variety of map types (geographical, thematic, process) and interpret and generate concept maps. Students should develop their own tables and charts to organize data according to their experimental designs. |
| *6.1.F, 7.1.F, 8.1.F construct appropriate tables, graphs, maps, and charts using **repeated trials** and means to organize data;* | **repeated trials** | Students should understand that scientists rely on repeated trials to ensure that data are accurate and precise. If data collected across multiple trials are inconsistent, this may indicate weaknesses in the data collection method. Students should measure quantities accurately—as close as possible to the actual value. Students should perform repeated tests with precision and, by the end of grade 6, average the data. |

| Science TEKS | Term or Phrase | Detailed Explanations from TEKS Guide |
|---|---|---|
| *Bio.1.F organize quantitative and qualitative data using scatter plots, line graphs, bar graphs, charts, data tables, digital tools, diagrams, scientific drawings, and student-prepared models;*<br><br>*Chem.1.F organize quantitative and qualitative data using oral or written lab reports, labeled drawings, particle diagrams, charts, tables, graphs, journals, summaries, or technology-based reports;*<br><br>*IPC.1.F organize quantitative and qualitative data using labeled drawings and diagrams, graphic organizers, charts, tables, and graphs;*<br><br>*Phys.1.F organize quantitative and qualitative data using bar charts, line graphs, scatter plots, data tables, labeled diagrams, and conceptual mathematical relationships;* | | While there are currently no detailed explanations for student expectation 1.F in the high school courses, each course provides a unique set of constructs that students should use to organize and represent data. Students in the high school courses will apply the mathematics and science skills learned in kindergarten through grade 8 to formulate or answer questions, identify patterns and trends in data, analyze their solutions to problems, develop models to explain concepts, and evaluate hypotheses. |

**TEKS Guide Glossary Terms (found in one or more student expectations of this vertical alignment):**

**Glossary terms and definitions in the TEKS Guide are consistent from kindergarten through high school. The definitions provide educators with a common understanding of the terms, regardless of the grade level they teach. Glossary definitions are not intended for use with students.**

**data:** factual information (such as observations, measurements, or statistics) used as a basis for reasoning, discussion, or calculation; often includes both useful and irrelevant or redundant information and must be processed to be meaningful

**cause and effect:** a type of relationship between two or more variables or phenomena whereby one variable or event leads to a predictable response

**qualitative data:** non-numerical factual information (such as observations) used as a basis for reasoning, discussion, or calculation; often includes both useful and irrelevant or redundant information and must be processed to be meaningful

**quantitative data:** numerical factual information (such as measurements or statistics) used as a basis for reasoning, discussion, or calculation; often includes both useful and irrelevant or redundant information and must be processed to be meaningful

**TEKS Guide Further Explanations:**

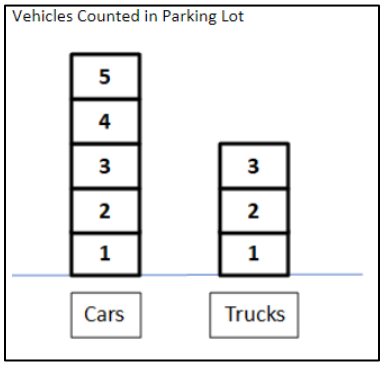
**The further explanation section is intended to serve as a resource to help educators better understand the topic their students are studying. Further explanations may be written at a level more complex than what is expected for students at that grade level.**

**Grade 2**

**Bar-Type Graph**

The following are true of a bar-type graph:

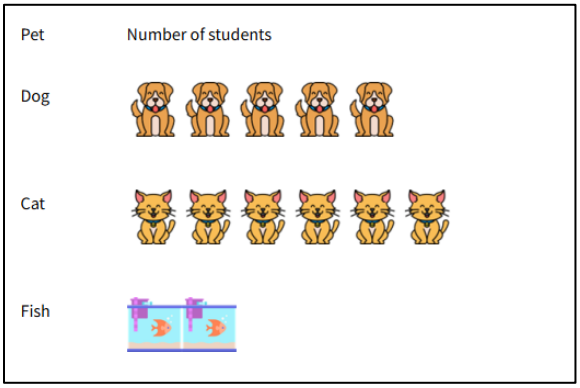
- uses bars of equal width divided into sections to represent the frequency of data values in a dataset
- represents one data point with each section
- represents data that can be numerical or categorical
- enables comparisons between and among quantities




**Pictograph**

The following are true of a pictograph:

- uses pictures to represent the frequency of data values in a dataset
- enables comparisons between and among quantities
- is also called a picture graph

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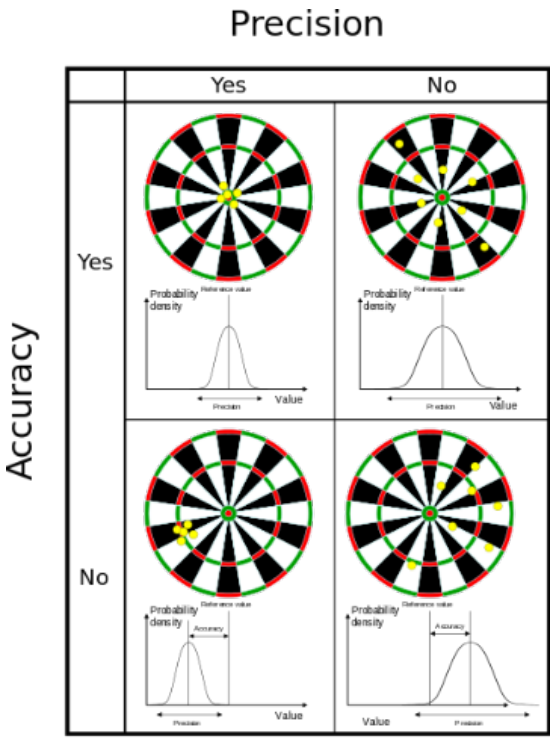
TEKS In Focus highlights concepts or student expectations to strengthen TEKS alignment, rigor, and shared understanding. It doesn't specify a particular order or timing but helps clarify TEKS expectations and serves as a guide for classroom instruction when relevant.

**Grades 6-12**

Accuracy and precision are related concepts that are often confused. Accuracy and precision are both measures of data. Accuracy measures how close results are to the true or known value, often expressed as percent error. Precision is a measure of how close results are to one another, often quantified by the standard deviation. Precision includes both repeatability and reproducibility. To ensure reproducibility of results, all variables, such as the instrument, operator, and environmental factors, are held constant. The same results must be obtained by different operators, on different instruments, and at different times. The image below shows the relationship between accuracy and precision.




Accuracy and precision combine to produce the margin of error (+/-). The accuracy and precision of data are often stated implicitly using significant figures. When the data are graphed, accuracy is reflected in the magnitude of the horizontal shift, and precision is reflected in the dispersion (spread) of the data.

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