Laboratory and Field Investigations
Frequently Asked Questions

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1. What is a laboratory investigation?

A school laboratory investigation (also referred to as a lab) is defined as an experience in the laboratory, the classroom, or the field that provides students with opportunities to interact directly with natural phenomena or with data collected by others using tools, materials, data collection techniques, and models (National Research Council, *National Science Education Standards*, 2006, p. 3).

2. Are there any new laboratory and field requirements in the 2010 science TEKS?

Yes. In the new Texas Essential Knowledge and Skills (TEKS) for science, laboratory and field investigations will take on increased importance. First, the 40% time requirement has been expanded from the high school level to the middle school level. Second, science equipment and supplies are now specified at the high school level, expanding on the K-8 requirements. Third, the elementary-level science TEKS now have recommendations for time percentages.

- How much laboratory and field time is suggested for elementary school science programs?

  In grades K-1, districts are encouraged to facilitate classroom and outdoor investigations for at least 80% of instructional time.

  In grades 2-3, districts are encouraged to facilitate classroom and outdoor investigations for at least 60% of instructional time.

  In grades 4-5, districts are encouraged to facilitate classroom and outdoor investigations for at least 50% of instructional time.

- How much laboratory and field time is required for middle school science programs?

  In grades 6-8, students for at least 40% of instructional time, conduct laboratory and field investigations.

- How much laboratory and field time is required for high school science programs?

  For all courses that receive science credit in grades 9-12, students for at least 40% of instructional time, conduct laboratory and field investigations.

All of the science TEKS are found in 19 Texas Administrative Code (TAC), Chapter 112, and are available at http://ritter.tea.state.tx.us/rules/tac/chapter112/index.html.

3. What types of investigations are cited in the 2010 science TEKS?

The 2010 science TEKS reference three types of investigations—descriptive, comparative, and experimental.

- **Descriptive investigations** involve collecting qualitative and/or quantitative data to draw conclusions about a natural or man-made system (e.g., rock formation, animal behavior, cloud, bicycle, electrical circuit). A descriptive investigation includes a question, but no hypothesis. Observations are recorded, but no comparisons are made and no variables are manipulated.

- **Comparative investigations** involve collecting data on different organisms/objects/ features/events, or collecting data under different conditions (e.g., time of year, air temperature, location) to make a comparison. The hypothesis identifies one independent (manipulated) variable and one dependent (responding) variable. A "fair test"* can be designed to measure variables so that the relationship between them is determined.

- **Experimental investigations** involve designing a "fair test"* similar to a comparative investigation, but a control is identified. The variables are measured in an effort to gather evidence to support or not support a causal relationship. This is often called a "controlled experiment."

* A fair test is conducted by making sure that only one factor (variable) is changed at a time, while keeping all other conditions the same.

4. How can classroom teachers design scientific descriptive and comparative investigations?

Science often emphasizes experimental investigation in which students actively manipulate variables and control conditions. In studying the natural world, it is difficult to actively manipulate variables and maintain "control" and "experimental" groups, so field investigation scientists look for descriptive or comparative trends in naturally occurring events. Many field investigations begin with counts (gathering baseline data). Later, measurements are intentionally taken in different locations (e.g., urban and rural, or where some natural phenomenon has created different plot conditions) because scientists suspect they will find a difference. In contrast, in controlled experiments, scientists begin with a hypothesis about links between variables in a system.

5. What types of variables are there in an experiment?

- **Manipulated (changed) variable, also called the independent variable** – the factor of a system being investigated that is deliberately changed to determine that factor's relationship to the responding variable
- **Responding variable, also called the dependent variable** – the factor of a system being investigated that changes in response to the manipulated variable and is measured
- **Controlled variables** – the conditions that are kept the same in a scientific investigation

6. What are the guidelines for field investigations?

- **Guidelines for Instructional Field Experiences** – This brochure is designed to provide administrators with information to support field investigations on the campus. This brochure is available on the TEA science website.
- **Field Investigations: Using Outdoor Environments to Foster Student Learning of Scientific Processes** – This document contains examples of descriptive and comparative investigations. This document is available at http://www.fishwildlife.org/pdfs/Field%20Investigation%20Guide.pdf.

7. What are the rules and laws regarding safety in science investigations?

Safety information, including classroom, laboratory, and field investigations is available in the Safety Standards. The new science TEKS have expanded the required safety equipment for grades K-12.

8. How many students can be placed in a science class?

Schools should carefully consider the actual size of the classroom and laboratory space and how that relates to safety. See question 9 below for further information.

9. What are the size requirements for school laboratories?

The following requirements for school facility standards shall apply to projects for new construction or major space renovations for which the construction documents have been approved by a school district board of trustees, or a board's authorized representative, on or after January 1, 2004.

Specialized Classrooms – The following provisions shall apply to combination science laboratories/classrooms, where each student has a lab station and where typically there is a clearly defined laboratory area and a clearly defined lecture area.

- Combination science laboratories/classrooms shall have a minimum of 900 square feet per room at the **elementary** school level. The minimum room size is adequate for 22 students; 41 square feet per student shall be added to the minimum square footage for each student in excess of 22.

- Combination science laboratories/classrooms shall have a minimum of 1,200 square feet per room at the **middle** school level. The minimum room size is adequate for 24 students; 50 square feet per student shall be added to the minimum square footage for each student in excess of 24.
- Combination science laboratories/classrooms shall have a minimum of 1,400 square feet per room at the **high** school level. The minimum room size is adequate for 24 students; 58 square feet per student shall be added to the minimum square footage for each student in excess of 24.

For districts that choose to use separate science classrooms and science laboratories, the following provisions shall apply:

- A science classroom shall be a minimum of 700 square feet regardless of grade level served.
- A science laboratory shall have a minimum of 800 square feet at the elementary school level. The minimum laboratory size is adequate for 22 students; 36 square feet per student shall be added to the minimum square footage for each student in excess of 22.
- A science laboratory shall have a minimum of 900 square feet at the middle school level. The minimum laboratory size is adequate for 24 students; 38 square feet per student shall be added to the minimum square footage for each student in excess of 24.
- A science laboratory shall have a minimum of 1,000 square feet at the high school level. The minimum laboratory size is adequate for 24 students; 42 square feet per student shall be added to the minimum square footage for each student in excess of 24.
- Science classrooms shall be provided at a ratio not to exceed 2:1 of science classrooms to science laboratories at the middle school and high school levels. The science laboratories shall be located convenient to the science classrooms they serve.

The complete Commissioner's Rules Concerning School Facilities is located at http://ritter.tea.state.tx.us/rules/tac/chapter061/ch61cc.html.

10. Where is information available for building science laboratories?

Detailed information on building new science laboratories, or renovating old science laboratories, is provided in the *Texas Facilities Standards*. In addition, information on constructing outdoor science learning facilities for your school may be found in this document. This document will be posted soon on the science curriculum website.

11. Can a school charge students "lab fees" to cover the cost of materials used in the science classroom or place items such as safety goggles on the student supply list?

No. A district must have statutory authorization to charge a fee. Texas Education Code (TEC) §11.158 is where most allowed fees are delineated. Specifically TEC §11.158(b)(1) prohibits fees for "textbooks, workbooks, laboratory supplies, or other supplies necessary for participation in any instructional course . . . ." There are some exceptions (band instrument rentals, for example), but they do not apply in this instance.

12. Do demonstrations, simulations and web explorations count as labs in regard to the 40% lab time requirement?

Scientists across the state and nation have noted the growing use of computer generated data collection and investigation. Computer software, hardware, and online instructional resources are now an integral part of most science classes. Students enjoy and can gain knowledge from the use of computers in science. It is appropriate to include some level of simulations and computer generated laboratory experiences as science laboratory time. It is important, however, that these simulations, demonstrations, and two dimensional laboratory experiences do not dominate the student experience in science. The very nature of science warrants student manipulation of equipment, earth materials and organisms that engage all of the student's senses in a way that no computer program can simulate. Demonstrations, simulations, and web explorations can be considered part of the 40% lab requirements if they incorporate active learning and engagement. Schools should carefully consider the portion of the 40% lab requirement that is made up of such activities.