Massachusetts Curriculum Framework | SCIENCE | HS

WHAT TO LOOK FOR

A quick guide for observing classroom content and practice

High School Technology Engineering instructional time should focus on four core ideas:

ETS1. Engineering Design

ETS2. Materials, Tools

ETS3. Technology Systems

ETS4. Energy and Power Technology

In a **High School Technology Engineering** class you should observe students engaged with at least one science concept and practice:

Science and Engineering Practices

- Asking questions and defining problems
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations and designing solutions
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

Science Concepts

Engineering Design

•Analyze a global challenge to specify a design problem that can be improved

•Determine qualitative and quantitative criteria for designing a solution.

•Break a complex real world problem into smaller, more manageable problems using scientific and engineering principles.

•Evaluate a solution to a complex real world problem based on prioritized criteria and trade-offs that account for a range of constraints as well as social, cultural, and environmental impacts

•Evaluate a problem that has interactions between two or more systems.

•Use a computer simulation to model impacts of a proposed solution.

•Plan a prototype or design solution using drawings and proper scale and proportions

•Communicate solutions to problems that include specifications, performance results, issues and limitations

Materials, Tools, and Manufacturing

•Determine best manufacturing processes and applications to create parts of desired shape, size, and finish based on available resources and safety.

•Explain how computers and robots can be utilized in a manufacturing system and what tasks are best suited for humans and for robots.

•Compare the costs and benefits of custom versus mass production of products

•Explain how manufacturing processes transform material properties to meet a specified purpose or function.

•Recognize that new materials can be synthesized through chemical and physical processes to meet specific needs.

Technological Systems

•Model a technological system where the output of one subsystem becomes the input to another subsystem.

•Explain using a model how information is transmitted via digital and analog signals and through different media.

• Analyze a communication problem and determine the best mode of delivery for the mode of communication.

•Explain designs considering live loads and dead loads when constructing structures and calculate the resultant forces for live and dead loads for various structural schemes.

•Model and analyze how the forces of tension, compression, torsion, and shear affect the performance of a structure and justify materials for the given structures based on their properties.

•Analyze how building designs are influenced by thermal conditions and how conduction, convection, and radiation are considered in the design of a heating system.

•Communicate and illustrate how a vehicle or device can be modified to produce a change in lift, drag, friction, thrust, and weight.

Energy and Power Technologies

•Research and describe ways that humans use energy and power systems to harness resources to accomplish tasks.

•Research and describe examples of energy and power systems, including fluid systems, thermal systems and electrical systems.

•Use a model to explain differences between open fluid systems and closed fluid systems.

•Explain how differences and similarities in energy and power systems lead to different applications in technologies of each.

•Compare and contrast hydraulic and pneumatic systems.

•Calculate and describe how a hydraulic system multiplies distance and force, and effects directional change.

•Explain how machines convert energy to do work efficiently and effectively.

NOTES

Comments on the Science and Engineering Practices: For a list of specific skills, see the *Science and Engineering Practices Progression Matrix* (www.doe.mass.edu/stem/review.html); Practices are skills **students** are expected to learn and do; standards focus on some but not all skills associated with a practice.

STE What to Look For The example below features three Indicators from the Standards of Effective Practice. These Indicators are just a sampling from the full set of Standards and were chosen because they create a sequence: the educator plans a lesson that sets clear and high **expectations**, the educator then delivers high quality instruction, and finally the educator uses a variety of **assessments** to see if students understand the material or if re-teaching is necessary. This example highlights teacher and student behaviors aligned to the three Indicators that you can expect to see in a rigorous High School Technology Engineering classroom.

Expectations (Standard II, Indicator D)	Plans and implements lessons that set clear and high expectations and also make knowledge accessible for all students.

What is the teacher doing?

- Creating culturally responsive lessons that engage and sustain student attention
- Focusing attention on scientific language (e.g., linguistic complexity, conventions, and vocabulary)
- Modeling how to evaluate reasoning behind currently accepted explanations or solutions

What are the students doing?

- Identifying a lesson's standards or objectives and how they connect to unit goals
- Using information from observations to construct an evidence based account for natural phenomena
- Developing a complex model of multiple variables that can be tested

Instruction (Standard II, Indicator A)	Uses instructional practices that reflect high expectations regarding content and quality of effort and work; engage all students; and are personalized to accommodate diverse learning styles, needs, interests, and levels of readiness.

What is the teacher doing?

- Providing opportunities for students to communicate ideas, ask questions, and make their thinking visible in writing and speaking
- Providing opportunities for students to conduct investigations that test models
- Creating activities that require sophisticated analysis (such as finding an equation) to find patterns

What are the students doing?

- Evaluating questions and arguments (e.g., to determine whether they are testable and relevant)
- Actively incorporating others into discussions about scientific ideas
- Using detailed statistical analysis or models that can evaluate data sets for consistency

Assessment (Standard I, Indicator B)	Uses a variety of informal and formal methods of assessments to measure student learning, growth, and understanding to develop differentiated and enhanced learning experiences and improve future instruction.

What is the teacher doing?

- Providing students with feedback aligned to long-term goals
- Conducting frequent checks for student understanding and adjusting instruction accordingly
- Providing exemplars of work (e.g. historical examples, student work)

What are the students doing?

- Reflecting on how they are progressing toward goals
- Demonstrating learning in multiple ways (e.g., mid-unit quiz, completion of investigation)
- Engaging in challenging learning tasks regardless of learning needs (e.g., linguistic background, disability, academic gifts)