Massachusetts Curriculum Framework | SCIENCE | HS

WHAT TO LOOK FOR

A quick guide for observing classroom content and practice

In **High School Physics**, instructional time should focus on four core ideas:

PS1. Matter and its Interactions

PS2. Motion and Stability: Forces and Interactions

PS3. Energy

PS4. Waves and their Applications in technologies for information transfer

In a **High School Physics** 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

Matter and its interactions (PS1)

•Predict the energy released or absorbed during the processes of fission, fusion, and radioactive decay.

Motion and Stability: Forces and Interactions (PS2)

•Describe and predict the change in motion of objects when acted on by a net force.

•Show mathematically that the total momentum of a system is conserved when there is no net force on the system.

•Design and create a device that minimizes forces on an object during a collision.

•Predict the effects of gravitational and electrostatic forces between objects.

•Provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.

•Predict changes to voltage, current, or resistance when simple changes are made to a circuit.

•Predict changes to velocity and acceleration for an object moving in one dimension

Energy (PS3)

•Calculate the change in energy of a system and identify energy transformations from one form to another.

•Show that energy at the macroscopic scale can be accounted for as either moving particles or energy stored in fields.

•Design and evaluate a device that works to convert one form of energy into another form of energy.

•Provide evidence that thermal energy will transfer between touching objects from high to low temperature to reach thermal equilibrium.

•Illustrate the forces and changes in energy between two magnetically or electrically charged objects changing position in a magnetic or electric field.

Waves and their Applications in Technologies for Information Transfer (PS4)

•Mathematically show the relationships among the frequency, wavelength, and speed of waves.

•Evaluate the idea that electromagnetic radiation can be understood by either a wave model or a particle model.

•Describe how devices use waves to transmit and capture information and energy.

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 Physics 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?

- Communicating a lesson's objectives and their connections to unit essential questions and goals
- 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?

- Persisting when engaging with meaningful scientific tasks
- Applying scientific knowledge when explaining natural phenomena or real world problems
- Evaluating the reasoning behind currently accepted explanations or solutions

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
- Highlighting culturally appropriate and effective negotiation skills they observe in students
- Modeling how to use detailed statistical analysis or models that can compare data sets for consistency

What are the students doing?

- Actively incorporating others into discussions about scientific ideas
- Using both linear and nonlinear functions to find patterns in data
- Using detailed statistical analysis or models that can evaluate data sets for consistency
- Conducting investigations that test models

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?

- 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)
- Using exemplars to inform their work