# Standards for the Preparation of Teachers

# Physics (DE)


Adopted by the Michigan State Board of Education
August 8, 2002

# Standards for the Preparation of Teachers of Physics (DE Endorsement)

# Preface

## Development of the Proposal

Over the last several years, a referent group of professional educators developed a proposal to adopt standards for the preparation of physics teachers. These standards align with standards developed by the National Science Teachers Association for teacher preparation standards and the Michigan Curriculum Framework for science education. Teachers who receive the endorsement in physics would be prepared to teach any physics course at their certificate level.

To provide information and gather feedback on the proposal, a copy was also forwarded to selected groups/organizations, all Michigan teacher preparation institutions, and a random sample of intermediate and local school districts for review and comment. As presented in this document, the standards reflect the feedback received.

State Board adoption of these standards typically leads to the creation of a new certification test for teachers prepared to teach this content area. Test development for a new Michigan Test for Teacher Certification in physics will be scheduled according to the recommendation of the Standing Technical Advisory Council.

## Approval of Programs

Teacher preparation institutions that wish to continue to offer programs to prepare physics teachers are required to submit an application for program approval that demonstrates how the new standards are met throughout the proposed curriculum. The programs must be re-approved to show compliance with the new standards. Following initial approval, the teacher preparation programs will be reviewed every five years through the Periodic Review/Program Evaluation process.

## Levels of Proficiency

**A – Awareness**
The physics teacher recognizes/recalls the existence of different aspects of the science of physics and related teaching strategies.

**B – Basic Understanding**
The physics teacher articulates knowledge about the science of physics and related instructional and assessment strategies. The physics teacher demonstrates proficiency in using the knowledge at a fundamental level of competence acceptable for teaching.

**C – Comprehensive Understanding**
The physics teacher is able to apply broad, in-depth knowledge of the different aspects of the science of physics in a variety of settings. (This level is not intended to reflect mastery; all teachers are expected to be lifelong learners.)

DIRECTIONS: List required courses on matrix and provide additional narrative to explain how standards are met. If electives are included, they should be clearly indicated. Adjust size of cells as needed.

*Submit a narrative that explains how this program:*

- uses the Michigan Curriculum Framework K-12 Science Content Standards and Benchmarks as the critical foundation for teacher preparation, ensuring that physics teachers have the content knowledge and the ability to teach this curriculum; and
- develops an understanding of the interconnectedness of all science, including biology, chemistry, and the earth/space sciences, and relates this understanding to the teaching of physics.

*The preparation of physics teachers will enable them to:*

1.0 understand and develop the major concepts and principles of physics as the study of matter and energy and of the interaction between the two and including mechanics, electricity, magnetism, thermodynamics, waves, optics, solid-state physics, atomic and nuclear physics, radioactivity, relativity, and quantum mechanics and shall include such topics as:

1.1 Matter and Energy

1.1.1 mechanics (C)

1.1.1.2 conservation of energy, momentum, angular momentum (C)

1.1.1.3 inertia(C)

1.1.1.4 oscillatory motion (C)

1.1.1.5 law of gravity(C)

1.1.2 Electricity and Magnetism

1.1.2.1 electro-statics – Coulomb's law (C)

1.1.2.2 electro-static field and potential (C)

1.1.2.3 electric dipoles (C)

1.1.2.4 electro-static energy and force (C)

1.1.2.5 Ohm's law (C)
1.1.2.6 magnetic induction field (C)
1.1.2.7 Biot-Savart law (B)
1.1.2.8 Ampere's law (B)
1.1.2.9 magnetic energy, force, and torque (C)
1.1.2.10 Maxwell's equations (A)
1.1.2.11 relativistic electro-dynamics (A)

1.1.3 Thermodynamics
1.1.3.1 Temperature (C)
1.1.3.2 Work (C)
1.1.3.3 specific heat (C)
1.1.3.4 Compressibility
1.1.3.5 Entropy
1.1.3.6 laws of thermodynamics (B)
1.1.3.7 internal energy (B)
1.1.3.8 Enthalpy (B)
1.1.3.9 Maxwell – Boltzmann theory (B)
1.1.3.10 cryogenics – properties of materials at low temperatures and safe handling of liquid nitrogen (A)

1.1.4 Optics
1.1.4.1 simple optical systems (C)
1.1.4.2 interference and interferometers (B)
1.1.4.3 diffraction (C)
1.1.4.4 double-slit (C)
1.1.4.5 Grating (C)
1.1.4.6 limit resolution (B)
1.1.4.7 polarization and reflection (C)
1.1.4.8 spectroscopy(C)
1.1.4.9 radiometry (A)
1.1.4.10 photometry (A)
1.1.4.11 lasers, holography, fiber optics (B)

1.1.5 Quantum Physics
1.1.5.1 blackbody radiation (B)
1.1.5.2 Schrodinger's equation (A)
1.1.5.3 multiple wave functions (A)
1.1.5.4 shell model of the atom (B)
1.1.5.5 theory of solids (A)
1.1.5.6 Fermi-Dirac statistics (A)
1.1.5.7 Bose-Einstein statistics (A)

1.1.6 Acoustics
1.1.6.1 wave motion (C)
1.1.6.2 sound waves (C)
1.1.6.3 doppler effect (C)
1.1.6.4 standing waves (C)
1.1.6.5 resonance (C)

1.1.7 Nuclear Physics
1.1.7.1 properties of nuclei (C)
1.1.7.2 nuclear models (C)

1.1.7.3 nuclear magnetic resonance (A)
1.1.7.4 radioactivity (C)
1.1.7.5 Fission (C)
1.1.7.6 Fusion (C)
1.1.7.7 elementary quark model (B)
1.1.7.8 standard model of elementary particle physics (B)

*The preparation of physics teachers will enable them to:*

2.0. apply mathematics, including statistics and calculus and introductory differential equations, to investigations in physics and the analysis of data;

3.0 relate the concepts of physics to contemporary, historical, technological, and societal issues; in particular, relate concepts of physics to current controversies and other issues;

4.0 locate resources, design and conduct inquiry-based open-ended investigations in physics, interpret findings, communicate results, and make judgments based on evidence;

5.0 construct new knowledge for themselves through research, reading and discussion, and reflect in an informed way on the role of science in human affairs;

6.0 understand and promote the maintenance of a safe science classroom as identified by the Council of State Science Supervisors, including the appropriate use and storage of scientific equipment, and safe storage, use, and disposal of materials;

7.0 demonstrate competence in the practice of teaching as defined within the Entry-Level Standards for Michigan Teachers;

8.0 create and maintain an educational environment in which conceptual understanding will occur for all science students;

9.0 demonstrate competence in the practice of teaching through investigative experiences and by demonstrating the application of the scientific processes and in assessing student learning through multiple processes; and

10.0 develop an understanding and appreciation for the nature of scientific Inquiry.