Instructional Modules to Assist You in Educating Pre-service Physics Teachers and in Conducting Professional Development for In-service Physics Teachers

Eugenia Etkina
Rutgers University, Graduate School of Education and Department of Physics and Astronomy
eugenia.etkina@gse.rutgers.edu

Monica Plisch
Associate Director of Education and Diversity American Physical Society
plisch@aps.org

Physics Teacher Education Coalition Meeting, 2015
What is the purpose of the modules?

• To provide materials for those programs that prepare physics teachers (or do professional development) to make the work of this programs more efficient,

• To use results of PER in practice,

• To “take advantage” of teacher educators who combine knowledge of physics, knowledge of PER and real high school teaching experience,

• To help teachers motivate high school students and ensure that they are successful.
What should a physics teacher know?

**PHYSICS**
Subject matter (concepts, rules, problem solving).
Methods of acquiring knowledge: How do we know what we know? What are accepted rules of the game?

**EDUCATION**
How human brain works.
How people learn.
How people work in groups.
How motivation is related to learning.

**WHAT IS MISSING?**
What should students learn in a physics course?
What difficulties do they have?
How can we help them best?
How can we assess them?
What resources are available?
How to structure the curriculum?
Elements of Teacher Knowledge

Content knowledge (CK)
- Physics department
- Pedagogical content knowledge (PCK)

Pedagogical knowledge (PK)
- School of education
- ???
The need for modules

- There is a lot of research on how to help students learn physics, be successful, stay motivated, etc. Learning and teaching physics is different from learning and teaching biology.
- The preparation for the challenges of every day instruction is what helps teachers be successful.
- We should be able to help our students who plan to teach physics – HOW TO TEACH PHYSICS.
Modules address most common aspects of teaching physics

A sequence of 3 Multiple representations modules (Kinematics, Dynamics, Momentum and Energy).

Module on planning instructional elements

Module on experimentation (physics experiments)
How to use the modules

• As materials for existing science methods courses
• As materials for a stand alone course/courses just for future physics teachers
• As materials used in independent study courses
• As materials supplementing physics courses for future physics teachers so they have a taste of pedagogy while learning physics
Examples
Multiple Representations Series

*Purpose:* the purpose of this module is to help pre-service physics teachers learn how to integrate science practices into the learning of physics. Specifically, the module focuses on multiple representations that are used in the practice of science (see Next Generation Science Standards) when scientists analyze and interpret data, construct models and explanations, evaluate claims, and communicate. Pre-service teachers will learn about most commonly used representations in a physics course, devise activities that help high school students “read and write” with those representations and interpret student work.
Multiple Representations Series

*Purpose:* the purpose of this module is to help pre-service physics teachers learn how to integrate science practices into the learning of physics. Specifically, the module focuses on multiple representations that are used in the practice of science (see Next Generation Science Standards) when scientists analyze and interpret data, construct models and explanations, evaluate claims, and communicate. Pre-service teachers will learn about most commonly used representations in a physics course, devise activities that help high school students “read and write” with those representations and interpret student work.
Kinematics Module

Read pages 4-8 in the handout, discuss with your neighbor and prepare to do italicized activities from the Designing your own activities part and Assessment part

**Designing your own activities**

- **Design activities for the students that they can self-assess using rubrics A5 and A8.**
- **Finally, design activities when students have to move from one representation to another, especially from velocity-versus-time graphs to motion diagrams and back.**

**Assessment questions**

- **How can you help students see the relationship between kinematics graphs and motion diagrams?**
Planning Instructional Elements

Module

The module consists of several small parts. Each part has two or more of the following components: brainstorming, information and activities. Assessment for the module will consist of you writing a unit plan and a lesson plan.

• What is an instructional element? 3 steps in planning any element
• Setting goals
• Matching assessment to the goals - formative and summative
• Planning instructional sequence. Writing a lesson plan
• Writing a unit plan
• Evaluation of teacher unit and lesson planning and assessment
Planning Instructional Elements
Module

What is an instructional element?

1. Brainstorming

Look back on all the years that you have been a student. In what kinds of educational activities did you participate? These were lessons in high schools, lectures, and labs. You probably have taken short and long courses and/or workshops. Possibly you have taken a driving course or a music instrument playing course, a cooking or a knitting course. A lesson, a lab, a workshop, and a course - these represent elements of instruction. An instructional element can be as short as 10 minutes or as long as a semester. Think of what all these elements have in common.

Make a list of these things. The find a partner, discuss your list with her/him and make a combined list.
Activities in “What is an instructional element”

Read pages 10-11 in your handout and examine the curriculum from one of NJ school districts

Can you identify units in the curriculum? How many units are in the curriculum? How long is each unit?
Future work and Thank you!

1. Hear back from the users and add/revise.
2. Add more representations – electricity, optics, etc.
3. Create modules with instructional sequences for particular concepts (Kinematics, Dynamics, etc.)
4. What do you think we need to do?

Eugenia.etkina@gse.rutgers.edu