



# An Evaluation of the NanoSense Curriculum Materials: Clear Sunscreen--The Interaction of Light with Matter

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# INTRODUCTION TO NANOSENSE

- Aimed at 9-12th graders
  - Chemistry and physics classes
  - Duration: up to 12 class periods
  - 5 lessons
  - How does light interact with matter--context of nanoparticulate sunscreens
  - Learning goals:
    - Light interacting with matter (absorption, scattering)
    - Effect of particle composition/size on transmission
    - What factors affect how suspended particles scatter light
    - Light interacts with objects, allowing humans to see the world
    - Evaluate advantages and disadvantages of using nanoparticulate sunscreens
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## PURPOSE & METHODS

Perform a systematic evaluation of the unit based on these two frameworks to improve the curriculum materials.

1. How educative are these curriculum materials for **students**?
  - Based upon six categories from AAAS Project 2061 Evaluation criteria (see headings in findings)
2. How educative are these curriculum materials for **teachers**?
  - Based upon four design heuristics from Davis and Krajcik (2005) (see headings in findings)
3. How could these materials be improved, based on these two sets of criteria?

## **FINDINGS -- STUDENT MATERIALS**

### **I. Providing a sense of purpose**

- Conveys unit, lesson, and activity purpose well to students and teachers

### **II. Taking account of student ideas**

- Students record their thoughts after each lesson

### **III. Engaging students with relevant phenomena**

- The unit provides a good assortment of vivid and vicarious experiences for students

### **IV. Developing and using scientific ideas**

- Introduces key terms in a meaningful way using accurate representations
- Students work with concepts in a variety of contexts

### **V. Promoting students' thinking**

- Encourages students to explain their ideas through questioning
- Students experience tasks that are specific and relevant

### **VI. Assessing progress**

- Assessments target broad concepts

## **FINDINGS -- EDUCATIVE FEATURES FOR TEACHERS**

### **Design Heuristics for PCK for Science Topics**

#### Using instructional representations

- Variety of representations presented to teacher to aid student learning
  - Opacity vs. blocking ability (complex terms are represented)
- Helps teacher note salient features of animations
- Ideas for short in-class demos (penny in pool, pencil in cup of water--refraction)

#### Dealing with students' idea

- Students record initial ideas, but teacher doesn't necessarily see them
- Minimal anticipated answers in teacher materials

### **Design Heuristics for PCK for Scientific Inquiry**

#### Engaging students in questions

- 3 driving questions guide the unit
- Students are prompted to write down other questions they have that arise from lessons ("what I still want to know")

### **Design Heuristics for Subject Matter Knowledge**

#### Subject matter knowledge

- Overview prepares teachers to "not know" all the answers
- Teachers do not seem to learn more than what is required for students

# IMPLICATIONS & SUGGESTIONS FOR IMPROVEMENT

## **Student Materials**

- Expand prerequisite knowledge for teacher and student
- Alert teacher to commonly held student ideas/  
misconceptions
- Link phenomena to key ideas more explicitly
- Adjust curriculum materials based on grade level
- Teachers should help students understand how their  
ideas have changed

# IMPLICATIONS & SUGGESTIONS FOR IMPROVEMENT

## Educative Features for Teachers

- More extensive teacher resources needed
- Use the assessment items to guide future activities
- Rationale for why representations and questions are useful
- More connections between representations and concepts (opacity and grape juice)
- Support teachers in evaluating students' initial ideas, and understanding why this is important
- Monitor students progression of ideas throughout with reflection sheets
- Rationale for why strong subject matter knowledge is important for teacher



## REFERENCES & ACKNOWLEDGEMENTS

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- Joe Krajcik
- Patti Schank
- Alyssa Wise



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