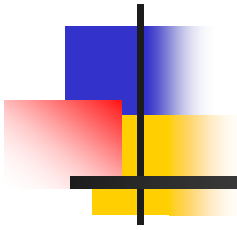


National Science Standards (First generation)



*National Science Education
Standards (NRC) and
Project 2061 Benchmarks (AAAS)*

Dennis Sunal



National Science Standards

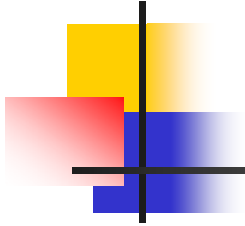
Outline

- I. National Science Education Standards (NSES) - National Research Council
- II. Benchmarks for Science Literacy - Project 2061
- III. Comparison Activity
- IV. Summary



Underlying Principles of the National Science Education Standards

- Science is for all students
- Learning science is something students do, not something that is done to them.
- Students should develop an understanding of what science is, what science can do, and how science contributes to culture.



- Improving science is part of systemic education reform.
- Scientific literacy implies that a person can identify scientific issues and express positions that are scientifically and technologically informed.



Organization of the National Science Education Standards

1. Science Teaching
2. Professional Development of Teachers of Science
3. Assessment in Science Education
4. Science Content
5. Science Education Programs
6. Science Education Systems

The National Science Education Standards

1. Science Teaching

- What should teachers of science at all grade levels know and be able to do?
- Planning inquiry based science programs.
- Actions taken to guide and facilitate learning.
- Assessments made of teaching and learning.
- Development of environments that enable students to learn science.
- Creation of communities of science learners.
- Planning and development of the school science program.

The National Science Education Standards

4. Science Content

- Underlying concepts and processes of science
- Science as inquiry
- Physical science
- Life science
- Earth and space science
- Science and technology
- Science in personal and social perspective
- History and nature of science
- Changing emphases in teaching



Group Activity

- Form groups of three at similar grade levels. Assign roles of discussion leader, recorder, and group spokesperson.
- Review the following PowerPoint slides of specific NSES changes to be made in teaching science, grades in schools.
- Note those items which are not compatible with actions a teacher of science should take on in an Alabama science classroom based on the Alabama Course of Study - Science.



National Science Education Standards

The **teaching standards** envision change throughout the system and encompass changes in emphases:

LESS EMPHASIS ON MORE EMPHASIS ON

- **Treating all students alike and always responding to whole group** **Responding to small groups and individuals**



LESS EMPHASIS ON

- Focusing on student acquisition of information
- Presenting ideas through lecture
- Recitation of acquired knowledge

MORE EMPHASIS ON

- Focusing on student understanding and use of ideas & skills
- Guiding students in active inquiry
- Opportunities for discussion & debate



LESS EMPHASIS ON

MORE EMPHASIS ON

- **Supporting competition between students**

Supporting classroom community, respect, & responsibility

- **Working alone**

Collegial & collaborative learning

- **Transmission of ideas by lecture & reading**

Learning by inquiry & investigation



National Science Education Standards

The **science content standards** envision change throughout the system and encompass changes in emphases:

- | LESS EMPHASIS ON | MORE EMPHASIS ON |
|--|--|
| <ul style="list-style-type: none">• Knowing facts & information | Understanding concepts & developing abilities |
| <ul style="list-style-type: none">• Studying disciplines for own sake | Learning disciplines in context of STS |



LESS EMPHASIS ON

- Covering many science concepts
- Teaching inquiry as a set of processes
- Separating science knowledge & process

MORE EMPHASIS ON

- Studying few, fundamental concepts
- Using inquiry as instructional strategy
- Integrating all aspects of science



National Science Education Standards

The standards envision change throughout the system and encompass changes in emphases to **promote inquiry**:

LESS EMPHASIS ON

- Activities that verify science content
- Process & lab skills out of context with content

MORE EMPHASIS ON

Activities that investigate science questions
Process and lab skills integrated with content



LESS EMPHASIS ON

MORE EMPHASIS ON

- Getting an answer or providing an answer
- Science as transmission or experiment
- Concluding inquiry with experiment

Using evidence and strategies in developing or revising

Science as argument and explanation

Applying results of experiments to arguments & explanations



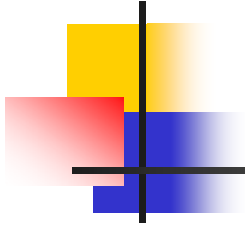
Group Activity

- Discuss the PowerPoint slides where specific NSES changes are not compatible with actions a teacher of science should take on in an Alabama science classroom based on the Alabama Course of Study - Science.
- The group spokesperson will report to the whole group the results of the discussion.
- Discuss report and summarize class responses.



Underlying Principles of Project 2061

- All students can learn
- Science literacy is a common core of learning
- Systemic reform of K-12 education
- Connections among subject disciplines
- Depth of useful learning over sheer coverage



- Relevant activities that engage students
- Diverse materials and methods for a diverse student population
- Teachers as professionals working in cross-grade, cross-discipline teams



Organization of Project 2061 Benchmarks

- The Nature of Science
- The Nature of Mathematics
- The Nature of Technology
- The Physical Setting
- The Living Environment
- The Human Organism
- Human Society
- The Designed World

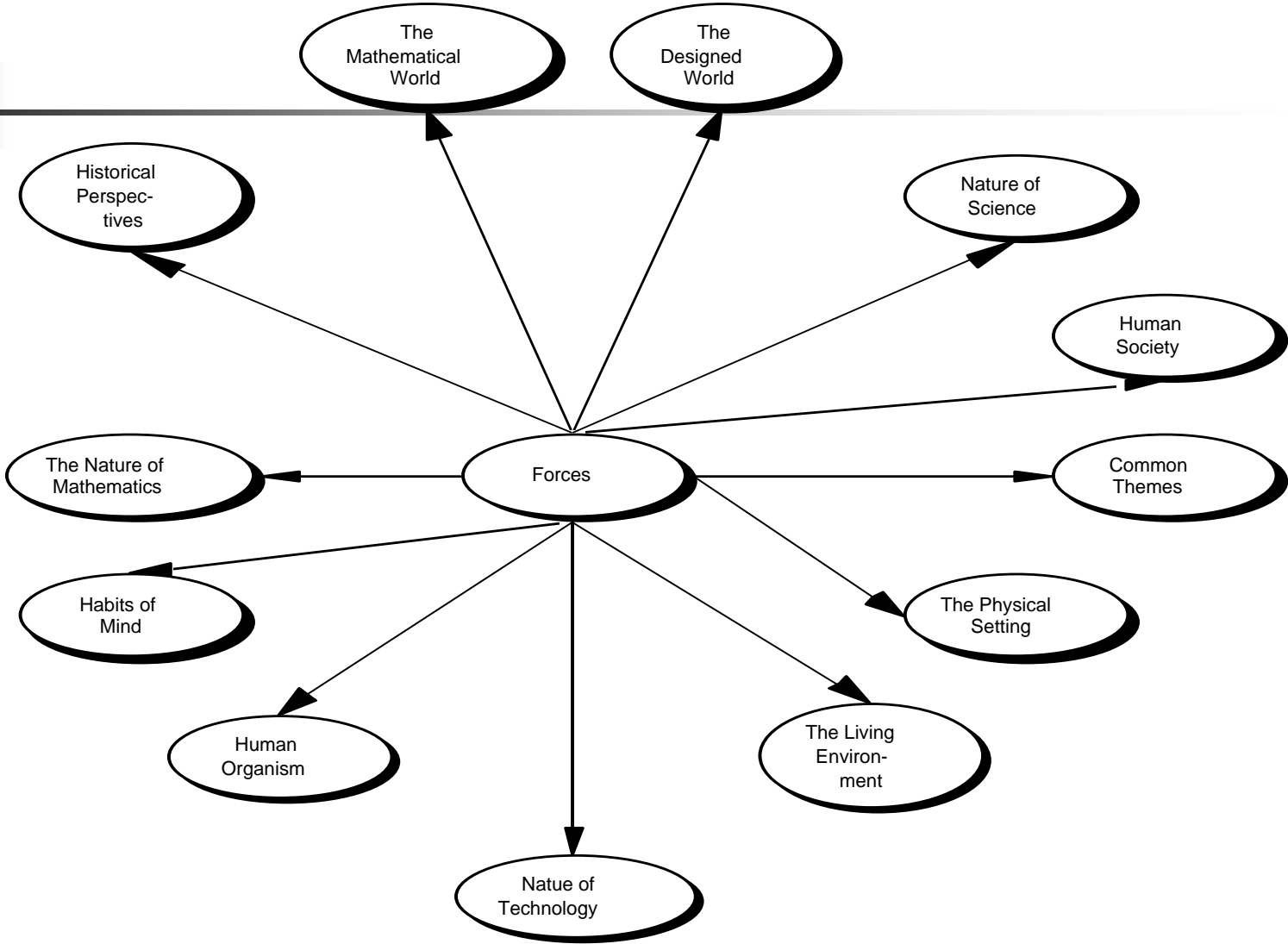
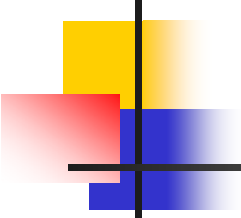


Organization of Project 2061 Benchmarks

- The Mathematical World
- Historical Perspectives
- Common Themes
- Habits of Mind

- The Origin of Benchmarks
- Issues and Language
- The Research Base
- Beyond Benchmarks

**Knowledge Structures That Education Majors
Need to Plan a Science Concept**





Knowledge Structure Needed to Plan Middle School Lessons for the Concept:

“Forces”

- **Nature of Science** - Everybody can reason scientifically
- **The Designed World** - New materials and techniques have been developed to withstand natural forces.
- **Mathematical World** - Sometimes changing one thing changes something else.
- **Historical Perspectives** - Isaac Newton
- **Nature of Mathematics** - Things move, or can be made to move, along straight, curved, circular, and jagged paths.
- **Habits of Mind** -- Estimation skills

Knowledge Structure for Non-Science Major (Cont.)




- **Human Organism** - Senses can be used for observation.
- **The Nature of Technology** - Tools are used to do things better and more easily.
- **The Living Environment** - Substances may change or move but never appear or disappear out of nothing
- **The Physical Setting** - Changes in speed and direction are caused by forces.
- **Common Themes** - Sketches and diagrams can be used to report objects and events
- **Human Society** - Forces can be used to help or hurt human beings



Knowledge Structure Needed to Plan High School Lessons for the Concept:

“Forces”

- **Nature of Science** - Theories can be changed over time
- **The Designed World** - Understanding of forces has improved manufacturing procedures
- **Mathematical World** - Mathematics provides a precise language to describe objects and events
- **Historical Perspectives** - Modern theory has altered our view of forces in very small and very large objects
- **Nature of Mathematics** - Improvements in mathematics lead the way for innovation in science
- **Habits of Mind** - Keeping an open mind



▶ **Human Organism** - Human beings have made tools and machines to sense and do things that they could not otherwise sense or do at all or as quickly or as well.

➤ **The Nature of Technology** - Technology affects people more than the pure science behind it.

➤ **The Living Environment** - Human activity and technology can change the flow of energy in the environment.

➤ **The Physical Setting** - Change in motion is proportional to force applied.

➤ **Common Themes** - The future of a system is not completely determined by its present state.

➤ **Human Society** - Benefits and costs of choices are long term and short term.



Group Activity

- Science students must be able to make interconnections between the ideas of the science discipline you present and other disciplines as described by Project 2061's Benchmarks for Science Literacy.
- Complete the following Table



Group Activity (Cont.)

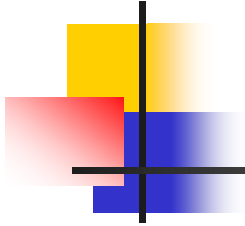
- Complete a few entries for a single concept on Figure 1 below.
- Your response answers the question, “What have you done to enable students of your course to accomplish their important science standards goals?”
- Completing entries in each category would effectively create a more “expert” knowledge structure for your students’ careers.



Table 1: Knowledge structure to be constructed by an student in your classroom for the concept of:

“ _____ (*concept?*)”

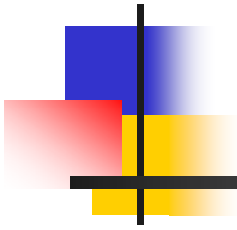
- **Nature of Science --**
- **The Designed World --**
- **Mathematical World --**
- **Historical Perspectives --**
- **Nature of Mathematics --**
- **Habits of Mind --**



“ _____ (*concept? Cont.*)”

- **Human Organism --**
- **The Nature of Technology --**
- **The Living Environment --**
- **The Physical Setting --**
- **Common Themes --**
- **Human Society --**

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