

National Science Education Standards

The development of the National Science Education Standards was guided by certain principles. Those principles, and how this Geodesy and Navigation unit addresses them, are:

- Science is for all students.

Geodesy is rather complicated, but in this unit it is broken down into basic concepts. Teachers will be able to explain geodesy and geodetic techniques through physics principles, which will make the material more accessible for the students.

- Learning science is an active process.

Through the use of activities, discussions, labs and assignments, students will be engaged in an interactive scientific process and use scientific instruments. This will be an investigation into the field of geodesy from the necessary background information to the application of geodetic techniques.

- School science reflects the intellectual and cultural traditions that characterize the practice of contemporary science.

The field of science is evolving as scientists make new and world changing discoveries. Through this unit, students will be able to witness the evolution of geodesy and recognize that it will continue to change as scientists learn more. This unit uses a multi-disciplinary approach through concepts from Physics, Chemistry, Astronomy, Geology, and Mathematics.

- Improving science education is part of systemic education reform.

By including this unit, students will be exposed to current science research that is relevant to their lives. Furthermore, the analysis skills used in this unit are useful to the students and can be applied to other disciplines.

The **National Science Education Standards** (NSES, 1996) are available for downloading at:
http://www.nap.edu/openbook.php?record_id=4962.

In the Geodesy and Navigation unit, we primarily focused on the **Eight Practices of Science and Engineering** from the **Next Generation of Science Standards**. The following represents the breakdown of the unit in terms of the individual lesson interjections and how they relate to the Eight Practices:

1. Asking Questions and Defining Problems
 - Size of the Universe
 - Time
 - Data Processing
 - Reference Frames
 - Very Long Baseline Interference
 - Global Positioning System
 - Satellite Laser Ranging
 - Post-Glacial Rebound
 - Interstellar Travel
2. Developing and Using Models
 - Size of the Universe
 - Time
 - Data Processing
 - Very Long Baseline Interference
 - Global Positioning System
 - Satellite Laser Ranging
 - Post-Glacial Rebound
 - Interstellar Travel
3. Planning and Carrying Out Investigations
 - Size of the Universe
 - Time
 - Data Processing
 - Reference Frames
 - Very Long Baseline Interference
 - Global Positioning System
 - Satellite Laser Ranging
 - Post-Glacial Rebound
 - Interstellar Travel
4. Analyzing and Interpreting Data
 - Data Processing
 - Very Long Baseline Interference
 - Global Positioning System
 - Post-Glacial Rebound
5. Using Mathematics and Computational Thinking
 - Size of the Universe

- Time
- Data Processing
- Reference Frames
- Very Long Baseline Interference
- Global Positioning System
- Post-Glacial Rebound
- Interstellar Travel

6. Constructing Explanations and Designing Solutions

- Size of the Universe
- Time
- Data Processing
- Very Long Baseline Interference
- Global Positioning System
- Satellite Laser Ranging
- Post-Glacial Rebound
- Interstellar Travel

7. Engaging in Argument from Evidence

- Size of the Universe
- Time
- Data Processing
- Very Long Baseline Interference
- Global Positioning System
- Satellite Laser Ranging
- Post-Glacial Rebound
- Interstellar Travel

8. Obtaining, Evaluating, and Communicating Information

- Size of the Universe
- Time
- Data Processing
- Reference Frames
- Very Long Baseline Interference
- Global Positioning System
- Satellite Laser Ranging
- Post-Glacial Rebound
- Interstellar Travel

The lesson plans contained within the Geodesy and Navigation unit addresses the **National Science Education Standards** recommendations for the following disciplines:

Physical Science – Content Standard B

As a result of activities in grades 9 – 12, all students should develop an understanding of

- Motions and forces
- Conservation of energy and increase in disorder
- Interactions of energy and matter

Earth and Space Science – Content Standard D

As a result of activities in grades 9 – 12, all students should develop an understanding of

- Origin and evolution of the earth system
- Origin and evolution of the universe

Science and Technology – Content Standard E

As a result of activities in grades 9 – 12, all students should develop

- Abilities of technological design
- Understandings about science and technology

Science in Personal and Social Perspectives – Content Standard F

As a result of activities in grades 9 – 12, all students should develop understanding of

- Personal and community health
- Population growth
- Environmental quality
- Natural and human-induced hazards
- Science and technology in local, national and global challenges

History and Nature of Science – Content Standard G

As a result of activities in grades 9 – 12, all students should develop understanding of

- Science as a human endeavor
- Nature of scientific knowledge
- Historical perspectives

Scientists have ethical traditions. Scientists value peer review, truthful reporting about the methods and outcomes of investigations, and making public the results of their work.

Science distinguishes itself from other ways of knowing and from other bodies of knowledge through the use of empirical standards, logical arguments, and skepticism.