



## National Standards Alignment: TEAMS Competition

The TEAMS Competition is a source of engineering, mathematical and scientific problem solving skill development for thousands of high school students throughout the United States.

To further validate the benefits of TEAMS to secondary students and schools, the competition is now aligned with multiple science, technology and mathematical standards.

The following document provides the:

- National Science Education Standards (NSES)
- International Technological Education Association (ITEA) Standards and the
- National Council of Teachers of Mathematics (NCTM) Standards for the 2007 TEAMS competition.

These standards are addressed in each competition problem.

In their present form, the standards listed here are intended to serve as a guide for future competitions. All future competitions may or may not meet or exceed every standard for every question.

Due to the consistency of the competition and the nature of engineering design, the standards indicated below should deviate only slightly.

# #1 - Air Transportation

## NSES 9–12

As a result of completing this problem in grades 9-12, all students should be introduced to or expand their knowledge regarding:

### Science as Inquiry - Content Standard A:

- Abilities necessary to do scientific inquiry
  - Use technology and mathematics to improve investigations and communications.
  - Formulate and revise scientific explanations and models using logic and evidence.
  - Recognize and analyze alternative explanations and models.
  - Communicate and defend a scientific argument.
- Understandings about scientific inquiry
  - Scientists conduct investigations for a variety of reasons.
  - Scientists rely on technology to enhance the gathering and manipulation of data.
  - Mathematics is essential in scientific inquiry.
  - Scientific explanations must adhere to criteria.
  - Results of scientific inquiry emerge from different types of investigations and public communication among scientists.

### Physical Science - Content Standard B:

- Motions and forces
  - Objects change their motion only when a net force is applied.
  - Gravitation is a universal force that each mass exerts on any other mass.

### Science and Technology – Content Standard E:

- Abilities of technological design
  - Communicate the problem, process and solution.
- Understandings about science and technology
  - Creativity, imagination and a good knowledge base are all required in the work of science and engineering.

### History and Nature of Science – Content Standard G:

- Science and a Human Endeavor
  - Individuals and teams have contributed and will continue to contribute to the scientific enterprise.
- Nature of Scientific Knowledge
  - Science distinguishes itself from other ways of knowing and from other bodies of knowledge through the use of empirical standards, logical arguments and skepticism, as scientists strive for the best possible explanations about the natural world.
  - Scientific explanations must meet certain criteria.
  - All scientific knowledge is, in principle, subject to change as new evidence becomes available.

# #1 - Air Transportation

## NCTM 9–12

### Number and Operations Standard:

- Compute fluently and make reasonable estimates
- Judge the reasonableness of numerical computations and their results

### Algebra Standard:

- Represent and analyze mathematical situations and structures using algebraic symbols
- Use symbolic algebra to represent and explain mathematical relationships
- Judge the meaning, utility, and reasonableness of the results of symbol manipulations, including those carried out by technology

### Problem Solving Standard:

- Solve problems that arise in mathematics and in other contexts
- Apply and adapt a variety of appropriate strategies to solve problems

### Communication Standard:

- Organize and consolidate their mathematical thinking through communication
- Communicate their mathematical thinking coherently and clearly to peers, teachers, and others
- Analyze and evaluate the mathematical thinking and strategies of others
- Use the language of mathematics to express mathematical ideas precisely

### Connections Standard:

- Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
- Recognize and apply mathematics in contexts outside of mathematics

# #2 - Roadway Sign Design

## NSES 9–12

As a result of completing this problem in grades 9-12, all students should be introduced to or expand their knowledge regarding:

### Science as Inquiry - Content Standard A:

- Abilities necessary to do scientific inquiry
  - Use technology and mathematics to improve investigations and communications.
  - Formulate and revise scientific explanations and models using logic and evidence.
  - Recognize and analyze alternative explanations and models.
  - Communicate and defend a scientific argument.
- Understandings about scientific inquiry
  - Scientists conduct investigations for a variety of reasons.
  - Scientists rely on technology to enhance the gathering and manipulation of data.
  - Mathematics is essential in scientific inquiry.
  - Scientific explanations must adhere to criteria.
  - Results of scientific inquiry emerge from different types of investigations and public communication among scientists.

### Physical Science - Content Standard B:

- Motions and forces
  - Objects change their motion only when a net force is applied.
  - Gravitation is a universal force that each mass exerts on any other mass.

### Science and Technology – Content Standard E:

- Abilities of technological design
  - Identify a problem or design an opportunity.
  - Evaluate the solution and its consequences.
  - Communicate the problem, process and solution.
- Understandings about science and technology
  - Creativity, imagination and a good knowledge base are all required in the work of science and engineering.

### History and Nature of Science – Content Standard G:

- Science as a Human Endeavor
  - Individuals and teams have contributed and will continue to contribute to the scientific enterprise.
- Nature of Scientific Knowledge
  - Scientific explanations must meet certain criteria.
  - All scientific knowledge is, in principle, subject to change as new evidence becomes available.

# #2 - Roadway Sign Design

## NCTM 9–12 Number and Operations Standard:

- Compute fluently and make reasonable estimates
- Judge the reasonableness of numerical computations and their results

## Algebra Standard:

- Represent and analyze mathematical situations and structures using algebraic symbols
- Use symbolic algebra to represent and explain mathematical relationships
- Judge the meaning, utility, and reasonableness of the results of symbol manipulations, including those carried out by technology

## Problem Solving Standard:

- Solve problems that arise in mathematics and in other contexts

## Communication Standard:

- Organize and consolidate their mathematical thinking through communication
- Communicate their mathematical thinking coherently and clearly to peers, teachers, and others
- Analyze and evaluate the mathematical thinking and strategies of others
- Use the language of mathematics to express mathematical ideas precisely

## Connections Standard:

- Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
- Recognize and apply mathematics in contexts outside of mathematics

# #3 - Hybrid-Electric Vehicles

**NSES 9–12** As a result of completing this problem in grades 9-12, all students should be introduced to or expand their knowledge regarding:

## Science as Inquiry - Content Standard A:

- Abilities necessary to do scientific inquiry
  - Use technology and mathematics to improve investigations and communications.
  - Formulate and revise scientific explanations and models using logic and evidence.
  - Communicate and defend a scientific argument.
- Understandings about scientific inquiry
  - Scientists conduct investigations for a variety of reasons.
  - Scientists rely on technology to enhance the gathering and manipulation of data.
  - Mathematics is essential in scientific inquiry.
  - Scientific explanations must adhere to criteria.
  - Results of scientific inquiry emerge from different types of investigations and public communication among scientists.

## Physical Science - Content Standard B:

- Chemical Reactions
  - Chemical reactions occur all around us.
  - Chemical reactions may release or consume energy.
- Motions and forces
  - Objects change their motion only when a net force is applied.
  - The electric force is a universal force that exists between any two charged objects.

## Science and Technology – Content Standard E:

- Understandings about science and technology
  - Science often advances the introduction of new technologies.
  - Creativity, imagination and a good knowledge base are all required in the work of science and engineering.

## History and Nature of Science – Content Standard G:

- Science and a Human Endeavor
  - Individuals and teams have contributed and will continue to contribute to the scientific enterprise.
- Nature of Scientific Knowledge
  - Scientific explanations must meet certain criteria.
  - All scientific knowledge is, in principle, subject to change as new evidence becomes available.

# #3 - Hybrid-Electric Vehicles

**ITEA 9–12** Students develop the ability to assess the impact of products and systems.

- Students learn to collect information and evaluate its quality
- Students learn to synthesize data, analyze trends, and draw conclusions regarding the effect of technology on the individual, society, and the environment.

Students develop an understanding of and be able to select and use energy and power technologies

- Students learn that energy cannot be created or destroyed; however, it can be converted from one form to another
- Students learn that energy can be grouped into major forms: thermal, electrical, mechanical, chemical, nuclear, and others
- Students learn that energy resources can be renewable or nonrenewable

**NCTM 9–12** Number and Operations Standard:

- Compute fluently and make reasonable estimates
- Judge the reasonableness of numerical computations and their results

Algebra Standard:

- Represent and analyze mathematical situations and structures using algebraic symbols
- Use symbolic algebra to represent and explain mathematical relationships
- Judge the meaning, utility, and reasonableness of the results of symbol manipulations, including those carried out by technology

Problem Solving Standard:

- Solve problems that arise in mathematics and in other contexts

Communication Standard:

- Organize and consolidate their mathematical thinking through communication
- Communicate their mathematical thinking coherently and clearly to peers, teachers, and others
- Analyze and evaluate the mathematical thinking and strategies of others
- Use the language of mathematics to express mathematical ideas precisely

Connections Standard:

- Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
- Recognize and apply mathematics in contexts outside of mathematics

# #4 - Longwall Coal Mining

## NSES 9–12

As a result of completing this problem in grades 9-12, all students should be introduced to or expand their knowledge regarding:

### Science as Inquiry - Content Standard A:

- Abilities necessary to do scientific inquiry
  - Use technology and mathematics to improve investigations and communications.
  - Formulate and revise scientific explanations and models using logic and evidence.
  - Recognize and analyze alternative explanations and models.
  - Communicate and defend a scientific argument.
- Understandings about scientific inquiry
  - Scientists conduct investigations for a variety of reasons.
  - Scientists rely on technology to enhance the gathering and manipulation of data.
  - Mathematics is essential in scientific inquiry.
  - Scientific explanations must adhere to criteria.
  - Results of scientific inquiry emerge from different types of investigations and public communication among scientists.

### Physical Science - Content Standard B:

- Motions and forces
  - Objects change their motion only when a net force is applied.

### Science and Technology – Content Standard E:

- Understandings about science and technology
  - Creativity, imagination and a good knowledge base are all required in the work of science and engineering.

### History and Nature of Science – Content Standard G:

- Science as a Human Endeavor
  - Individuals and teams have contributed and will continue to contribute to the scientific enterprise.
- Nature of Scientific Knowledge
  - Science distinguishes itself from other ways of knowing and from other bodies of knowledge through the use of empirical standards, logical arguments and skepticism, as scientists strive for the best possible explanations about the natural world.
  - Scientific explanations must meet certain criteria.
  - All scientific knowledge is, in principle, subject to change as new evidence becomes available.

# #4 - Longwall Coal Mining

## NCTM 9–12 Number and Operations Standard:

- Compute fluently and make reasonable estimates
- Judge the reasonableness of numerical computations and their results

## Algebra Standard:

- Represent and analyze mathematical situations and structures using algebraic symbols
- Use symbolic algebra to represent and explain mathematical relationships
- Judge the meaning, utility, and reasonableness of the results of symbol manipulations, including those carried out by technology

## Problem Solving Standard:

- Solve problems that arise in mathematics and in other contexts

## Communication Standard:

- Organize and consolidate their mathematical thinking through communication
- Communicate their mathematical thinking coherently and clearly to peers, teachers, and others
- Analyze and evaluate the mathematical thinking and strategies of others
- Use the language of mathematics to express mathematical ideas precisely

## Connections Standard:

- Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
- Recognize and apply mathematics in contexts outside of mathematics

# #5 - Paper Making Process

## NSES 9–12

As a result of completing this problem in grades 9-12, all students should be introduced to or expand their knowledge regarding:

### Science as Inquiry - Content Standard A:

- Abilities necessary to do scientific inquiry
  - Use technology and mathematics to improve investigations and communications.
  - Formulate and revise scientific explanations and models using logic and evidence.
  - Recognize and analyze alternative explanations and models.
  - Communicate and defend a scientific argument.
- Understandings about scientific inquiry
  - Scientists conduct investigations for a variety of reasons.
  - Scientists rely on technology to enhance the gathering and manipulation of data.
  - Mathematics is essential in scientific inquiry.
  - Scientific explanations must adhere to criteria.
  - Results of scientific inquiry emerge from different types of investigations and public communication among scientists.

### Physical Science - Content Standard B:

- Chemical Reactions
  - Chemical reactions may release or consume energy.

### Science and Technology – Content Standard E:

- Understandings about science and technology
  - Creativity, imagination and a good knowledge base are all required in the work of science and engineering.

### History and Nature of Science – Content Standard G:

- Science as a Human Endeavor
  - Individuals and teams have contributed and will continue to contribute to the scientific enterprise.
- Nature of Scientific Knowledge
  - All scientific knowledge is, in principle, subject to change as new evidence becomes available.

# #5 - Paper Making Process

- ITEA 9–12** Students develop the ability to assess the impact of products and systems.
- Students learn to collect information and evaluate its quality.

Students develop an understanding of and be able to select and use energy and power technologies

- Students learn that energy cannot be created or destroyed; however, it can be converted from one form to another
- Students learn that energy can be grouped into major forms: thermal, electrical, mechanical, chemical, nuclear, and others

**NCTM 9–12** Number and Operations Standard:

- Compute fluently and make reasonable estimates
- Judge the reasonableness of numerical computations and their results

Algebra Standard:

- Represent and analyze mathematical situations and structures using algebraic symbols
- Use symbolic algebra to represent and explain mathematical relationships
- Judge the meaning, utility, and reasonableness of the results of symbol manipulations, including those carried out by technology

Problem Solving Standard:

- Solve problems that arise in mathematics and in other contexts

Communication Standard:

- Organize and consolidate their mathematical thinking through communication
- Communicate their mathematical thinking coherently and clearly to peers, teachers, and others
- Analyze and evaluate the mathematical thinking and strategies of others
- Use the language of mathematics to express mathematical ideas precisely

Connections Standard:

- Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
- Recognize and apply mathematics in contexts outside of mathematics

# #6 - Manufacture of Insulin

## NSES 9–12

As a result of completing this problem in grades 9-12, all students should be introduced to or expand their knowledge regarding:

### Science as Inquiry - Content Standard A:

- Abilities necessary to do scientific inquiry
  - Use technology and mathematics to improve investigations and communications.
  - Formulate and revise scientific explanations and models using logic and evidence.
  - Recognize and analyze alternative explanations and models.
  - Communicate and defend a scientific argument.
- Understandings about scientific inquiry
  - Scientists conduct investigations for a variety of reasons.
  - Scientists rely on technology to enhance the gathering and manipulation of data.
  - Mathematics is essential in scientific inquiry.
  - Scientific explanations must adhere to criteria.
  - Results of scientific inquiry emerge from different types of investigations and public communication among scientists.

### Physical Science - Content Standard B:

- Chemical Reactions
  - Chemical reactions may release or consume energy.
- Conservation of energy and the increase in disorder
  - The total energy in the universe is constant.
  - Heat consists of random motion and the vibrations of atoms, molecules and ions.
  - Everything tends to become less organized and less orderly over time.

### Science and Technology – Content Standard E:

- Abilities of technological design
  - Communicate the problem, process and solution.

### History and Nature of Science – Content Standard G:

- Science as a Human Endeavor
  - Individuals and teams have contributed and will continue to contribute to the scientific enterprise.
- Nature of Scientific Knowledge
  - Scientific explanations must meet certain criteria.
  - All scientific knowledge is, in principle, subject to change as new evidence becomes available.

# #6 - Manufacture of Insulin

**ITEA 9–12** Students develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

- Students learn that technological innovation often results when ideas, knowledge, or skills are shared within a technology, among technologies, or across other fields
- Students learn that technological progress promotes the advancement of science and mathematics

**NCTM 9–12** **Number and Operations Standard:**

- Compute fluently and make reasonable estimates
- Judge the reasonableness of numerical computations and their results

**Algebra Standard:**

- Represent and analyze mathematical situations and structures using algebraic symbols
- Use symbolic algebra to represent and explain mathematical relationships
- Judge the meaning, utility, and reasonableness of the results of symbol manipulations, including those carried out by technology

**Problem Solving Standard:**

- Solve problems that arise in mathematics and in other contexts

**Communication Standard:**

- Organize and consolidate their mathematical thinking through communication
- Communicate their mathematical thinking coherently and clearly to peers, teachers, and others
- Analyze and evaluate the mathematical thinking and strategies of others
- Use the language of mathematics to express mathematical ideas precisely

**Connections Standard:**

- Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
- Recognize and apply mathematics in contexts outside of mathematics

# #7 - Characterizing the Impact of Hurricanes

**NSES 9–12**

As a result of completing this problem in grades 9-12, all students should be introduced to or expand their knowledge regarding:

## Science as Inquiry - Content Standard A:

- Abilities necessary to do scientific inquiry
  - Use technology and mathematics to improve investigations and communications.
  - Formulate and revise scientific explanations and models using logic and evidence.
  - Recognize and analyze alternative explanations and models.
  - Communicate and defend a scientific argument.
- Understandings about scientific inquiry
  - Scientists conduct investigations for a variety of reasons.
  - Scientists rely on technology to enhance the gathering and manipulation of data.
  - Mathematics is essential in scientific inquiry.
  - Scientific explanations must adhere to criteria.
  - Results of scientific inquiry emerge from different types of investigations and public communication among scientists.

## Physical Science - Content Standard B:

- Motions and forces
  - Objects change their motion only when a net force is applied.
  - Gravitation is a universal force that each mass exerts on any other mass.
- Conservation of energy and the increase in disorder
  - The total energy in the universe is constant.
  - All energy can be considered to be either kinetic or potential energy.
  - Everything tends to become less organized and less orderly over time.
- Interactions of Energy and Matter
  - Waves, including sound and seismic waves, waves on water, and light waves, have energy and can transfer energy when they interact with matter.

## Earth and Space Science – Content Standard D:

- Energy in the earth system
  - Heating of the earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents.

## Science and Technology – Content Standard E:

- Abilities of technological design
  - Identify a problem or design an opportunity.
  - Propose designs and choose between alternative solutions.
  - Evaluate the solution and its consequences.
  - Communicate the problem, process and solution.
- Understandings about science and technology
  - Creativity, imagination and a good knowledge base are all required in the work of science and engineering.

## Science in Personal and Social Perspectives – Content Standard F:

- Natural and human induced hazards
  - Some hazards, such as earthquakes, volcanic eruptions, and severe weather, are rapid and spectacular.
  - Natural and human induced hazards present the needs for humans to assess potential danger and risk.

# #7 - Characterizing the Impact of Hurricanes

## NSES 9–12 History and Nature of Science – Content Standard G:

- Science as a Human Endeavor
  - Individuals and teams have contributed and will continue to contribute to the scientific enterprise
- Nature of Scientific Knowledge
  - Science distinguishes itself from other ways of knowing and from other bodies of knowledge through the use of empirical standards, logical arguments and skepticism, as scientists strive for the best possible explanations about the natural world
  - Scientific explanations must meet certain criteria
  - All scientific knowledge is, in principle, subject to change as new evidence becomes available

## ITEA 9–12 Students develop the ability to assess the impact of products and systems.

- Students learn to collect information and evaluate its quality
- Students learn to synthesize data, analyze trends, and draw conclusions regarding the effect of technology on the individual, society, and the environment

## Students develop an understanding of and be able to select and use construction technologies

- Students learn the design of structures includes a number of requirements

## NCTM 9–12 Number and Operations Standard:

- Compute fluently and make reasonable estimates
- Judge the reasonableness of numerical computations and their results

## Algebra Standard:

- Represent and analyze mathematical situations and structures using algebraic symbols
- Use symbolic algebra to represent and explain mathematical relationships
- Judge the meaning, utility, and reasonableness of the results of symbol manipulations, including those carried out by technology

## Problem Solving Standard:

- Solve problems that arise in mathematics and in other contexts

## Communication Standard:

- Organize and consolidate their mathematical thinking through communication
- Communicate their mathematical thinking coherently and clearly to peers, teachers, and others
- Analyze and evaluate the mathematical thinking and strategies of others
- Use the language of mathematics to express mathematical ideas precisely

## Connections Standard:

- Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
- Recognize and apply mathematics in contexts outside of mathematics

# #8 - Nuclear Engineering

## NSES 9–12

As a result of completing this problem in grades 9-12, all students should be introduced to or expand their knowledge regarding:

### Science as Inquiry - Content Standard A:

- Abilities necessary to do scientific inquiry
  - Use technology and mathematics to improve investigations and communications.
  - Formulate and revise scientific explanations and models using logic and evidence.
  - Recognize and analyze alternative explanations and models.
  - Communicate and defend a scientific argument.
- Understandings about scientific inquiry
  - Scientists conduct investigations for a variety of reasons.
  - Scientists rely on technology to enhance the gathering and manipulation of data.
  - Mathematics is essential in scientific inquiry.
  - Scientific explanations must adhere to criteria.
  - Results of scientific inquiry emerge from different types of investigations and public communication among scientists.

### Physical Science - Content Standard B:

- Structure of Atoms
  - Matter is made of minute particles called atoms, and atoms are composed of even smaller components.
  - The atom's nucleus is composed of protons and neutrons, which are much more massive than electrons.
  - Radioactive isotopes are unstable and undergo spontaneous nuclear reactions, emitting particles and/or wavelike radiation.
- Motions and forces
  - Objects change their motion only when a net force is applied.
- Conservation of energy and the increase in disorder
  - The total energy in the universe is constant.
  - All energy can be considered to be either kinetic or potential energy.
  - Everything tends to become less organized and less orderly over time.
- Interactions of Energy and Matter
  - Waves, including sound and seismic waves, waves on water, and light waves, have energy and can transfer energy when they interact with matter.
  - Electromagnetic waves result when a charged object is accelerated or decelerated.

### Science and Technology – Content Standard E:

- Abilities of technological design
  - Communicate the problem, process and solution.
- Understandings about science and technology
  - Creativity, imagination and a good knowledge base are all required in the work of science and engineering.

### History and Nature of Science – Content Standard G:

- Science as a Human Endeavor
  - Individuals and teams have contributed and will continue to contribute to the scientific enterprise.
- Nature of Scientific Knowledge
  - Science distinguishes itself from other ways of knowing and from other bodies of knowledge through the use of empirical standards, logical arguments and skepticism, as scientists strive for the best possible explanations about the natural world.
  - Scientific explanations must meet certain criteria.
  - All scientific knowledge is, in principle, subject to change as new evidence becomes available.

# #8 - Nuclear Engineering

**ITEA 9–12** Students develop the ability to assess the impact of products and systems.

- Students learn to collect information and evaluate its quality
- Students learn to synthesize data, analyze trends, and draw conclusions regarding the effect of technology on the individual, society, and the environment

Students develop an understanding of and be able to select and use energy and power technologies

- Students learn that energy cannot be created or destroyed; however, it can be converted from one form to another
- Students learn that energy can be grouped into major forms: thermal, electrical, mechanical, chemical, nuclear, and others
- Students learn that energy resources can be renewable or nonrenewable

**NCTM 9–12** Number and Operations Standard:

- Compute fluently and make reasonable estimates
- Judge the reasonableness of numerical computations and their results

Algebra Standard:

- Represent and analyze mathematical situations and structures using algebraic symbols
- Use symbolic algebra to represent and explain mathematical relationships
- Judge the meaning, utility, and reasonableness of the results of symbol manipulations, including those carried out by technology

Problem Solving Standard:

- Solve problems that arise in mathematics and in other contexts

Communication Standard:

- Organize and consolidate their mathematical thinking through communication
- Communicate their mathematical thinking coherently and clearly to peers, teachers, and others
- Analyze and evaluate the mathematical thinking and strategies of others
- Use the language of mathematics to express mathematical ideas precisely

Connections Standard:

- Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
- Recognize and apply mathematics in contexts outside of mathematics

# JETS - TEAMS 2007 - Standards Alignment

## National Science Education Standards

		Science as Inquiry Content Standard A	Physical Science Content Standard B	Life Science Content Standard C	Earth and Space Science Content Standard D	Science and Technology Content Standard E	Science in Personal and Social Perspectives Content Standard F	History and Nature of Science Content Standard G
1	Air Transportation	x	x			x		x
2	Roadway Sign Design	x	x			x		x
3	Hybrid-Electric Vehicles	x	x			x		x
4	Longwall Coal Mining	x	x			x		x
5	Paper Making Process	x	x			x		x
6	Manufacture of Insulin	x	x			x		x
7	Characterizing the Impact of Hurricanes	x	x		x	x	x	x
8	Nuclear Engineering	x	x			x		x

