PRINCIPLES OF ENGINEERING/ TECHNOLOGY

PURPOSE
To evaluate each contestant's understanding of basic technical concepts/principles of the applied sciences and their ability to demonstrate and explain the concept/principle in action and application.

First, download and review the General Regulations at: http://updates.skillsusa.org.

ELIGIBILITY
The contest is open to all active SkillsUSA members either presently enrolled in or having completed the Project Lead the Way principles of engineering course, the principles of technology physics course or an equivalent applied physics course in career and technical education. Contestants may enter from any course of study skill area.

CLOTHING REQUIREMENT
Class A: SkillsUSA Attire:
- Red SkillsUSA blazer, windbreaker or sweater, or black or red SkillsUSA jacket.
- Button-up, collared, white dress shirt (accompanied by a plain, solid black tie), white blouse (collarless or small-collared) or white turtleneck, with any collar not to extend into the lapel area or the blazer, sweater, windbreaker or jacket.
- Black dress slacks (accompanied by black dress socks or black or skin-tone seamless hose) or black dress skirt (knee-length, accompanied by black or skin-tone seamless hose).
- Black dress shoes.

These regulations refer to clothing items that are pictured and described at: www.skillsusastore.org. If you have questions about clothing or other logo items, call 1-888-501-2183.

Note: Contestants must wear their official contest clothing to the contest orientation meeting.

EQUIPMENT AND MATERIALS
1. Supplied by the technical committee:
   a. Timekeeper
   b. 8'x12' space, a 30"x72" table and one 110-volt (15 amp) electrical outlet
2. Supplied by the contestant:
   a. Contestants are required to bring five copies of the discussion paper to the contestant orientation meeting
   b. All materials and equipment required for the demonstration
   c. If electricity is required, contestant must have a 20-foot heavy-duty extension cord
   d. All competitors must create a one-page résumé and submit a hard copy to the technical committee chair at orientation. Failure to do so will result in a 10-point penalty.

   Note: Your contest may also require a hard copy of your résumé as part of the actual contest. Check the Contest Guidelines and/or the updates page on the SkillsUSA website at http://updates.skillsusa.org.

SCOPE OF THE CONTEST
Knowledge Performance
There is no written knowledge test for this contest. Instead, a paper will be prepared and presented in this contest.

Skill Performance
The second portion of the contest is a technical demonstration where the knowledge, underlying theories, and applications of the chosen principle(s) in action and application will be demonstrated.

Contest Guidelines
1. Present a technical demonstration of (a) chosen principle(s) of technology. Demonstrate the principle(s) in theory and/or application and leave the judges with a clear comprehension of the subject unit or sub-unit from principles of technology.

2. Answer questions and discuss the application of the principle(s) with the judges.
3. Any technical concept may be demonstrated, provided it is related to physics, can be referenced to the course curriculum, and incorporates basic principles of applied physics. If any hazardous or caustic materials are used, contestants must bring the associated Material Safety Data Sheet(s) (MSDS) to the contestant meeting and present five copies along with the five copies of the discussion paper for committee review.
4. The recitation of curriculum experiments is not, in and unto itself, sufficient to meet the requirements of the contest. Thorough research and in-depth treatment of the subject matter will be required to comply with the requirements of the contest and to be competitive. Imagination and innovation will be expected by the judges.
5. Any visual aids (signs, charts, transparencies, slides, diagrams) are to be prepared by the contestants. Professionally prepared visual materials are not permitted. No sound device of any kind may be used to transmit or amplify audible words unless they are integral to the technical demonstration itself. No compressed air, gas or flammable liquid may be used.
6. The contestant will use his or her contestant number only and will not mention his or her school, city or state.
7. The Principles of Engineering contest is an individual performance event. However, others can assist to set up and/or tear down the demonstration. Only students can be used as models or props in the demonstration.
8. Discussion paper — The contestant will prepare and present to the contest chair five copies of a discussion paper in accordance with the following requirements.
    a. The discussion paper shall include subjects (such as background, history, development, explanation of the theory, applications, examples, methods of demonstration or benefits) to be addressed to the extent appropriate to present a clear explanation and demonstrate the contestant's understanding of the subject.
    b. The discussion paper must be typed, one-and-a-half- or double-spaced in 10- or 12-point type, must have 1-inch margins on all sides and must be four to eight pages long. Each page (except the cover) is to have a one-up page number at the bottom of the page. *The cover page will not be counted in the page count; however, all tables, graphs, pictures and illustrations will be counted.*

       A cover page is required and must include the following: "(current year) Principles of Engineering Contest," and title of the technical demonstration and blanks for date, time and contestant number in the upper right-hand corner. The contestant number shall be placed in the upper right-hand corner of each page before handing in the paper.
    c. The discussion paper shall conform to the following format:
        1. Title — short, descriptive title for the technical demonstration, centered near the top of the page.
        2. Introduction — a descriptive introduction to the technical demonstration principle(s) involved, objectives of the demonstration and reason(s) for the choice.
        3. Discussion — as a minimum, include a detailed discussion of the following subject areas:
            a. The history and background of the principle(s) involved
            b. A description of the principle(s) involved and an explanation of the scientific theories embodied in the principle(s)
            c. The technical demonstration to be given: how it will be conducted, what will be shown and how it relates to the subject matter
            d. Practical applications of the principle (or principles) involved, including past, present and/or future
            e. Provide examples of demonstrations of the

principle(s) that are possible or in existence, but are not practical for the contest

f. Cite the particular unit and/or sub-unit in Principles of Technology curriculum that is the basis for this technical demonstration

4. Summary — present a concluding discussion of the principle(s) to be demonstrated, what the demonstration will have achieved, relevance to the practical world and any concluding remarks or conclusions.

d. A bibliography shall be included with the discussion paper to properly credit reference sources. Footnotes are required in the text to credit specific references. All bibliography and footnote information shall be included at the end of the paper. Formatting is at the discretion of the contestant; however, complete credit and reference data is mandatory. Page numbers such as "B1" will be used for the bibliography and footnote section but will not be included in the page count.

9. Technical demonstration — The contestant shall prepare and present a technical demonstration to a panel of judges in accordance with the following requirements. The purpose of the technical demonstration is for the contestants to demonstrate thorough knowledge and awareness of the history, underlying theories, descriptive knowledge and applications of the chosen principle(s) in action and application. The contestants shall be prepared to present their demonstrations three times. Exhibition of the contestants' demonstrations to the general public will be required, but not scored.
10. Contestants will be allowed five minutes to set up the demonstration and five minutes to clear the demonstration room. Penalty: Five points will be deducted for each 30 seconds or fraction thereof over the five-minute setup or clearing times.

    Each presentation of the technical demonstration to the judges shall be at least 10 minutes in length and shall not exceed 15 minutes in length. Penalty: Five points will be deducted for each 30 seconds or fraction thereof under 10 minutes or over 15 minutes in length. The timekeeper will indicate elapsed time of the demonstration at the 10-, 13- and 15-minute points.

    Setup time will begin when the contestant indicates readiness to set up by handing to the lead judge a 3"x5" card containing the title of the technical demonstration and the contestant number. The demonstration time will begin when the contestant indicates readiness and will stop when the contestant indicates that the technical demonstration has ended. The tear-down time will be timed from the end of the question and answer period until the contestant indicates completion to the lead judge.
11. A question and answer period will be allowed at the conclusion of each demonstration to permit the contest judges to query the contestants and further evaluate the contestants' understanding of the demonstrated principle. Questions by the judges may cover any aspect of a contestant's chosen principle(s) as presented in the discussion paper or technical demonstration. **This question and answer period is not to exceed 10 minutes in length.**

Standards and Competencies

PT 1.0 — Integrate knowledge of basic physics principles into technical writing and presentations following the guidelines the contest technical committee has established

1.1 Apply physics knowledge in the areas of force, work, rate, resistance, energy, power, force transformers, momentum, waves and vibrations, energy converters, transducers, radiation, optical systems and time constraints

PT 2.0 — Construct a discussion paper focusing on the technical principle(s) selected for the contest that meets both the contest guidelines of the technical committee and the formatting guidelines established by the Modern Language Association (MLA)

2.1 Write the discussion paper to follow the formatting and grammar standards established by the MLA

2.2 Construct the content of the discussion paper to match the contest guidelines established by the contest's technical committee

- 2.2.1 Write a short, descriptive title for the technical paper and center near the top of the page
- 2.2.2 Write a descriptive introduction to the technical demonstration that includes the principle(s) involved, the objectives of the demonstration and the reason(s) for the choice
- 2.2.3 Describe in detail the history and background of the principle(s)
- 2.2.4 Describe in detail the principle(s) involved and an explanation of the scientific theories embodied in the principle(s)
- 2.2.5 Explain thoroughly how the technical presentation will be given, how it will be conducted, what will be demonstrated and how it relates to the subject matter
- 2.2.6 Relate the practical application of the principle(s) involved, including past, present, and/or future applications of the principle(s)
- 2.2.7 Provide examples of the principle(s) that are possible or in existence, but are not practical for the contest
- 2.2.8 Cite the particular unit and/or sub-unit in Principles of Technology curriculum that is the basis for the discussion paper and presentation

2.3 Create a concluding discussion of the principle(s) to be demonstrated

- 2.3.1 Explain what the demonstration will have achieved
- 2.3.2 Identify what the relevance of the demonstration is to the practical world
- 2.3.3 Articulate any concluding remarks or conclusions

2.4 Include technical data in the discussion paper

2.5 Use equations and mathematical analysis to support findings

PT 3.0 — Effectively create and deliver a technical presentation that exhibits the knowledge and skills developed through the Principles of Technology learning curriculum that focuses on the principle(s)

3.1 Make a formal and effective introduction to the speech

3.2 Demonstrate an effective and pleasing delivery style

3.3 Communicate the primary points of the presentation in a compact and complete manner

3.4 Effectively use verbal illustrations and examples to explain technical information

3.5 Use a variety of verbal techniques including modulation of voice, changing volume, varied inflection, modifying tempo and verbal enthusiasm

3.6 Demonstrate poise and self-control while presenting

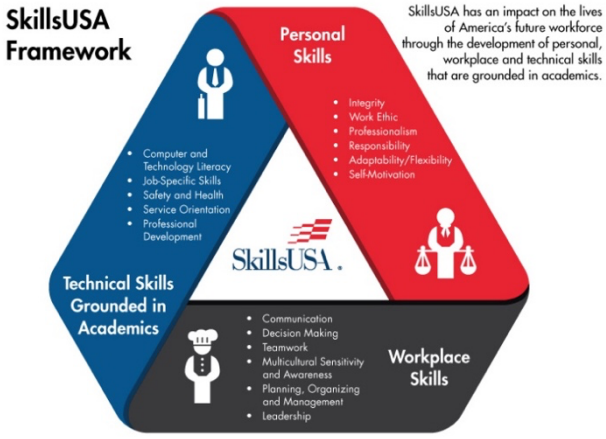
3.7 Demonstrate good platform development and personal confidence

3.8 Tie organizational elements together with an effective ending

3.9 Complete the speech within the time limits set by contest requirements

3.10 Respond to questions from judges following the presentation

PT 4.0 — SkillsUSA Framework



The SkillsUSA Framework is used to pinpoint the Essential Elements found in Personal Skills, Workplace Skills, and Technical Skills Grounded in Academics. Students will be expected to display or explain how they used some of these Essential Elements. Please reference the graphic above, as you may be scored on specific elements applied to your project. For more, visit: www.skillsusa.org/about/skillsusa-framework/.

Committee Identified Academic Skills

The technical committee has identified that the following academic skills are embedded in this contest.

Math Skills

- Use fractions to solve practical problems.
- Use proportions and ratios to solve practical problems.
- Simplify numerical expressions.
- Use scientific notation.
- Solve practical problems involving percentages.
- Solve single variable algebraic expressions.
- Solve multiple variable algebraic expressions.
- Measure angles.
- Find surface area and perimeter of two-dimensional objects.
- Find volume and surface area of three-dimensional objects.
- Apply transformations (rotate or turn, reflect or flip, translate or slide, and dilate or scale) to geometric figures.
- Construct three-dimensional models.
- Apply Pythagorean Theorem.
- Make predictions using knowledge of probability.
- Make comparisons, predictions and inferences using graphs and charts.
- Organize and describe data using matrices.
- Graph linear equations.
- Solve problems using proportions, formulas and functions.
- Find slope of a line.
- Use laws of exponents to perform operations.
- Solve quadratic equations.
- Solve practical problems involving complementary, supplementary and congruent angles.
- Solve problems involving symmetry and transformation.
- Use measures of interior and exterior angles of polygons to solve problems.
- Find arc length and the area of a sector.

Science Skills

- Plan and conduct a scientific investigation.
- Use knowledge of the particle theory of matter.
- Describe and recognize elements, compounds, mixtures, acids, bases and salts.
- Describe and recognize solids, liquids and gases.
- Describe characteristics of types of matter based on physical and chemical properties.
- Use knowledge of physical properties (shape, density, solubility, odor, melting point, boiling point, color).
- Describe and use the Periodic Table — symbols, atomic number, atomic mass, chemical families (groups), and periods.
- Use knowledge of classification of elements as metals, metalloids and nonmetals.
- Use knowledge of potential and kinetic energy.
- Use knowledge of mechanical, chemical and electrical energy.
- Use knowledge of heat, light and sound energy.
- Use knowledge of temperature scales, heat and heat transfer.
- Use knowledge of sound and technological applications of sound waves.

- Use knowledge of the nature and technological applications of light.
- Use knowledge of speed, velocity and acceleration.
- Use knowledge of Newton's laws of motion.
- Use knowledge of work, force, mechanical advantage, efficiency and power.
- Use knowledge of simple machines, compound machines, powered vehicles, rockets and restraining devices.
- Use knowledge of principles of electricity and magnetism.
- Use knowledge of static electricity, current electricity and circuits.
- Use knowledge of magnetic fields and electromagnets.
- Use knowledge of motors and generators.

Language Arts Skills

- Provide information in conversations and in group discussions.
- Provide information in oral presentations.
- Demonstrate use of verbal communication skills: word choice, pitch, feeling, tone and voice.
- Demonstrate use of nonverbal communication skills: eye contact, posture and gestures using interviewing techniques to gain information.
- Organize and synthesize information for use in written and oral presentations.
- Demonstrate knowledge of appropriate reference materials.
- Demonstrate narrative writing.
- Demonstrate informational writing.

Connections to National Standards

State-level academic curriculum specialists identified the following connections to national academic standards.

Math Standards

- Numbers and operations.
- Algebra.
- Geometry.
- Measurement.
- Data analysis and probability.
- Problem-solving.
- Reasoning and proof.
- Communication.
- Connections.
- Representation.

Source: NCTM Principles and Standards for School Mathematics. For more information, visit: http://www.nctm.org.

Science Standards

- Understands the structure and properties of matter.
- Understands the sources and properties of energy.
- Understands forces and motion.
- Understands the nature of scientific knowledge.
- Understands the nature of scientific inquiry.
- Understands the scientific enterprise.

Source: McREL Compendium of National Science Standards. To view and search the compendium, visit: http://www2.mcrel.org/compendium/browse.asp.

Language Arts Standards

- Students read a wide range of print and nonprint texts to build an understanding of texts, of themselves and of the cultures of the United States and the world; to acquire new information; to respond to the needs and demands of society and the workplace; and for personal fulfillment. Among these texts are fiction, nonfiction, classic and contemporary works.
- Students apply a wide range of strategies to comprehend, interpret, evaluate and appreciate texts. They draw on their prior experience, their interactions with other readers and writers, their knowledge of word meaning and of other texts, their word identification strategies and their understanding of textual features (e.g., sound-letter correspondence, sentence structure, context, and graphics).
- Students adjust their use of spoken, written and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.
- Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes.
- Students apply knowledge of language structure, language conventions (e.g., spelling and punctuation), media

techniques, figurative language and genre to create, critique, and discuss print and nonprint texts.
- Students conduct research on issues and interests by generating ideas and questions and by posing problems. They gather, evaluate and synthesize data from a variety of sources (e.g., print and nonprint texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience.
- Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.
- Students use spoken, written and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

Source: IRA/NCTE Standards for the English Language Arts. To view the standards, visit: www.ncte.org/standards.