LEVEL UP 2026 - 2027

NYS SkillsUSA

ADDITIVE MANUFACTURING

PURPOSE

To evaluate each team's preparation for employment and to recognize outstanding students for excellence and professionalism in the field of Digital Design and Additive Manufacturing (AMF).

ELIGIBILITY (TEAM OF TWO)

Open to a team of two (2) active NY SkillsUSA members from the same local chapter (school) enrolled in computer-aided design (CAD) classes, design classes, manufacturing, etc. Each school may send one high school team. A full team of 2 must be registered

CLOTHING REQUIREMENT

Class E: Competition Specific — Business Casual

- Official NY SkillsUSA white polo shirt or white polo.
- Black dress slacks or black dress skirt (knee-length minimum) Black closed-toe dress shoes.
- Note: Wearing socks or hose is no longer required. If worn, socks must be black dress socks, and hose must be either black or skin-tone and seamless/nonpattern.

Note: Competitors must wear their official competition clothing to the competition orientation.

EQUIPMENT AND MATERIALS

1. Supplied by school or BOCES site:
   a. 3D printers and post processing equipment (if needed)
   b. Post processing tools
2. Supplied by the competitor:
   a. Personal computer system (laptop preferred) with a computer design system capable of rendering files in STL format. Competitors should ensure that software licensing will work without an internet connection in the competition space outside of the competitor's school's location and outside of the competitor's school's normal calendar year. All competitors must bring their own computer. Stratasys, SME, Allegheny Educational Systems and SkillsUSA NY are not responsible for computers, or any property left overnight in the competition space.
   b. CAD Design program or program(s) of choice these can include but are not limited to: SOLIDWORKS, Autodesk Fusion, Inventor, Onshape, TinkerCAD. Competency or familiarity in more than one program is not required but is highly encouraged to maximize success.
   c. GrabCAD Print software (free version) downloaded to computer for competitors to use at competition. Software available for download at this link https://grabcad.com/print. This software will be used during the competition. Competitors should download and familiarize themselves with this software before competition.
   d. Empty USB Drive for transferring competition files (including .print, .txt, STL files). The USB Drive must be clearly labeled with team identification (number and letter). The team's competitor number must be on the outside of the USB drive, securely attached and clearly visible.
   e. Calipers
   f. Needle nose pliers
   g. Pencil or pen
   h. Sandpaper
   i. Two 6' multiple-outlet surge protectors
   j. All competitors must create and submit online a one-page single sided resume.

PROHIBITED DEVICES

Cellphones, electronic watches and/or other electronic devices not approved by a competition's state technical committee are ***NOT*** allowed to be visible in the competition area. They may be powered off and store away in a competitor's bag. Please follow the guidelines in each technical standard for approved exceptions. Technical committee members may also approve exceptions onsite during the NY SkillsUSA Championships if deemed appropriate.

Penalties for Prohibited Devices

If a competitor's electronic device makes noise or if the competitor is seen using it at any time during the competition, an official report will be documented for review by the Director of the NY SkillsUSAChampionships. If confirmed that the competitor used the device in a manner which compromised the integrity of the competition, the competitor's scores may be removed.

SUBMISSION REQUIREMENTS

All NY SkillsUSA competitors must submit their one-page single sided resume at orientation as dictated by NY SkillsUSA.
Failure to submit any of the required document(s) listed below by the established deadline will result in a 10-point penalty.

1. one-page single sided resume

SCOPE OF THE COMPETITION

KNOWLEDGE PERFORMANCE

All competitors are required to take a SkillsUSA Professional Development Test. Competitors will have up to 60 minutes to complete the exam. Competitors will need to score 70% or higher to pass the exam.

Additionally, the competitors are required to bring their own laptop for the Additive Manufacturing exam portion of the competition.

The exam taken during the NY SkillsUSA Additive Manufacturing Competition will be using select free and open-source resources from the SME and Stratasys that are also used at nationals please reference the following body of knowledge:

3D Printing Glossary: https://www.padtinc.com/digital-manufacturing/3dprinting-glossary/one-page/

Support Center: https://support.stratasys.com/en

Please visit the above links to prepare for the exam.

SKILL PERFORMANCE

1. Please bring the following to NY SkillsUSA and be ready to be evaluated on:
    a. An original designed and 3D printed object to be tested by the judges on-site at NY SkillsUSA (please see Guidelines below for the 2026 design problem prompt). This 3D design needs to demonstrate thoughtful design for additive manufacturing and solve a given problem under given constraints of size and print time.
    b. An engineering notebook – physical copy, hand written or printed and spiral bound or in a binder - documenting design process from ideation through competition day, please leave blank pages in notebook to add to it on-site.
    c. A presentation, in PowerPoint, Google Slides, Canva or other presentation tool of your choice – documenting design process, and print results (prior to competition). Onsite teams will add to presentation part performance and re-design results.
    d. A 1-page resume
    e. The competition will focus on real-world challenges of an individual and team and build on each team's understanding of:
    f. Physical, functional, and performance characteristics or specifications that uniquely identify a component or device and determine its interchangeability in a system
    g. DfAM – Design for Additive Manufacturing

COMPETITION GUIDELINES

The 2026 State Challenge will be a entitled – Send It - " The Mini-Figure Catapult/Trebuchet Challenge."

The Additive Manufacturing (AM) contest evaluates competitors' ability to design, prototype, validate, and communicate a functional mechanical device using **only 3D-printed components**.
Competitors must design a **catapult or trebuchet** capable of **launching a standard LEGO® minifigure** using **no added materials**, relying exclusively on the **properties of 3D-printed plastics**

Competitors create a **fully additively manufactured launcher**—catapult or trebuchet—where all energy storage and mechanical action originate from **3D-printed geometry alone**, including:

- Printed torsion beams
- Printed elastic flexures
- Printed springs or spring arms
- Printed counterweights (printed material only)
- Printed tension/flexural systems

No external rubber bands, cords, metals, or weights may be used.

Design Requirements

Each team must design a launcher that:

1. **Launches a standard LEGO® minifigure** (supplied by contest judges).
2. Stores and releases energy **using only 3D-printed material behavior**:
    - Elastic bending
    - Torsional flexure
    - Printed leaf or coil springs
    - Beam deflection
    - Printed counterweight (printed plastic only)
    - No metal, rubber, glue, magnets, or external energy inputs.
3. Operates using **a catapult or trebuchet mechanism**:
    - Catapult: energy stored in flexural or torsional arms.
    - Trebuchet: energy stored in printed counterweight or pendulum motion.
4. Has a locking trigger mechanism
5. Is safe and stable during operation.
6. Requires no fasteners—**all connections must be printed or snap-fit**.
7. May be a **single print** or **multi-component assembly** (can use multiple 3D printed material):
    - **Bonus points** for functionally integrated, single-print solutions.

Size & Print Constraints

- Fully assembled launcher must fit inside: **150 × 150 × 150 mm**
- All components must be **100% 3D-printed**
- **Any** 3D printer technology may be used:
    - FDM, SLA, DLP, PolyJet, SLS, SAF, MJF, etc.
- **Any printable material** is allowed:
    - PLA, ABS, TPU, Nylon, resin, PA11/12, etc.
- If multiple materials are used, all still must be 100% AM-produced.

Performance Requirements

During testing, each launcher must:

1. Securely hold and release the minifigure.
2. Launch the figure forward, not upward only.
3. Complete **three launches**, which are measured for:
    - Distance
    - Repeatability (all three launches must land within a 6-inch diameter of first launch.
    - Safety and stability (No part interference, damage during operation, or unsafe trajectories)

4.1 1 Energy Storage Methods

(Allowed) Teams may use:

- Printed flexible beams (like bow limbs)
- Printed torsion rods
- Printed leaf springs
- Printed coil springs
- Printed counterweights (solid or hollow filled only with printed material)
- Printed whip-action arms

4.2 2 Energy Storage Methods (NOT Allowed)

- Rubber bands
- Metal or lead weights
- Ball bearings
- Strings or ropes
- Electronics
- External kinetic input beyond human-triggered release

4.3 Stability & Safety

- Broad base recommended
- Ensure center of mass remains within footprint
- Avoid high-tension prints that may crack explosively
- Ensure minifigure is not struck by structural components during firing

4.4 4 AM Material Behavior Tips

- FDM: stronger along filament path; avoid layer-splitting by orienting beams horizontally
- Resin: brittle; great for fine details but avoid ultra-high deflection
- SAF/SLS: excellent for small flexures; nylon is durable
- Multi-material: optimize stiffness vs elasticity

4.5 5 Recommended Geometries

- Arched, tapered arms for elastic bending
- Hollow counterweights (printed-only mass)
- Integrated bearings or bushing pockets
- Snap-fit axles and pivot joints
- Lattice structures for energy absorption

3. Teams will present and turn in their engineering notebooks to the judges. Notebooks should include all areas of the scoring rubric provided on the day of the competition, such as concept description, specifications, dimensional drawings, design tree (flow chart), considerations of design for 3D, finishing aspects that impact design, and mistakes/lessons learned.
4. Engineering notebook and competition designs, in printed form and 3D design software, will be presented to the judges. Teams may use any presentation software i.e., Google Slides, PowerPoint, etc. to create a digital presentation that shows screen shots of the design process to complement their engineering notebook. The digital presentation and engineering notebook will guide the conversation with judges. Competitors should be prepared to answer questions about designs and processes and add to this onsite.
5. Items on which competitors will be evaluated:
    a. Knowledge Exam
    b. Design Challenge
    c. Engineering Notebook
    d. Presentation

State Competition Procedure

During Contest

Part 1 – Day 1

1. Competitors check-in & receive orientation/schedule.
2. Competitors take knowledge exam.
3. Competitors submit:
    a. Engineering Notebook (Engineering notebook guidelines below)
    b. Physical parts
    c. On a thumb drive: CAD Files and STLs on a

Part 2 – Day 2

4. Designs are evaluated and results recorded. (Approx. 1 hour)
5. Redesign time is given. (90 minutes)
6. Presentation & notebook updates time is given. (30 minutes)
7. Teams present to judges.

State Competition Judging Criteria

1. The Engineering Notebook should contain robust content, including at a minimum the following:
    1.1. Be clearly labeled with contestant name(s), date and page # on each page.
    1.2. Begin with a problem statement.
    1.3. Include discovery and documentation of approach to solve problem.
    1.4. Include sketched design concepts with critical features labeled.
    1.5. Critical dimensions clearly labeled in design sketch.
    1.6. Considerations for designing for additive manufacturing distinctly addressed (i.e. part strength, part orientation) especially including any expected risks during

Grading Rubric

GR.1 Launch Performance — 35 pts

- Distance (best of 3 launches): 25 pts
    - Compare to peer competitors.
- Consistency: 5 pts (all 3 figures land within a 6-inch diameter)
- Safe trajectory & controlled release (no interference or damage to parts while operating): 5 pts

GR.2 DFAM Execution & Print Quality — 20 pts

- Efficient use of AM geometry
- Thoughtful layer orientation
- Integrated mechanisms (springs, hinges, etc.)
- Complexity that adds functional value
- Built in locking trigger
- Clean print
- Quick assembly
- Good tolerances

GR.3 Engineering Notebook — 15 pts

- Completeness
- Technical clarity
- Analysis & iteration
- CAD quality

GR.4 Presentation — 15 pts

GR.5 Knowledge Exam - 15 pts

- **Pass with 70% or better or Fail.**

STANDARDS AND COMPETENCIES

AMF 1.0 — Design sketch and plan machine work to U.S. National CAD Standards

1.1. Create CAD file for manufacturing using standard CAD terminology and standard practice

1.2. Initiate manufacturing documentation process
1.3. Export a CAD file to .stl format
1.4. Process engineering change orders

AMF 2.0 — Preform and inspect part(s) using a Total Quality Management process

2.1. Verify part(s) to provided standards
2.2. Verify part(s) to ECO standards
2.3. Document process of verification and inspection

AMF 3.0 — Demonstratesafety practicesinaworking situation totherelated dutytasks of the National Institute for Metalworking Skills (NIMS) Duties and Standards

3.1. Carry out assigned responsibilities while adhering to safe practices in accordance with OSHA requirements and guidelines
3.2. Document safety activities as required

AMF 4.0 — Provide an accurate quotation given an automated manufacturing technology simulated scenario

4.1. Solve various solutions to the process that is involved in quoting a job in a rapid prototyping environment

AMF 5.0 — 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. For more, visit: www.skillsusa.org/who-we-are/skillsusa-framework/.

COMMITTEE IDENTIFIED ACADEMIC SKILLS

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

Math Skills

- Numbers and operations
- Algebra
- Geometry
- Measurement
- Problem Solving
- Reasoning and proof
- Communication
- Connections
- Representation
- Use fractions to solve practical problems.
- Use proportions and ratios to solve practical problems.
- Simplify numerical expressions.
- Solve single variable algebraic expressions.
- Solve multiple variable algebraic expressions.
- Measure angles.

- Use scientific notation.
- Find surface area and perimeter of two-dimensional objects.
- Construct three-dimensional models.
- Apply Pythagorean Theorem.
- Make predictions using knowledge of probability.
- Solve problems using proportions, formulas and functions.
- Find slope of a line.
- Solve practical problems involving complementary, supplementary and congruent angles.
- Solve problems involving symmetry and transformation.

Science Skills

- Use knowledge of the particle theory of matter.
- 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).
- Use knowledge of classification of elements as metals, metalloids and nonmetals.
- Describe and identify physical changes to matter.
- Predict changes to matter (types of reactions, reactants, and products; and balanced equations).
- Use knowledge of potential and kinetic energy.
- 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.

Language Arts Skills

- Provide information in conversations and in group discussions.
- Demonstrate comprehension of a variety of informational texts.
- Use text structures to aid comprehension.
- Organize and synthesize information for use in written and oral presentations.
- Demonstrate knowledge of appropriate reference materials.
- Demonstrate use of such verbal communication skills as word choice, pitch, feeling, tone and voice.
- Demonstrate use of such nonverbal communication skills as eye contact, posture and gestures using interviewing techniques to gain information.
- Demonstrate informational writing.
- Edit writing for correct grammar, capitalization, punctuation, spelling, sentence structure and paragraphing.

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. 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 inquiry

Language Arts Standards

- 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, 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 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 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 participate as knowledgeable, reflective, creative and critical members of a variety of literacy communities.
- 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.*