2026 NJ TSA HIGH SCHOOL DESIGN PROBLEMS

Coding

STEM Career Path Explorer

PROBLEM STATEMENT

Many students are interested in careers in science, technology, engineering, and mathematics (STEM), but lack clear information about the education, skills, and experiences required to work toward those careers. Competitors are challenged to design and code an app that helps users explore STEM careers and understand the essential pathways to achieve those careers.

Competitors will research at least six (6) STEM career pathways by identifying required academic coursework, relevant extracurricular and career-technical activities, post-secondary education options, and professional experiences. The research must clearly demonstrate how each component contributes to preparation for, and successful entry into, the selected STEM careers. Information should be organized, accurate, and suitable for implementation within a coded solution.

DESIGN BRIEF

Participants will design and code an interactive software application that:

- Identifies at least 6 STEM careers based on user input;
- Displays a structured educational and skill-development pathway for each career;
- Includes a user input system that collects interests and strengths;
- Creates a logical method for recommending STEM careers;
- Includes a career pathway, outlining steps from secondary education to entry-level employment; and
- Includes a clear, user-friendly interface.

Brainstorm to identify ideas that will help direct students on how to achieve their STEM career goals. Develop a model app to guide students toward a STEM career path. Provide information and pictures for a minimum of six (6) STEM-based career paths.

For each career path include:

- 2-4 sentences of additional information to describe the career;
- High School course preparation;
- Extra-curricular activities and experiential learning opportunities;
- Professional skills needed;
- At least three (3) links for post-secondary education options (college majors, technical programs, and certifications); and
- Entry Level job examples.

Keep in mind that the goal is to lead students to understand what is needed to pursue specific careers in STEM.

• ***Platform***: The app can be on any platform.
• ***Programming Language***: Use any programming language.
• ***Functionality***: The app must have some degree of functionality.
• ***Content Suitability***: All content must be in good taste and must observe all school rules.
• ***Originality***: The app must be original in design and content.
• ***Video***: Create a 1-3 minute video that contains the following information:

- Team registration number
- The name of the app
- Clearly explain the purpose of the app
- The tools and coding language used to create the app
- The video must show and demonstrate how the app works

***DO NOT INCLUDE STUDENT OR SCHOOL NAMES IN THE VIDEO OR DOCUMENTATION*.**

SUBMISSION

1- Video: *Submit the Video through YouTube- Submit YouTube link*

2- Documentation: PDF file of documentation that includes the following information:

- Title Page including
  - Your ID number(s)
  - Title of the app
- Explanation of the app in ONE sentence.
- What is your app trying to accomplish? (200 characters max.)
- What technical /coding difficulty did you face in programming your app, and how did you
- address this technical challenge? (500 characters max.)
- With what you've learned, what improvements would you make to version 2.0 of your
- app? (500 characters max.)

EVALUATION

• ***Video*** (50 points)

- The purpose of the app is explained (10 points)
- Tools and coding language are explained (10 points)
- At least 3 features of the app are demonstrated and explained (30 points)

• ***Documentation*** (50 points)

- Written description of the app's purpose (10 points)
- Technical difficulty and solution are explained (20 points)
- Improvements that should be included in version 2.0 are explained (20 points)

SUBMISSION INSTRUCTIONS

The PDF of the documentation, and URL of the video, must be finished, submitted, and accessible via the Internet by 11:59pm on April 1, 2026. Submission procedures for NJ TSA's online system will be shared with advisors.

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Computer-Aided Design (CAD), 2D Architecture

Adaptive Reuse of a Historic Railroad Station

PROBLEM STATEMENT

Adaptive reuse is the creation of new life in old buildings. Rather than demolishing structures, adaptive reuse repurposes them for modern needs, preserving history while reducing waste and minimizing environmental impact. With the built environment responsible for about 42% of global carbon emissions, adaptive reuse is gaining traction as a critical strategy for sustainable development.

Many historic railroad stations across the United States are no longer used for their original transportation purpose but remain architecturally and culturally significant. Rather than demolishing these structures, communities are choosing **adaptive reuse** to preserve history while meeting modern needs.

DESIGN BRIEF

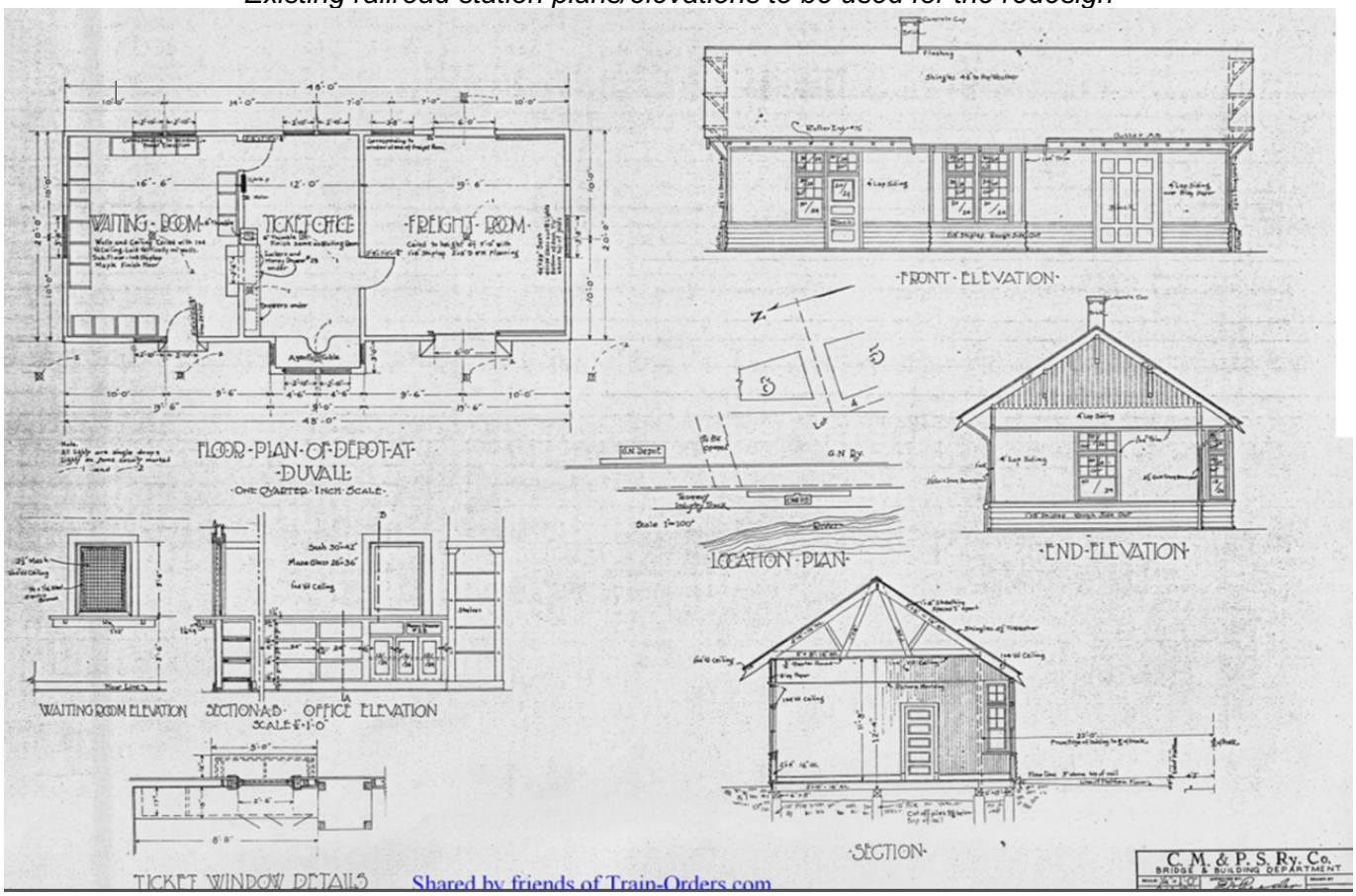
You are an architect tasked with transforming an abandoned railroad station into a new public-use space. Participants will develop a **redesign** that adaptively reuses an existing railroad station into a **new functional community-based facility**, while maintaining key historic elements of the original structure.

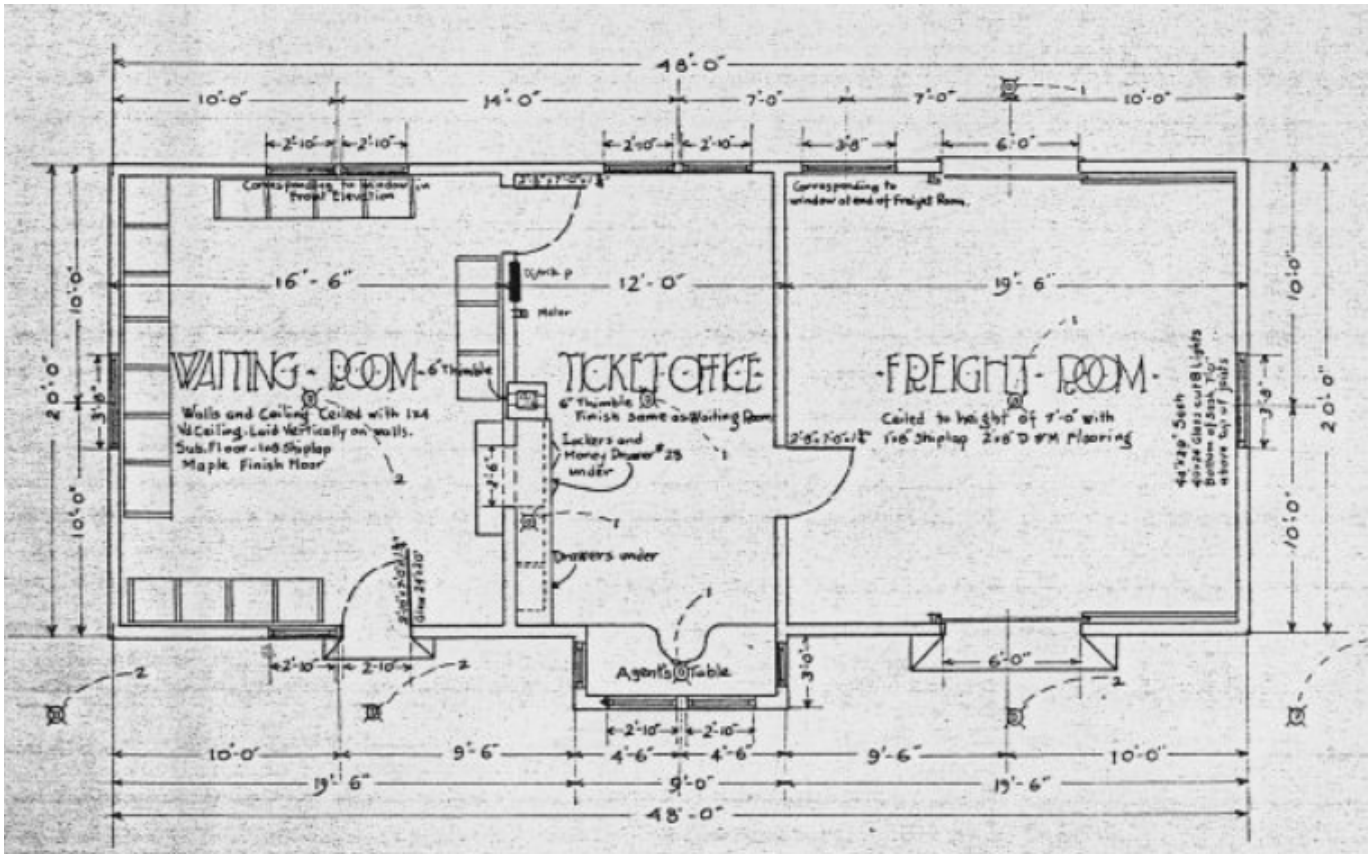
Use the attached plans and elevations for the existing abandoned railroad station redesign and provide a 500 sq ft addition to the existing building footprint. The additional 500 sq ft can be added as multiple additions adding up to 500 sq ft or a single 500 sq ft addition. First-floor and/or second-floor addition is allowed.

The new function may be selected from, *but not limited to*, the following options: community center, public market or food hall, museum/exhibit space, or multi-use venue.

The redesign must also demonstrate how the existing structure is preserved, modified, and repurposed to meet modern accessibility (ADA), safety, and functional requirements.

Existing railroad station plans/elevations to be used for the redesign





Participants must create CAD drawings that include:

1. Existing Conditions Floor Plan
    - Original walls, openings, and features.
    - Clearly labeled elements to be preserved.
2. Proposed Adaptive Reuse Floor Plan with a 500 SF addition to the existing space
    - New room layouts and functions.
    - Clearly labeled spaces.
    - Dimensioned.
3. Final Exterior Elevations (Front, Back, and Left Side) and 3D Rendered Views
    - Demonstrate how existing features are maintained.
    - Show any modern additions or façade updates.
4. Accessibility and Code Considerations
    - ADA-compliant entrances and restrooms.

SPECIFICATIONS

In addition to the drawings

- Include notes that identify at least 4 ways you preserved the existing elements of the station.
- Include where you added ADA Compliances.
- Include any other views / 3D renderings that will enhance the presentation.
- Use proper scale, dimensions, and notes.
- The maximum paper size is 24” x 36” or smaller sheets mounted on a 24” x 36” sheet with no overlapping papers.

Computer-Aided Design (CAD) 3D, Engineering

Electric Bike Safety Accessory

PROBLEM STATEMENT

Electric bikes (E-bikes) have become very popular and are increasingly used for short-distance transportation, especially on school campuses and in urban environments. However, many e-bikes lack adequate visibility, signaling, and rider interface features, which reduces rider visibility and safety. This increases the risk of e-bike accidents, especially at night or in traffic.

Engineers are needed to design an accessory that improves safety while maintaining usability and compatibility with existing e-bike designs.

DESIGN BRIEF

The Trek Bicycle Corporation is a recognized leader in the electric bicycle market, but faces increasing competition. To further strengthen its market position, the company is seeking a designer/engineer to develop an innovative safety solution that improves the e-bike riding experience. An Engineer is needed to design an All-In-One aftermarket accessory that will improve safety while maintaining usability and compatibility with existing e-bike designs.

You have been tasked with designing a prototype of a **detachable, all-in-one safety add-on** that improves rider awareness, visibility, and usability without permanently modifying the e-bike.

SPECIFICATIONS/DRAWING REQUIREMENTS:

- Include at least 2 electrical/electronic features and at least 2 mechanical features.
- Show how the accessory will be powered
- Include a parts list that identifies all the major mechanical and support components of the equipment.
- Show the necessary views to describe the way one would attach/detach and use the device.
- Include any views or renderings that will enhance the presentation.

The maximum paper size is 24” x 36” or smaller sheets mounted on a 24” x 36” sheet with no overlapping papers.

SUBMISSION

Follow the directions in the NJ TSA Supplement to submit your entry.

Optical Engineering

Optical Micro-Inspection Tool

PROBLEM STATEMENT

Modern industries such as electronics manufacturing, medical device production, and precision engineering require the inspection of extremely small components to ensure quality, safety, and reliability. Defects such as micro-cracks, solder bridge failures, surface contamination, or dimensional inaccuracies are often too small to be detected with the unaided human eye.

A regional electronics manufacturing facility produces printed circuit boards (PCBs) used in medical devices, automotive sensors, and consumer electronics. Due to the increasing miniaturization of components, defects that are invisible to the unaided eye are causing costly product failures and rework.

The company has contracted your TSA engineering team to design a **portable micro-optical inspection system** that allows technicians to quickly inspect small-scale electronic components during assembly and quality control.

DESIGN BRIEF

TSA competitors are challenged to design and create a physical prototype of an optical micro-inspection tool that allows users to clearly view and analyze small-scale features of components while remaining portable, safe, and cost-effective.

Competitors will research, design, model, and document a portable optical inspection device that uses optical engineering principles to magnify and enhance the visibility of small electronic circuit boards. The system must be suitable for use in educational, laboratory, or light-industrial settings.

INSPECTION FOCUS

The optical system must be capable of inspecting **one or more** of the following micro-scale features:

- Solder joint integrity on surface-mount components.
- Hairline cracks in circuit traces.
- Misalignment of microchips or connectors.
- Surface contamination such as dust, flux residue, or corrosion.
- Bent or damaged connector pins.

DESIGN REQUIREMENTS

The optical micro-inspection tool must:

- Be powered by AA or AAA batteries.
- Utilize at least two optical components (e.g., lenses, mirrors, prisms, filters, light sources).
- Provide a measurable magnification appropriate for micro-scale inspection.
- Include a stable viewing system that minimizes distortion and vibration.
- Incorporate safe illumination to enhance visibility without damaging components or eyes.
- Be portable and designed for tabletop or handheld use. No larger than 12” x 12” x 12”

In addition to the physical prototype, **prepare the documentation as outlined in the NJ TSA Supplement**.

SUBMISSION

Follow the directions in the NJ TSA Supplement to submit your entry.

System Control Technology

Automated Warehouse Sorting & Conveyor System

PROBLEM STATEMENT

Modern distribution centers rely on highly automated system control solutions to process thousands of packages per hour with speed, accuracy, and safety. Companies such as *Amazon* use advanced conveyor systems, sensors, and programmable controllers to identify, sort, and route packages to their correct destinations while minimizing errors and downtime. A new company is striving to outperform existing distribution centers and is seeking a design team to help them reach their goal.

DESIGN BRIEF

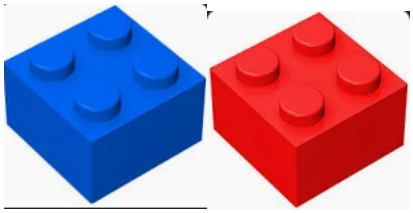
Competitors are challenged to design, construct, and demonstrate a **scaled automated warehouse sorting and conveyor system** that simulates how large-scale fulfillment centers—such as those operated by Amazon- use system control principles to manage logistics operations efficiently. The system must detect and separate packages by characteristics, make control decisions, and activate mechanical components to route packages accurately and safely.

- Your model working system should be no larger than 2' x 2'.
- 24 Packages will be sorted by size and color.
- Packages should be sorted efficiently and promptly.

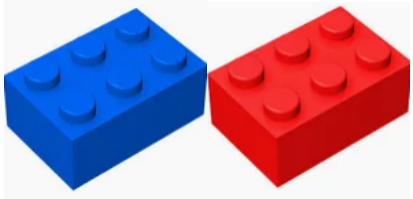
Total packages needed for demonstration

- There are 24 packages that need to be sorted efficiently.
- Packages must first be sorted by ***size*** into 2 containers, and then separated again by color for a total of 4 individual containers.

12- LEGO 2x2 brick (Part #3003) *each Lego measures approx. 0.6 inches x 0.6 inches x 0.5 inches (1.5 cm x 1.5 cm x 1.2 cm)* (6 blue, 6 red)



12- LEGO 2x3 brick (Part #3002) *each Lego measures approx. 0.9 inches x 0.6 x 0.5 inches (2.3 cm x 1.5 cm x 1.25 cm) high* (8 blue, 4 red)



SYSTEM REQUIREMENTS

The system must include:

Input Components

- At least **two (2) sensors** are used to detect package characteristics (e.g., size, color, weight, or presence).
- A manual start/stop control.

Processing / Control

- A programmable control device (PLC, microcontroller, or equivalent).
- Control logic that determines package routing based on sensor input.
- A feedback loop that confirms successful sorting or identifies errors.

Output Components

- A motorized conveyor system.
- At least **one (1) automated sorting mechanism** (diverter, gate, arm, or ramp).

SUBMISSION

Follow the directions in the NJ TSA Supplement to submit your entry.