TETRIX® Individual Engineering Kits and Build Challenges

TETRIX® is much more than a robotics building system. It is an engineering system. By breaking TETRIX sets down to individual building kits without the electronic control elements, students can still engage in hands-on problem-solving as they solve engineering challenges and complete activities. These smaller individual kits enable students to build while being separated and help minimize germs from being passed around. Depending on the situation and how the sets are broken down, students might even be able to take them home to build their set remotely.

Creating Individual Engineering Kits

To break your TETRIX sets into engineering kits, start by removing the electronic components. There won't be enough of these to go around. Remove these items:

- Batteries
- Gamepads
- R/C Receivers
- Programmable Controllers
- Motors
- Servos
- Sensors
- Switches
- Battery Chargers
- Expansion Modules

Next, locate additional storage containers. These could be shoe boxes, resealable bags, or extra TETRIX bins. You'll need a storage container for each individual engineering kit you create.

Divide your TETRIX sets up by separating the parts into individual kits. This could be as simple as dividing sets in half or fourths. Depending on the challenges you give students, you might want to have different kits for different challenges. Or, you can try to make every kit the same so students have the same parts to work from. Small components such as kep nuts, screws, set collars, bushings, and spacers might need to be placed in small resealable bags so they don't get lost. Store all components of the individual engineering kits in the storage containers.

Challenge Ideas

The following is a list of engineering challenges students can attempt using their individual engineering kit.

- **Five-Piece Challenge** – Have students create an invention using only five TETRIX pieces. This is a great way to introduce students to the building system. Give them five or 10 minutes to come up with their idea and prototype. Then, have students share a one-minute spiel about their prototype and the purpose it serves. As part of the spiel, students should share what they would do to improve their prototype given more time or more parts. Usually, connector pieces (screws, nuts, quick rivets) do not count as part of the five pieces. This is a fun activity that should foster creativity. It's perfectly OK for students to come up with off-the-wall ideas that serve no real purpose or would never be developed into real products.
- **Simple Machines** – Have students build and model as many simple machines as they can. Have them calculate the mechanical advantage of each model. Then, have them create a compound machine (one that combines multiple simple machines) with the highest mechanical advantage possible.
- **Rube Goldberg Machine** – Have students research Rube Goldberg machines. Then, have them design and build their own Rube Goldberg machine from the engineering kit. Consider letting students add other consumable materials to their machines such as paper, cardboard, or craft sticks.
- **Engineer for Good** – Have students design and build something that does good in the world. While the engineering design process of creating an invention or innovation is certainly part of this challenge, the focus of this challenge is about fostering empathy, understanding, and a general sense of helping others.
- **Invention Challenge** – Have students use the engineering design process (EDP) to develop an invention. There should be at least three iterations of the EDP with changes/improvements to the prototype documented. Students should develop a *Shark Tank*-style product spiel highlighting the features of their invention and why companies should invest in their product.

- **TETRIX Game** – Have students design a game using the parts of their engineering kit. Students need to develop the purpose of the game, rules, and how the game is won (or lost). Students should test their game with family members or people they generally have close contact within a safe environment. A video of the game play can be made and shared with the rest of the class.
  - Alternate Idea – Have students create a game that can be played through a teleconference call. Test the game with a friend or classmate.
- **Long Gripper** – Have students create an assistive gripper device to help people reach things in hard-to-reach places. Add string, rubber bands, and other consumable items to the kits so students can spring-load their gripper, making it easier to open and close. Students should demonstrate their gripper device.
- **Highest Mechanical Advantage Gear Train** – Have students create a gear train with the highest mechanical advantage possible. For this challenge, students should have access to as many gears as possible, so you might need to make a special kit for this challenge. Make sure there are enough axles, bushings, axle hubs, and set collars for the number of gears in the set. Students should create compound gears to multiply the mechanical advantage of the system. When finished, students should calculate and compare the ideal mechanical advantage to the actual mechanical advantage of the gear train.
- **Robot Subsystems** – Have students design, build, and experiment with different robotic systems. Although they won't have the electronic components to remotely activate or program the subsystems, there is still a lot of value in engineering mechanical aspects of these subsystems. Here are some subsystem ideas for students to investigate:
  - Drivetrains and Steering
    - Ackerman System
    - Swerve Drive System
    - Crab Drive System
  - End Effectors
    - Gripper
    - Scoop/Bucket
    - Grappler
  - Lifting Mechanisms
    - Lever Arm
    - Parallel Linkage
    - Elevator
  - Gear Trains
    - Torque Amplifier Gear Train
    - Speed Amplifier Gear Train
    - Multispeed Transmission
  - Rotational to Linear Motion
    - Crank and Slider Linkage
    - Scotch Yoke
    - Scott Russell Linkage
  - Suspensions
    - Springs
    - Linkages