LEGO Prime Principle

Mid-Valley
STEM-CTE HUB

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LEGO Prime Principle

The LEGO® Prime Principle STEAM Kit is an advanced extension set designed to deepen student exploration of engineering, physics, and design when paired with LEGO® SPIKE™ Prime or Essential kits. This kit includes structural and mechanical components such as gears, levers, beams, and connectors, allowing students to construct more complex machines and investigate core STEM principles like force, torque, and motion. It's ideal for enhancing problem-solving skills, supporting iterative design, and bridging classroom robotics with real-world engineering.

Grade Level

5th - 12th

Group Size

2 - 3 Students per set

Time Duration

45 - 90 minutes

Content of Kits

Components

- 6 Complete sets of LEGO Prime Principle

Extension kit for:

- LEGO Spike Prime
- LEGO Spike Essential

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Usage

Getting Started

1. **Introduce as an Extension Kit** – Clarify to students that this kit builds on prior knowledge from SPIKE™ Prime or Essential, allowing for more complex engineering challenges.

2. **Review Key Mechanical Concepts** – Before using the new components, revisit gear ratios, levers, force, and structural stability to ground their application in theory.

3. **Explore the New Parts** – Give students time to freely explore and sort the new pieces—especially gear trains, beams, and connectors—so they can better plan their builds.

4. **Assign Engineering Design Roles** – For multi-step builds, assign roles like structural engineer, mechanical designer, and programmer to promote collaboration and focus.

5. **Start with a Challenge Prompt** – Use open-ended tasks like "build a lifting mechanism" or "design a weight-bearing structure" to activate problem-solving.

Storage

- **Sort by Component Type** – Organize gears, axles, levers, and beams into labeled bins or compartments for fast access.
- **Label Extension Parts** – Use color-coded or labeled stickers to distinguish Prime Principle pieces from SPIKE™ core components.
- **Store components as deconstructed parts** - Ensure all battery packs are unplugged and components are with correct kits.

Troubleshooting

- **Gears Not Meshing** – Check for proper spacing and alignment between axles; adjust the beam layout if gears are slipping or skipping.
- **Structure Too Weak** – Reinforce key joints with cross-bracing or triangle formations to add rigidity and improve load-bearing.
- **Mechanism Doesn't Move Smoothly** – Look for bent axles, misaligned beams, or over-tight connections that may cause friction or binding.
- **Motors Underpowered** – Encourage gear reduction (larger gear driving a smaller one) to increase torque for heavy-duty mechanisms.

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Activity Guide

Beginner

Simple Gear Train
Students will build a basic two- or three-gear system and attach it to a motor (via SPIKE™ hub). They'll observe how gear size and configuration affect speed and direction, laying the foundation for mechanical advantage and rotational systems.

Intermediate

Lever-Operated Lifting Arm
Students will build a lifting mechanism using a lever and gear system. By adjusting pivot points and gear combinations, they'll test how much weight the arm can lift and how efficiently it can be controlled with the motor. This ties into real-world applications like cranes or robotic arms.

Advanced

Weight-Bearing Bridge or Crane
In teams, students will design a bridge or crane that can support the greatest weight using beams, braces, and gears. They'll test their design with gradually increasing weights and analyze how structural shape and gear reduction contribute to performance. This promotes engineering design, iteration, and teamwork.

Extension Activities:

Automated Gearbox Challenge
Students will design a simple gearbox that shifts between two or more gear ratios, mimicking machines like bicycles or winches. They'll program the SPIKE™ hub to switch motor direction or speed based on input, encouraging creative problem-solving and integration of mechanical and digital systems.

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Learning Extensions

STEAM Connections: Robotics - Engineering - Computer Science

Learning Objectives:

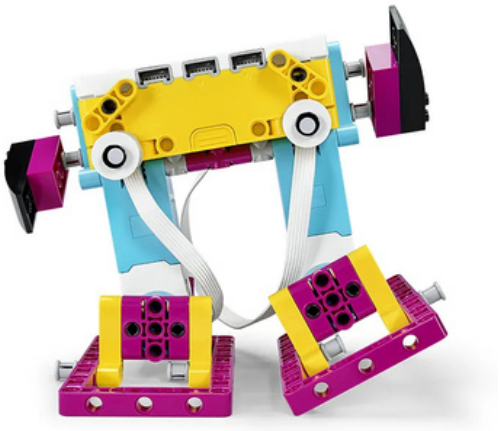
- Understand and apply key mechanical concepts such as gears, levers, torque, and structural stability.
- Design, build, and iterate physical systems to solve real-world inspired engineering challenges.
- Explore the relationship between gear ratios, speed, and force in mechanical assemblies.
- Integrate physical builds with programmable motion using SPIKE™ hubs and motors.
- Strengthen teamwork and communication through collaborative engineering tasks.

Career Connections:

- **Mechanical Engineer** – Designs machines and systems that rely on motion, force, and structural integrity.
- **Industrial Designer** – Creates efficient, user-centered products by prototyping mechanical parts and systems.
- **Construction & Civil Engineer** – Applies load-bearing and design principles to structures like bridges, cranes, and lifts.
- **Mechatronics Technician** – Combines electronics, robotics, and mechanics to develop complex automated systems.
- **Automotive Engineer** – Designs drivetrains, gear systems, and structural components in vehicle engineering.

Essential Employability Skills:

- Problem-Solving
- Critical Thinking
- Creativity & Innovation
- Teamwork & Collaboration
- Attention to Detail



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Resources and Accessibility

Safety Guidelines

- **Maintain a Clean Workspace** – Ensure all pieces are cleared from the floor and tabletops to prevent tripping, slipping, or stepping on small components.
- **Unplug Motors After Use** – Disconnect SPIKE™ hub motors when not in use to preserve battery life and avoid unintended activation.
- **Handle Gears and Axles Carefully** – Teach students to avoid forcing tight pieces together or pulling them apart quickly, which can cause strain or pinching.
- **Avoid Over-tightening Mechanisms** – Show students how excessive tension in gears or levers can lead to breakage or reduce motor performance.

Accessibility

- Provide Pre-Sorted or Simplified Component Sets – For students with motor or attention challenges, offer kits with a limited selection of essential parts to reduce overwhelm.
- Offer Role Flexibility – Let students contribute through planning, coding, documenting, or directing builds based on their strengths.
- Incorporate Peer Support and Partner Builds – Pair students intentionally to encourage teamwork and enable shared task completion.

Library Catalog

Library Resources

Feedback

QR to feedback survey