South Dakota State University Extension

4-H STEM Challenge

2026 Challenge Packet

Photos courtesy of SDSU Department of Ag and Biosystems Engineering

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Challenge Overview

The South Dakota 4-H STEM Challenge is an opportunity for youth to apply their knowledge of science, technology, engineering and math to build a machine designed to perform a specified task. The challenge encourages creativity, collaboration, communication and critical thinking in young people.

Event Location

The event will be held Friday, September 4, 2026, on the South Dakota State Fairgrounds, Huron, SD. The challenge will be held in the Nordby Exhibit Hall on the State Fair Grounds.

Eligibility

1. Team registration is taken on a first-come-first-serve basis through **August 1, 2026**. This registration deadline will be strictly enforced.
2. Teams **must have at least two** members with a **max of 3**.
3. Teams may consist of youth from different counties.
4. All participants must be actively enrolled in 4-H and at least 8 years of age by January 1, 2026, but not have turned 19 years old prior to January 1, 2026.

Schedule

Schedule is tentative and subject to change

1:00 p.m. – 2:00 p.m. Teams will check in and begin set up and testing of their machines. Teams can arrive at any time during this period and are not required to remain at their machines the whole time. However, machine set up should be completed by the youth and not coaches or parents.

2:00 p.m. - 3:30 p.m. Team judging*

*Teams will be present at their projects for the entirety of this time. This will allow them to share their projects with the public while waiting for the judges.

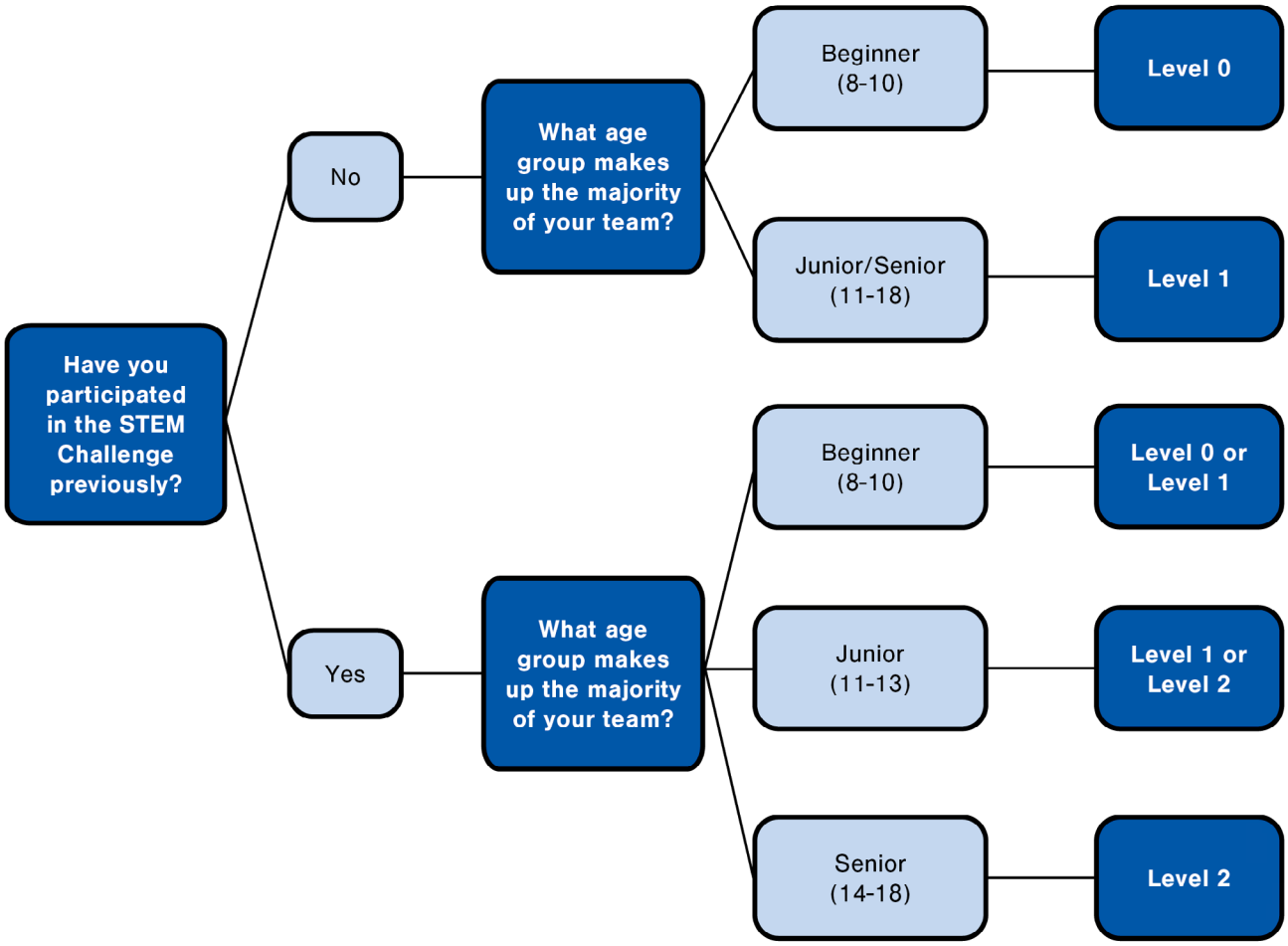
Challenge Task Guidelines

The theme of the 2026 South Dakota 4-H STEM Challenge is Forces and Energy.

Teams will:

- Develop a machine meeting given specifications using the Engineering Design process.
  - Teams building a Level 0 Machine will employ physics and engineering to create a machine that can accomplish a task..
  - Teams building both Level 1 and Level 2 Machines will employ physics and engineering to build on to the Level 0 machine to meet additional challenges.
- Record the development process in an engineering notebook (Appendix A).
- Develop a presentation (2-3 min) to share their design process and their machine's story (Appendix B).

Choosing appropriate challenge level



*Note: While the above graphic can provide guidance on selecting the level at which to enter, teams may choose to enter any level.

Level 0 Machine

The Level 0 Machine introduces youth to STEM principles and engineering design concepts as they act as Mechanical Engineers to accomplish a designated task.

STEM Concepts to Understand

- **Newton's First Law of Motion:** an object at rest will stay at rest unless acted upon by an unbalanced force.
- **Newton's Second Law of Motion:** acceleration is produced when unbalanced forces act upon an object.
- **Newton's Third Law of Motion:** for every action there is an equal and opposite reaction.
- **Friction:** the invisible force that opposes motion.
- **Gravity:** the universal force pulling everything downward.
- **Aerodynamics:** how air moves around an object.
- **Potential Energy:** stored energy due to position or arrangement
- **Kinetic Energy:** energy possessed due to motion

The Challenge

You have been hired by 4-H & Co. to design and construct a vehicle to deliver products from the manufacturing lines to the delivery trucks. You will need to consider the constraints of:

Capacity: Teams must design a machine to carry a box of paper clips down a ramp and coast a specified distance.

Efficiency: Teams should try to utilize as few parts as possible. (1 straw = 1 part even if cut into multiple pieces).

Complexity: Teams must utilize at least 5 different types of materials. (1 straw, 3 craft sticks = 2 types of materials but 4 parts).

Suggested Materials: craft sticks, paper clips, binder clips, drinking straws, coffee stirrer (straw type), rubber bands, toy wheels, wood skewers. Level 0 machines may use any appropriate materials and do not need to keep track of the vehicles cost.

Set Up Needed for Level 0:

4-H STEM Challenge – Level 0 Worksheet

Team Members: _____

Identify – The challenge is to design a vehicle that will roll freely down a ramp and coast a distance of 9 ft from base of ramp. It must be able to carry a box (approximately 2.75 inches x 0.75 inches x 1.75 inches and 1.5 oz (a full box of paperclips)). What might be some things that will make this challenge hard?

_____

_____

_____

_____

Explore – What are some supplies that could be helpful in building your vehicle?

_____

_____

_____

_____

Design – Use the space below to sketch what your vehicle will look like.

Create - Attach a picture of your vehicle

Test – Test and record the results of your design. Some information you might want to record includes: Did it stay on a straight path? How long did it coast? Did it coast the desired distance? If not, did it get stopped before or travel past it? Did the vehicle stay in one piece, or did it break?

Improvements – Brainstorm what improvements you would like to make to the vehicle and what you think should stay the same. Write them down below and use them when you restart the Engineering Design Method the next time you meet to design and create your vehicle!

Share – Explain the science of the design and its movement using the terms: gravity, potential energy, momentum, friction, and incline plane.

Level 1 Machine - Self Propelled Delivery

*Teams building a Level 1 machine should first start by building a Level 0 machine and utilizing the Level 0 worksheet to start their team notebook. The Level 0 machine will then be used as the beginning platform of your Level 1 machine.

The Level 1 machine is a vehicle that will travel 9 ft on a flat surface. It must be able to carry a box (approximately 2.75 inches x 0.75 inches x 1.75 inches and 1.5 oz (a full box of paperclips)). Unlike the Level 0 Machine which is propelled by gravitational forces, teams must design some sort of mechanism to drive or propel their vehicle forward on a flat surface (for an example, search for rubber band cars on the internet).

Capacity: Teams must design a machine to carry a box of paper clips across a flat surface, a minimum distance of 9 feet.

Efficiency: Teams should try to utilize as few parts as possible. (1 straw = 1 part even if cut into multiple pieces).

Complexity: Teams must utilize at least 8 different types of materials. (1 straw, 3 craft sticks = 2 types of materials but 4 parts).

Cost: (Junior and Senior level youth only) Teams should manage their cost of production and should aim to spend less than $35. Total cost should include supplies needed to build a Level 0 machine plus any supplies used to modify it to become self propelled. Any materials used that are not listed below have a cost of $2.

Material Price Sheet

Item/Part Description	Price Per Item
Craft Stick – large	$3.00
Craft Stick – small	$2.00
Paper Clip – large or small	$1.00
Brass Brad	$1.00
Binder Clip – various sizes	$2.00
Drinking Straw	$2.00
Coffee Stirrer Straw	$1.00
Rubber Band	$1.00
Wheel	$3.00
Hobby Wheels	$3.00
Recycled materials – bottle caps, cardboard, etc	$2.00
Tape	$0.50 / inch
Hot Glue	$1.00 / stick

Level 2 Machine - Keep the Cargo Safe!

*Teams building a Level 2 machine should first start by building a Level 0 machine and utilizing the Level 0 worksheet to start their team notebook. The Level 0 machine will then be used as the beginning platform of your Level 2 machine.

The Level 2 Machine is propelled by gravitational forces (like the Level 0 machine) and must be equipped with safety features to protect the cargo (an egg). Level 2 Machines must be able to travel up to 9 feet (like the Level 0 Machine) when unobstructed. Teams must consider the principles of force, impact, and structural engineering as they design their Level 2 machine to survive an impact and protect the cargo.

Once the machine has successfully been able to carry the cargo up to 9 ft, an obstacle (box or other) will be placed in the pathway at 5 ft. The vehicle will be released from the top of the ramp and collide with the obstacle. Upon collision, the vehicle and cargo should not be damaged.

Capacity: Teams must design a machine to carry an egg down a ramp and coast 9 feet. It must also be able to survive a crash with an obstacle at 5 feet.

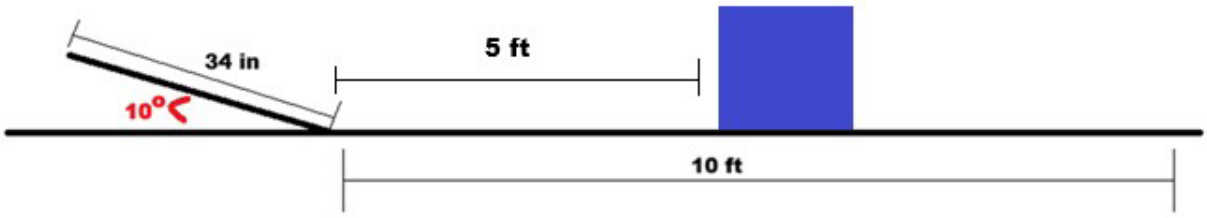
Efficiency: Teams should try to utilize as few parts as possible. (1 straw = 1 part even if cut into multiple pieces).

Complexity: Teams must utilize at least 8 different types of materials. (1 straw, 3 craft sticks = 2 types of materials but 4 parts).

Cost: (Junior and Senior level youth only) Teams should manage their cost of production and should aim to spend less than $50. Total cost should include supplies needed to build a Level 0 machine plus any supplies used to modify it to hold and protect the cargo. Any materials used that are not listed below have a cost of $2.

Consider using a ziplock back for containing eggs when testing machines – these will be used at state fair to contain mess.

Set Up Needed for Level 2:



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Drinking Straw	$2.00
Coffee Stirrer Straw	$1.00
Rubber Band	$1.00
Wheel	$3.00
Hobby Wheels	$3.00
Recycled materials – bottle caps, cardboard, etc	$2.00
Tape	$0.50 / inch
Hot Glue	$1.00 / stick
Cotton Ball	$0.25 / cotton ball
Bubble Wrap	$3.00
Foam	$3.00
Sponge	$2.00
Other	$3.00

Appendix A: Team Notebook

As teams work to design and build their machine, they should be diligently documenting their progress in a **Team Notebook.**

- Each team needs to keep a written team notebook to document the team's work, including research, successes, setbacks and progress.
- It serves as a record of the team's ideas and accomplishments throughout the process of designing and building the machine.
- The notebook is a means of reflecting on what they learned and accomplished each time they met, and how the engineering design process guided the team's work.

Engineering Design Process

Teams are required to use this process to help guide the machine planning and creation. **Teams are required to use the Design Process throughout creating their machine and be able to explain how they did so.**

1. **Ask:** Define the challenge objectives, constraints, and resources.
2. **Imagine:** Information gathering/idea generation.
3. **Plan:** Make a plan.
4. **Create:** Begin constructing and refining design.
5. **Test:** What works and what needs improved.
6. **Improve:** Redesign.
7. **Share:** Participate in the State 4-H STEM Challenge.

Notebook Tips and Suggestions

- The notebook can be a spiral-bound school notebook, a three-ring binder with loose-leaf sheets, a bound book with blank pages or an electronic notebook in a computer file.
- Should be accessible to all the team members and everyone should have the opportunity to make entries and record information.
- A useful notebook contains both writing and drawings as a way of capturing ideas and figuring out how to make the machine work. If an idea is not used or if something does not work, make a note next to the drawing or writing explaining why the idea was not used or why it did not work.
- We recommend that each time the team meets, use the last 10 minutes of the meeting to discuss and add an entry to the team notebook.
- The best notebooks are used consistently throughout the process of building the machine.

For examples of what your notebook can look like, visit Minnesota 4-H's Engineering Design Challenge for Teams section: https://extension.umn.edu/projects-and-more/4-h-engineering-design-challenge#for-teams-1397213

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Engineering Design

* At any given point you may return to a previous step in order to improve.

Appendix B: Presentation

To foster creativity and communication skills, teams are asked to develop a brief presentation to share their machine with the judges.

Presentation

The presentation should highlight the experience of creating the machine in a summary that includes:

- Youth introductions
- Machine design elements (challenges and victories)
- Machine story – what is happening?

4-H STEM Challenge Contact Information

Christine Wood, SDSU Extension 4-H Science Technology Engineering and Math (STEM) Field Specialist
Robics Committee Advisor
(605) 782-3290 | christine.wood@sdstate.edu

Nathan Skadsen, SDSU Extension 4-H Educator - Minnehaha County
Robotics Committee Co-Chair
nathan.skadsen@sdstate.edu

4-H STEM Challenge Registration

Due: August 1, 2026

Email Forms to: Christine Wood – christine.wood@sdstate.edu

County: _____

Team: _____

Coach: _____ **Phone Number:** _____

Email: _____

Machine Level: _____ **Age Level:** Beginner Junior Senior

Team Member	Age
1.	
2.	
3.	
4.	
5.	

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