



ENGINEERING

MACHINE DESIGN CONTEST

Team Recruitment

[ENGINEERING.MNSU.EDU/ENGINEERING-MACHINE-DESIGN-CONTEST](https://engineering.mnsu.edu/engineering-machine-design-contest)



A product of:



MINNESOTA STATE
Engineering Center of Excellence

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ENGINEERING

MACHINE DESIGN CONTEST

The Engineering Machine Design Contest is an opportunity for teams of **5th-12th grade** students to **design and build a complex machine** using everyday objects with the guidance of a coach. The completed machine will use **multiple steps to complete a simple task**.

Teams showcase and exhibit their machine at a **regional contest** with the opportunity to advance to the Engineering Machine Design **Championship**, a multi-state event.



"What an awesome event for students to participate in.

**This STEM program is the
WHOLE package!**

It not only hits on engineering and science, but strengthens skills in public speaking, writing (journal), creativity, problem-solving, and artistic abilities.

You will not find a better low-cost STEM program for students to get excited about!"

Devin
Senior Division Coach
Science & Technology Teacher

OBJECTIVES

The Engineering Machine Design Contest is guided by three primary objectives:

1. Provide a low-cost or affordable learning experience that is accessible to students from underserved or rural communities.
2. Inspire an interest in engineering and related career pathways.
3. Equip students with skills that will help prepare them for future careers.

REAL-WORLD CONNECTION

Each year a competition theme is chosen to guide the machine build and allow for whimsical creativity to flourish. Students are able to **explore science, technology, engineering, and mathematic (STEM) principles** while having fun in a collaborative environment.

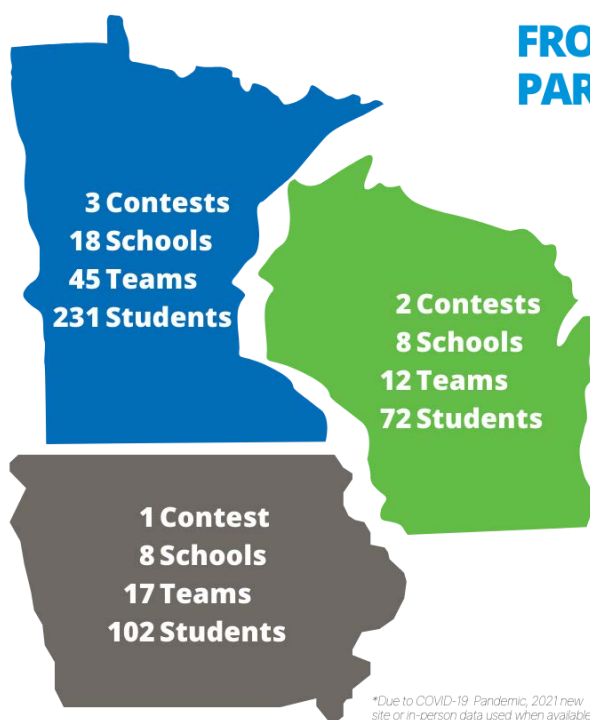
Creating **awareness and connection to real-world challenges** is an important aspect of the Engineering Machine Design Contest.

Each year's theme is chosen in consideration with current topics and aligned to the **National Academy of Engineering Grand Engineering Challenges**.

In addition to being evaluated on their machine operation and integration of the theme, teams are evaluated on a Team Presentation and Design Journal - reinforcing **career readiness skills** such as teamwork/collaboration, oral and written communication, and critical thinking/problem-solving.



2020 PARTICIPATION*



FROM 2019 TO 2020, PARTICIPATION INCREASED BY...

50%
more
SCHOOLS



100%
more
TEAMS



59%
more
STUDENTS



*Due to COVID-19 Pandemic, 2021 new site or in-person data used when available.

NEEDS FOCUSED PROGRAM

Stakeholder needs and feedback are the **driving force** behind this program and inform resource development, rule revisions, annual contest theme, and more. It is vital that this program is **addressing the needs of students, educators/coaches, and future employers**. Based on data from the 2021 Program Evaluation, **100% of coaches agree** that this program addresses the following:

This program connects the dots of engineering and engineering technology learning and real-world application.



Students increase their knowledge and acquire new and/or advanced skills.

This program contributes to students achieving their professional/career interests/goals.



Students gain knowledge upon which to base their decisions/actions related to engineering design.

This program equips students with skills that will help prepare them for future careers.



They would recommend this program to others!

9 OUT OF 10 **ENGAGING**
UNDERSERVED
UNDERREPRESENTED
ECONOMICALLY
DISADVANTAGED
STUDENTS

Coaches reported their students were from underserved or rural communities and/or underrepresented populations in STEM.



MACHINE SPECIFICATIONS

Machine Dimensions | No more than 5'X5'X5'.

Smaller tabletop machines are equally competitive than large machines (and easier to transport).

Number of Steps | 10-15 steps for Junior Division and 15-20 steps for Senior Division.

Steps Labeled | Each step must be labeled on the machine.

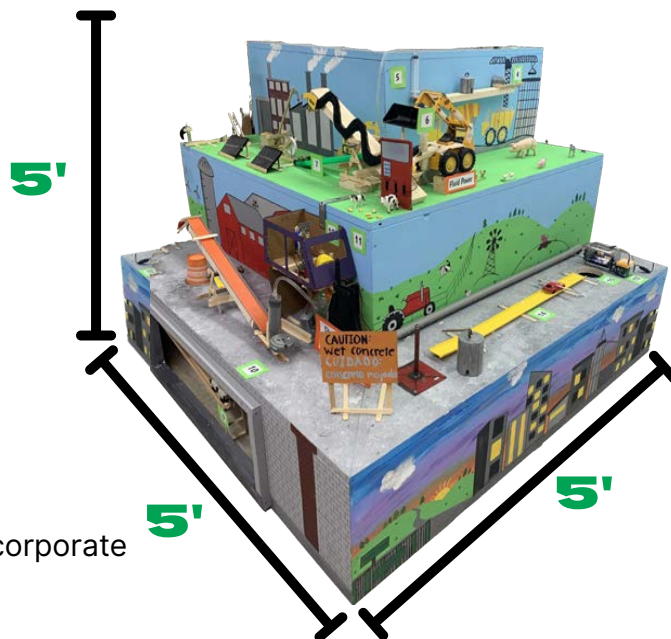
Advanced Components | Senior Division teams must have at least one of each component including:

- Chemical Reaction,
- Electrical,
- Fluid Power, and
- Mechanical.

Junior Division teams are encouraged to incorporate Advanced Components, but not required.

MAX. DIMENSIONS

5 FT X 5 FT X 5 FT



Safety | Machines must be safe for all team members and observers.

Flying Objects | All objects must stay within the parameters of the machine.

Run Time | No more than two minutes.

Refer to the Official Engineering Machine Design Contest Handbook for additional details and specifications.

SCORED COMPONENTS



Team Journal (50 Points) | Each team is encouraged to keep a journal that captures the design process and development of their machine. Drawings, pictures, and written narrations documenting progress, challenges, and successes of their machine build are encouraged.

Teams will articulate in their journal how they used the Engineering Design to identify a problem and design a solution to address it. In doing so, teams will document the things they tried that did not work and why aspects of the machine may have changed over time. All of this is part of the Engineering Design Process. Individual and team reflection is an important part of this process.



Team Presentation (50 Points) | During the contest, teams will give a short presentation about their machine. Teams are encouraged to incorporate a machine storyline in their presentation, as well as highlight challenges faced during the design and building process. Additionally, teams should provide an explanation of their machine's steps including relevant and age-appropriate scientific and engineering principles

related to how steps operate. Judges will pay special attention to how team members contributed to the machine and engaged in the presentation.



Machine Run and Operation (150 Points) | Teams will have the opportunity to run their machine twice. Judges will watch for human interventions, among other possible penalties, while assessing the machine for things such as the use of building materials, innovation and creativity, machine complexity, and integration of STEM principles.



50 pt.



50 pt.



150 pt.

MAX. 250 POINTS

Refer to the Official Engineering Machine Design Contest Handbook for additional details and specifications.

TESTIMONIALS



A great experience for students to **apply their STEM knowledge to a real-life problem**. Very well run and organized and tons of support provided. We loved our experience and look forward to next year!

Tammy
Senior Division Coach
Science & Physics Teacher

My students have competed in the Engineering Machine Design Competition for several years at the regional level. This year we made it to the Championship competition that was held virtually. My students have learned so much through the **engineering process and problem-solving**. The collaboration on this project is **not only STEM but also public speaking, art, and teamwork**. This competition meets NGSS Standards and 21st-century skills.

Susan
Senior Division Coach
Science & Mathematics Teacher



The Engineering Center of Excellence demonstrated an unwavering commitment to supporting students in their efforts to design the future. The EMDC was carefully planned and supported and well-executed. The cadre of judges **inspired students to rise and exceed every expectation** while they **solved real-time problems** while working collaboratively. Students call it '**hard fun**'.

Bradley
Junior Division Coach
Design & Engineering Lab Director

I loved this. **My students loved this**. One of our team members, who often has behavioral challenges, excelled in this program. **He rocked this experience and emerged as a positive leader**. This student also came to respect and appreciate students who may have different talents than he possessed. He looked at them through new goggles. I hope this program continues to grow. I had another team member who was never a behavior problem but just kind of existed in school. He tests off the charts but often seems bored with daily school work. **He ate this up**. He wants to continue to compete at the Senior level.

Sheila
Junior Division Coach
Technology & Media Teacher

This program is well organized. Through proper coaching, this program allows students the opportunity to **function as part of a team to solve problems** using a clear process. It can help teach both engineering principles and soft/interpersonal skills. The students I saw in the competition were all **positive, passionate, professional, and mature**. They looked like they were enjoying themselves and their projects were well done. It was a great experience.

Carl
Championship Judge
Industry Professional

This is exactly the kind of experience that **builds true self-esteem and skills in young people** and could help build a stronger **pipeline of a diverse group of new engineers** in the future. As a person that helps young people with entrepreneurial ideas, this type of competition could be what **sparks a new inventor or convinces a young person** they do have what it takes to lead.

Yvonne
Championship Judge
Business and Entrepreneurship Consultant

This year was my first time serving as a judge and I was **blown away** by how **creative and inspiring** the students were. I absolutely loved seeing the variety of approaches they took and hearing about their experiences with the program and the competition. I would recommend being a judge without hesitation!

Lin
Championship Judge
Integrated Engineering University Faculty

This activity is a wonderful opportunity for students to **combine their imaginative abilities with scientific and engineering principles** to grow in multiple aspects. **Problem-solving and team building/development** will be critical skills in their future, regardless of their career path.

Aaron
Regional and Championship Judge
Engineering University Faculty

This program is an amazing way to create group **hands-on experiences that is learning-focused**. Students of all ages and levels can compete, and are guaranteed to walk away with **increased self-efficacy, understanding of the engineering process, and a sense of accomplishment**. The rubrics for students and judges' are extremely easy to follow with enough instruction to standardize submissions but enough variability to allow for great differentiation, in process and thought.

Michael
Regional Judge
Science Education College Professor

FAQs

When do the contests take place?

The Regional Contests take place in January - March with the Championship taking place on the fourth Friday in April.

How long has this program been around?

The Engineering Machine Design Contest started in 2018 with a single contest at Minnesota State University, Mankato. St. Angar High School in Iowa became the second contest site in 2019. In 2020, Anoka Technical College in Minnesota and CESA 10 in Wisconsin joined the program. The Virtual Open Regional Contest was piloted in 2021, which was the same year STEM Forward out of Milwaukee, Wisconsin became the fifth Regional Contest site. That was the same year the Minnesota State Engineering Center of Excellence organized the first Engineering Machine Design Championship.

Are there age divisions?

Teams will enter in either the Junior Division (5th-8th grade) or the Senior Division (9th-12th grade). Each division will be judged separately following the same process. If a single team has students spanning both grade divisions, that team must enter the Senior Division.

How do schools implement this program?

Teams are generally formed within an existing class. For example, a Physics Instructor or a Career and Technical Educator Instructor will incorporate the machine build into their existing course. Alternatively, some teams are formed as an extracurricular activity. Additionally, teams are not required to be school-based. Individuals from different schools or areas can form a team.

Can a team have help from an adult?

Teams should have an adult coach that helps guide them through the competition process. Additionally, they may wish to seek the assistance of a mentor that can provide technical leadership and assistance as needed. The coach and/or mentor should only provide resource support and ensure safe working conditions, such as with the use of saws or other power tools.

How much time does it take for a team to build their machine?

The time it takes to build a machine depends a lot on the time available to the team. Some teams will begin brainstorming their design in September, while other teams may not start working on their machine until a month before their Regional Contest.

How should a team get started with building their machine?

Teams are encouraged to follow the Engineering Design Process as they build their chain reaction machines. The first step in this process is to determine any parameters, limitations, and resources available. Then, teams should brainstorm ideas. After an exhaustive list of ideas has been shared, the team can choose the best idea(s), sketch out a plan, and begin building. It is important to test concepts and steps as components are built to ensure a reliable machine.

Tips for Teams

- Read the handbook carefully and review the score sheets, machine specifications, and penalties.
- Be creative in translating the theme to the machine. Enjoy the process and have fun as a team!
- When designing the machine, avoid having action hidden behind other parts of the machine. The judges are only able to evaluate what they can see.
- Consider using more simple steps and actions as they are generally more repeatable and have fewer glitches. Some steps that are too complex are also more likely to cause issues in competition.
- Communicate the machine design clearly through the Team Journal and Team Presentation. It is best if the information is clearly communicated so judges do not have to make assumptions or try to interpret what is meant. Judges are not experts in all areas.

Direct questions to: engineering@mnsu.edu.



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