2024

STEM CHALLENGE

RULE BOOK

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Introduction

"Worthy are you, our Lord and God, to receive glory and honor and power, for you created all things, and by your will they existed and were created" (Revelation 4:11, ESV).

Welcome to the Answers STEM Challenge hosted by Answers in Genesis! The Answers STEM Challenge exists to give young adults ages 14–18 an opportunity to collaborate in a friendly competition while learning about a STEM topic from a biblical worldview. This is a one-day, hands-on design competition where participants are presented with a design task related to a STEM topic. Each participating team will create a design that will be evaluated by a panel of experts, and the top three winning designs will be awarded a monetary prize. Participating young adults will also hear from keynote speakers that love God's Word and are experts in or related to the topic of the design challenge.

The challenge will take place in the Answers Center located at the Ark Encounter in Williamstown, Kentucky. The challenge will occur the day prior to the free Creation College Expo event that is also hosted by Answers in Genesis at the Ark Encounter. We encourage participating teams to stay for the free Creation College Expo during the days following the STEM challenge to learn more about Christian institutions across the country who hold to biblical authority and young-earth creation. To learn more about the free Creation College Expo, visit the events tab of the Ark Encounter website.

Participation

All young adults ages 14–18 are welcome to participate in the Answers STEM Challenge. All members must be between the ages of 14–18 on the day of the competition to be eligible to enter as a team in the challenge. Teams can be comprised of 2–4 members but cannot exceed a maximum of four members. Each team is required to have an adult coach (21 years or older) to enter. Please note, the coach is responsible for the supervision, management, and registration of their team.

Registration

Teams can register and find additional details for the cost of registration at the Answers STEM website: **https://answersingenesis.org/outreach/event/stem-2024**

Challenge

Each year, participants will be presented with a design challenge related to a topic in the STEM field. Teams are required to design their project following the stipulations outlined in the Design Rules section of the rule book. Each team's design will be evaluated by a panel of experts that will judge the designs by the outlined criteria in the Design Evaluation section of the rule book.

For the 2024 Answers STEM Challenge, participants will be tasked with creating a wind turbine.

The use of alternative energy such as wind turbines is a complex environmental issue. When considering proposed solutions to environmental issues, people must remember God's command to exhibit dominion (Genesis 1:28). People are commanded to actively exercise dominative authority to the glory of God (Colossians 3:17) and the benefit of neighbor (Luke 10:27) while also avoiding dominative extremes that would cause destruction of the earth as well as the worship of the creature rather than the Creator (Romans 1:18–23).

These biblical principles must be applied when people are considering the use of any proposed energy source. The 2024 Answers STEM Challenge wind turbine design task provides a unique opportunity for teams to apply these biblical principles when considering the design of their turbines. Additionally, the 2024 challenge will provide an opportunity for teams to explore how their turbine design could apply to real-world scenarios while learning about complex environmental issues from a biblical worldview. Our prayer is that this challenge would encourage and equip teams to stand on the authority of God's Word when presented with environmental issues.

Equipment

All 2024 wind turbine designs must include the following components:

- Generator (provided)
- Housing (Nacelle)
- Blades
- Tower
- Base

We encourage creativity and experimentation for the equipment and materials used (e.g., the use of 3D-printed materials, gear sets, etc.). However, please be aware that if any material used appears to be unsafe (see Design Rules), the panel of experts will disqualify the wind turbine from the challenge. Materials should be, to the extent possible, built by the team to meet the needs of their design and manufactured to those specifications, not purchased as a kit to be assembled.

Design Rules

Dimensions

Wind turbines will be evaluated in front of a 4-fan array and must be designed to fit the 1.2 m by 1.2 m dimensions of the fan array. The base of your tower should be designed so it can be clamped to a stationary board at a distance of 2 m from the center of the fan array.

Generator

Teams are only allowed to use one generator. You must use the generator provided to your team for the competition. The generator must have clearly marked positive (red) and negative (black) leads extending at least 25 cm beyond the base for the attachment of the measurement device with bare wire ends for alligator clips to be attached.

Blades
Each team must design their own blades. Premanufactured blades, airfoils, and sheets are not allowed. Blades must be made using safe materials—examples include plastic, wood, or similar material. Metals and plexiglass are considered unsafe materials and will not be allowed.

Tower and Base
Towers must be designed so wind turbines are freestanding and stable on their base. The base must be constructed so that it can be attached with a clamp to a board in front of the fan array. We will provide a video on the event registration page showing the setup of the array and its dimensions.

Gears
Gears and pulleys may be used to increase power output but are not required.

Design Practice

During the design evaluation, your turbine's power output (voltage and amperage) will be collected by the panel of experts using data logging software. You will be evaluated on a 30-second average (mean calculated by the software) of your power output during the 60-second trials. We recommend teams practice to learn how to measure the power output of their turbines prior to competition. Teams can measure the power output of their turbines by connecting it to a load and measuring power through the use of a multimeter device or through data logging software such as Vernier Go Direct Energy Sensors.

Each team will have one opportunity to test their turbine design in the fan array prior to evaluation. Teams will only be allowed a single opportunity to bring their turbine design to the fan array to practice for a period of three minutes prior to evaluation. Practice is not required and is optional for teams that desire to test their device prior to evaluation.

If a team chooses to practice, they must check in with the attendant before placing their turbine in the fan array for a practice round. Teams will be allowed a combined period of three minutes to set up as well as practice testing their turbine design prior to evaluation. Once the 3-minute period has expired, the team must exit the fan array and are not allowed to reenter until evaluation.

Design Evaluation

A panel of experts will evaluate all participating teams the day of the challenge. Evaluation will occur in two ways. Each team will be required to test their design as well as present their design to the panel of experts.

Testing
Teams will be required to place their turbines to be tested in front of a 1.2 m by 1.2 m fan array. The fan array will be constructed using four fans arranged in a square frame with a board for securing the tower base at 2 m. The panel of experts will evaluate the turbine design by measuring the turbine's average power output over a 30-second period. Teams will check in with the attendant during the

testing session. After checking in, teams will be allowed to enter the array to set up their device within a 2-minute time period. After the allotted 2-minute setup period, the panel of experts will connect the team's turbine to the data logging software using the leads from the generator and turn on the fan array. Each team is allowed a maximum of two 60-second trials. The turbine's data will be collected for a period of 60 seconds and a 30-second average during that period will be used for the evaluation. The highest value will be used for the evaluation.

Please note, if a team's turbine is damaged or does not work during the evaluation period, the team will not be allowed to retest their turbine if they have already used the two trials.

Team Presentation
All teams are required to present their design to the panel of experts through a poster or digital presentation. If you are using a digital presentation, you must bring an HDMI-compatible device to connect and present from. All presentations must not exceed five minutes and include the following:

Evaluation Rubric
Your team's design will be evaluated within three categories (design, testing, and presentation). Please see the descriptions below for further details regarding each rubric category.

Design Evaluation Categories	Further Details
Appropriate materials were used	Team used safe and appropriate materials.
Craftsmanship	Random materials were not thrown together—team used organization and attention to detail with quality of construction.
Proficiency	Design demonstrated a knowledge of turbine architecture and function.
Demonstrated creativity and innovation	The design showed originality and ingenuity.

Turbine Testing Categories	Further Details
Functionality	Turbine was operational within the tunnel.
Energy output	Turbine gave off power to demonstrate it worked.
Structurally sound	Turbine withheld during the testing with little damage to the structure and demonstrated stability.

Presentation Categories	Further Details
Described design process with adequate detail, including introduction, methodology, and conclusion	Details of the design process were clearly laid out and had a logical flow.
Communication and team collaboration clear and concise	Team demonstrated that they worked together and their presentation was well thought out and organized.
Demonstrated knowledge of wind energy science	Team clearly indicated how they thought out and applied real-world scenarios to their design.
Application of biblical worldview to the design task	Team showed the importance of standing on the authority of God's Word when faced with complex environmental issues.

Answers STEM Challenge Judging Rubric

Team Name: _____

Overall Score: ___/55
Judges will place a mark in the criteria that best describes each category.

Design Evaluation Categories	Poor (1)	Average (2)	Good (3)	Very Good (4)	Excellent (5)	Total
Appropriate materials were used						
Craftsmanship						
Proficiency						
Demonstrated creativity and innovation						
						/20

Turbine Testing Categories	Poor (1)	Average (2)	Good (3)	Very Good (4)	Excellent (5)	Total
Functionality						
Energy output						
Structurally sound						
						/15

Presentation Categories	Poor (1)	Average (2)	Good (3)	Very Good (4)	Excellent (5)	Total
Described design process with adequate detail, including introduction, methodology, and conclusion						
Communication and team collaboration clear and concise						

Demonstrated knowledge of wind energy science						
Application of biblical worldview to the design task						
						/20

Presentations that do not include a clear, biblical worldview connection will not be eligible for prizes.

Awards

Scan the QR code or go to the website for a current list of prizes: **https://answersingenesis.org/outreach/event/stem-2024**

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