Venturing and Sea Scouting Unit Guide for STEM Nova Activities

Unit Guide for STEM Nova Activities

Venturing and Sea Scouting Program Features

INTRODUCTION

STEM stands for Science, Technology, Engineering, and Mathematics. STEM has been an integral part of Scouting since day one: fire building, astronomy, physical fitness, and shooting sports are all fantastic examples of STEM in action. Scouting has always taught Scouts the most current skills and knowledge, and the need for STEM education is now greater than ever today, both for the employment opportunities it brings and to be an informed citizen. Now, STEM has its own set of supplemental awards in Scouting—the Nova and Supernova awards.

There are four different Nova awards at the Venturing and Sea Scout level, one for each discipline of STEM. Venturers and Sea Scouts can earn them all, along with the three Supernova awards. Completion of one Nova award allows a Sea Scout or Venturer to wear the Nova patch, and completion of any additional Nova award is recognized by a pi pin that is placed on one of the points on the patch.

Award-Based vs. Activity-Based Implementation

Do the youth in your unit love earning patches and awards? Or do the members just want to do fun stuff? This guide includes ideas for integrating both award- and activity-based STEM activities into the Venturing and Sea Scouting programs, depending on the interest level of your crew or ship. As a reminder, these are only suggestions and should be modified to fit the needs and interests of your unit.

Demonstration vs. Experiment

The main goals of STEM are to have youth explore, learn, ask questions, and develop and test their own hypotheses.

- A **demonstration** involves showing something interesting and then explaining what happened. The outcome of a demonstration is understood in advance.
- An **experiment** is a planned series of activities where the outcome is, in principle, unknown. The activity is repeated multiple times, changing one parameter at a time and evaluating how that change affects the outcome. An experiment should test an explanation.

Demonstrations are more useful for introducing a topic, while experiments are better for engaging participants and forming a deeper understanding of the topic.

IMPLEMENTING THE NOVA AWARD PROGRAM

This section will describe two different possible lesson plans for working on Nova awards that could happen in a typical crew or ship meeting.

Power Up Nova

The following plan is for completing the Power Up (technology) Nova Award using the Aviation exploration. This is one suggestion for how youth can work toward earning the Nova Award over the course of four 2½- to 3-hour meetings as a crew or ship with some outside activities; these are not verbatim requirements, and the specific requirements should be followed to ensure proper completion of the award. A trained and registered Nova counselor must work with youth to verify completion of the requirements. *In the following plan, it is assumed that, while the activities are youth-led, a Nova counselor is present as well to work with the unit (this could be a unit leader, for example, or another parent).*

Calendar of Requirements

Unit Meeting 1—Opening (5 minutes)

Requirement 1 (2 hours 25 minutes)

Unit Meeting 2—Opening (5 minutes)

Requirement 3 (1 hour 30 minutes)

Exploration Activity 1 (55 minutes)

Unit Meeting 3—Opening (5 minutes)

Exploration Activity 2 (1 hour)

Expert Presentation (45 minutes)

Exploration Activity 3 (40 minutes)

Unit Meeting 4—Opening (5 minutes)

Exploration Activity 4 (10 minutes)

Requirement 4 (1 hour 30 minutes)

Requirement 5/Exploration Conclusion (45 minutes)

Requirement 1:
Read/research/watch about three hours of transportation-related material

This can be done by watching a movie or documentary during a crew or ship meeting or holding a unit movie night. After the movie, the unit should discuss ideas that are presented in the movie. If the unit members wish to avoid watching a movie during meeting time, this activity could be replaced with a live demonstration at a local science center or by bringing experts to a unit event to conduct a demonstration. Additionally, Sea Scouts or Venturers could research or watch videos on transportation technology outside of meetings and share what they learned in a crew or ship discussion. Discussions could occur at a meeting but could also occur around a campfire or in the car on the way to an event or high-adventure outing. For instance, Sea Scouts or Venturers could investigate the technology related to locomotives and issues the railroad industry is currently facing to discuss them on a train ride to Philmont, or youth could research the state of self-driving cars or GPS technology and discuss on the ride to summer camp.

Requirement 2: Aviation exploration

All the following requirements must be completed by each Sea Scout or Venturer to receive credit for the exploration. Be sure to check the exact requirements to make sure each youth has actually and personally earned the award.

Consultant: Invite someone from the aviation industry to come talk at a meeting or visit the person at a local airport. This expert could be a pilot, control tower operator, or aerospace engineer, or hold a similar position. Have this person talk especially about the development of the field of aviation, risks and risk management, his or her job, and other jobs in the industry.

Activity 1: Explore factors affecting the flight of paper airplanes. Provide members of your unit with the materials necessary to make paper airplanes and have a competition to see whose airplane stays aloft the longest, has the straightest path, or possesses some other quality. Some factors to consider are weight distribution, size of wings, and shape of wings. Materials you may want to have on hand are paper; sample airplane designs; clay, paper clips, or pennies for weight; scissors; and tape. It may also be helpful to have a paper airplane launcher to ensure that the airplanes are launched with approximately the same amount of force each time. (See the end of this guide for a photo of a sample launcher.)

Activity 2: Using what they learned from the paper airplane activity, have unit members construct balsa wood gliders with the goal of either staying aloft the longest or flying the farthest. This can be done in groups to conserve materials. Have participants create and draw out plans for the gliders before beginning construction. There are many resources online that can serve as references for designing gliders, such as www.amaflightschool.org/diy/what-it-takes-make-good-indoor-glider/.

Activity 3: Fly the gliders and compare the flight of the different glider designs. Discuss what could be done differently to improve the gliders. Discuss external factors that could have affected the flight of the gliders (i.e., how they were launched, weather, wind, etc.).

Activity 4: Spend time on an online flight simulator. Youth can do this outside of meeting time, where they have access to computers (home, school, libraries, community centers, etc.). At the unit meeting, discuss the impressions youth had of the simulation.

Conclusion: As a group, discuss the importance of aviation in the world today and how the role of aviation may change in the future. This is a great chance to discuss current events relating to aviation.

Requirement 3: Explore energy sources

As a unit or in smaller groups, talk about the energy sources used in STEM exploration fields (see Nova Award requirements) and energy sources that can be used in transportation. In the full group, share the highlights of what each smaller group learned.

To discuss alternative energy sources, conduct several ethical controversies—debating a specific form of alternative energy and a specific fossil fuel energy source, or debating two different alternative energy sources. Depending on the level of background knowledge the youth have, suggest that they research the energy sources before the meeting. This research could also include having an expert come talk about different energy sources.

Requirement 4: Design and build a model vehicle (not from a kit)

Obtain a variety of different parts or have each youth be responsible for bringing different parts. These parts could include wheels and axles (such as those from a pinewood derby car), wood or cardboard to serve as the body of the vehicle, motors, batteries, solar panels, pneumatic systems, and propellers. Note that while the youth cannot assemble a vehicle from a kit, materials can come from multiple, different kinds of kits. Start by displaying the materials that the youth have available and allow them to plan and draw out their design. Then, let the youth create their model vehicles, working either in

groups or individually. Once all vehicles have been assembled, set up a race to decide which vehicle is the fastest. As a group, discuss what worked well and what improvements could be made to the vehicles. If time permits, make some design modifications and repeat the competition.

Requirement 5: Big Ideas

As a group, discuss the effects that technology has on everyday life. Consider both high-tech and low-tech (digital technology vs. other types of technology). Predict how technologies may continue to develop in the future. Some questions to consider could be: Where do you see technology in your everyday life? How does technology affect your way of thinking? How does technology have a negative or positive impact on society? What purpose does technology serve in our world?

Hang On! Nova Award

The following plan is for completing the Hang On! (engineering) Nova Award using the Inventing exploration. This is one suggestion for how youth can work toward earning the Nova Award over the course of four 2½- to 3-hour meetings as a unit; the specific requirements should be followed to ensure proper completion of the award. A trained and registered Nova counselor must work with youth to verify completion of the requirements. In the following plan, it is assumed that, while the activities are youth-led, a Nova counselor is present as well to work with the unit (this Nova counselor could be a leader, for example, or another parent).

Calendar of Requirements

Unit Meeting 1—Opening (5 minutes)

Requirement 1 (2 hours 25 minutes)

Unit Meeting 2—Opening (5 minutes)

Requirements 3A and 3B (30 minutes)

Requirement 4B (40 minutes)

Requirement 5 (45 minutes)

Unit Meeting 3—Opening (5 minutes)

Expert Presentation (45 minutes)

Exploration Activity 1 (40 minutes)

Exploration Activity 2 (1 hour)

Unit Meeting 4—Opening (5 minutes)

Exploration Activity 3 (1 hour)

Exploration Activity 4 (40 minutes)

Requirement 6/Exploration Conclusion (45 minutes)

Requirement 1: Read/research/watch about three hours of motion-related material

This can be done by watching a related movie or documentary during a meeting or holding a movie night. For instance, National Geographic's documentary "Megastructures: World's Fastest Rollercoaster" could make up a portion of the video material. After the movie, the youth should discuss ideas that appear in the movie. If the unit wishes to avoid sitting for a long period of time or watching a movie during meeting time, the movie could be replaced with a live demonstration at a local science center or by bringing in experts to conduct a demonstration at an event. Additionally, members could research or watch videos on motion outside of meetings and share what they learned in a discussion. Discussions like these could occur at a meeting, but could also occur around a campfire or in the car on the way to a

unit event or high-adventure activity. For instance, members could consider all the technology related to amusement park rides and the safety features included in them and discuss at a meeting or on the drive to an event.

Requirement 2: Inventing exploration

As a group, discuss the effects that technology has on everyday life. Consider both high-tech and low-tech (digital technology vs. other types of technology). Predict how technologies may continue to develop in the future. Some questions to consider could be: Where do you see technology in your everyday life? How does technology affect your way of thinking? How does technology have a negative or positive impact on society? What purpose does technology serve in our world?

All the following requirements must be completed by each Sea Scout or Venturer to receive credit for the exploration. Be sure to check the exact requirements to make sure each youth has actually and personally earned the award.

Consultant: Invite a consultant with expertise in marketing or production to talk to the unit about what it takes to create, produce, and market products. This expert could be an entrepreneur, an inventor, a businessperson, an engineer, etc. The expert should make sure to discuss his or her own job and career, as well as other options in that field.

Activity 1: Individually brainstorm problems that people encounter daily or that the youth routinely run into, especially those that might be solvable with a product. Then discuss the problems as a group and keep a running list of as many as you can think of. Talk about which problems could be solved through engineering.

Activity 2: Split the unit into smaller groups (depending on unit size) and have each group pick one of the problems to solve. Have them brainstorm multiple solutions and draw out several. The groups should select the single most promising solution to move forward, which may be a combination of several designs. The groups should then identify what components this solution will have and how they could be modeled; they should plan to bring materials for a prototype to the next meeting.

Activity 3: The groups should build a prototype of their solution. Before beginning to build, they should identify any relevant safety precautions. They should test the product and iterate to improve it. They should also identify and discuss the simple machines that are involved in their solution.

Activity 4: The groups should discuss how their product could be marketed and who the target audience would be. They can present this marketing strategy to the other groups or the unit committee.

Conclusion: The crew or ship should, as a group, discuss the role of inventing in society and the impact inventing has in solving world problems.

Requirement 3: Simple machines

Requirements 3A and 3B—As a group, discuss the six simple machines. A good way to do this is to have each youth present one or two machines to the rest of the group, noting where each is commonly seen.

Requirement 4: Application of simple machines

Requirement 4B—Visit a local playground, either at your chartered organization, a school, or a community park. Have each youth identify the simple machines and forces involved in at least two different pieces of playground equipment.

Requirement 5: Designing equipment

After exploring the playground equipment, have each youth draw out a design for a new piece of playground equipment. As a group, have the youth share their designs and talk about the simple machines and energy sources in their design.

Requirement 6: Big ideas

As a group, discuss the impact engineering has on society and how society can be used in solving problems. Consider gearing the discussion toward current events such as natural disaster relief or community building projects.

INTEGRATING STEM ACTIVITIES INTO YOUR VENTURING CREW OR SEA SCOUT SHIP

Highlighting the STEM in Venturing and Sea Scouting

STEM is everywhere around us and is especially prevalent in the Scouting program. A few examples are listed below.

Science: astronomy, water treatment, weather conditions for better sailing

Technology: geocaching, GPS, maritime communication equipment

Engineering: fire construction, backpacking gear, knots

Mathematics: calculating how long it will take to hike x number of miles with y amount of weight, figuring out how much food to purchase with x people and a budget limit, determining magnetic declination when navigating

This section reviews easy ways to highlight the STEM you're already doing in your crew or ship for those units that do not want to work toward earning awards. For example, you can point out how your unit uses math to determine your location when hiking or sailing.

Remember, neither adults nor youth need to be experts in any of the STEM topics that the unit talks about. Discussions could be about how those in the unit think something may work, with follow-up later. Some units may have different members explore different aspects of a topic, then report back to the group. Other units may bring in outside consultants to talk about topics. Often units have "hidden experts" in the form of a youth or leader who may be knowledgeable about a topic from experience, a hobby, or a job. Of course, discussions may simply introduce leading questions to start the youth thinking, which the youth could explore later if they are interested.

When holding discussions about STEM topics, be careful to avoid lectures or lessons that make it seem as if you are in a classroom. Discussions should generally be informal and may be held around a campfire or in conjunction with a story. These come up as "teachable moments" and don't need to be a set length or too intense.

Hiking/Sailing

While your unit is out hiking or sailing, encourage STEM-based conversations. Don't lecture; that makes the conversation too much like school and not enjoyable. Have those in your unit communicate about the technology of hiking boots or deck shoes, for example. Discuss how the technology has changed and advanced to keep up with the ever-growing demands of the niche they serve, and how better products allow people to do things not previously possible.

You can begin the conversation by asking questions such as:

- How have hiking boots/deck shoes changed in the past 50 years? 100 years?
- What modifications have been made to improve the quality of the boots/shoes for hikers/sailors?

- How has the weight changed?
- What about the technology of waterproofing new materials?
- Why do we have to "break in" our boots?
- What are the specific properties that make a poor hiking boot or a good deck shoe?

This is just one example of a conversation that could take place while on a hike or sailing excursion. Others are geology/rock formation, trail building and maintenance, ship upkeep, technology of backpacks, or even the different forms of water treatment.

Pioneering

While working on wilderness survival and pioneering projects, Sea Scouts or Venturers could talk about the history of survival, and how people had to use different engineering techniques to make tools and survive without all the commodities of today. For example, a conversation about bridge construction, materials used to construct bridges, and how the builders planned for maximum load could lead to comparisons of how bridges are built today. Talk about how explorers had to use a map to navigate mountains or use a nautical chart and compass to navigate uncharted territory. Or even mention some first-aid practices from the past and discuss the lack at that time of more advanced methods to help heal the sick and injured.

First Aid

Along those lines, you could talk about the first aid of today with your unit and how it has transformed throughout history. What major scientific and technological discoveries have we made that have extended the human lifespan and improved the quality of life? What household first-aid treatments that were once commonplace have been dispelled as wrong or harmful? What are some practices that we think are healthy but are not—and how did scientists discover that?

Camping/Sailing Overnight

A campout/overnight trip is filled with STEM opportunities for you and your unit to think about and discuss. From the leaves changing color and the specific heat of different materials to tide/water levels and astronomy, camping and sailing hold a treasure trove of STEM topics. STEM is everywhere around us, and overnights are the perfect opportunity to see this firsthand.

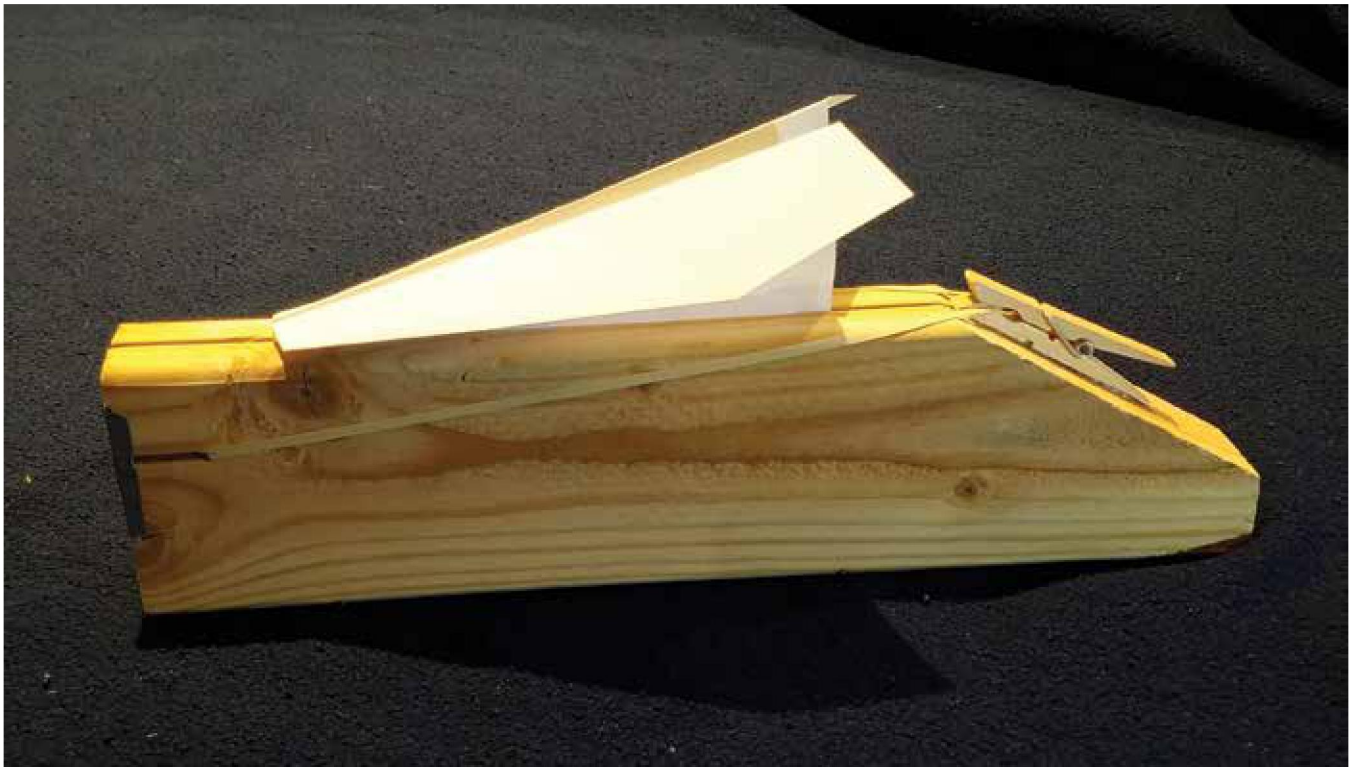
Money

To plan out that amazing campout or sailing adventure, your unit must calculate the cost of supplies and divide that among the members. How much will each person pay for food and gas? Will you be going to any restaurants or attractions where payment is required? Even basic activities such as counting tents and calculating the space required for your unit to stay are arithmetic skills necessary throughout life.

ADVANCING TO SUPERNOVA AWARDS

The Supernova awards require moving to the next level and demonstrating superior achievement in the understanding and appreciation of the STEM fields. The Supernova awards are available to Venturers and Sea Scouts who have completed at least three Nova awards. Supernova awards, unlike the Nova awards, cannot be earned in a group setting but instead must be pursued individually. Also, unlike the Nova awards, the Supernova awards require the Sea Scout or Venturer to work closely with a trained and registered Supernova mentor. Contact your local district or council advancement chair to locate a council-approved Supernova mentor in your area.

SAMPLE FOR CONSTRUCTING A PAPER AIRPLANE LAUNCHER (See page 4.)



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