The BSA NOVA and SUPERNOVA Scouting STEM Program

Background:

Youth enjoy learning about the world. Their curiosity drives them to learn how and why things work. They are natural born Scientists when they observe natural phenomena around them or experiment with things they see. When they try and figure out physical relationships or answer problems, they are exercising/developing Mathematical skills. When they start programming our smart phones and writing apps, they are developing Technology skills. Then when they put it all together and build a replica power plant using Legos or try and make a rocket or fort, they are using Engineering skills.

It is a fact that over 50% of engineers were in scouting in some form or fashion, about 80% of astronauts were in in Scouting. Commonly, successful individuals in STEM fields credit some of their success to the principles and experiences that they learned in Scouting. Encouraging a Scout's natural interest and inclination to study the world around them is a fundamental aspect of scouting and has been since its inception.

Science, Technology, Engineering and Mathematics (STEM) studies have been a part of Scouting for a very long time but was never referred to as STEM. Many of those Scouting STEM activities from decades ago have now made it into the mainstream education program. Scouting was a STEM program long before STEM was popular or even called STEM.

About five years ago, BSA decided to formalize and expand the STEM content for ALL levels of scouting to encourage youth exposure to Science, Technology, Engineering and Mathematics. Youth crave STEM and the world needs more Scientists, Technologist, Engineers and Mathematicians to continue to help solve our problems. Even if Scouts don't end up with STEM careers, the skills they develop in STEM activities and the critical thinking skills are important for their success.

The STEM program and awards are called NOVAs and SUPERNOVAs and integrate with the rest of the Scouting program.

Overview:

What is STEM? Science, Technology, Engineering and Mathematics. STEM loosely applies to anything relating to studying the STEM fields or interest in the STEM fields. In BSA, the STEM program is a formal part of the overall BSA program and is integrated into the activities at all levels. The STEM awards (NOVAs and SUPERNOVAs) are recognitions for Scouts who show added interest in these fields.

Why is STEM important to Scouting? STEM studies have always been a part of Scouting, although not formally called STEM until recently. The principles behind STEM directly relate to the Aims of Scouting: Character Development (becoming self-sufficient and capable), Citizenship (understanding the world around us and how it works), Mental and Physical Fitness (developing critical thinking and reasoning skills).

Is there a Scouting STEM Program? Yes, it is in parallel with the rank advancements and has links to many of the adventures (Cubs), merit badges (Boy Scouts), Fields of Interest (Venturing).

Who all is it open to? The STEM program is open to any and all Scouts in BSA. The awards can only be earned by registered Scouts. However, including parents and siblings can make the activities more fun and inclusive.

How is STEM integrated with the Scouting programs? Each level of Scouting has its own NOVA and SUPERNOVA awards with requirements that are age appropriate. NOVA awards require completion of certain STEM related adventures/merit badges/activities

Will STEM count toward any other awards/advancements? There are elements of STEM within each rank advancement and other award. However, NOVA and SUPERNOVA awards are not required for any award outside of the STEM program.

Are Adventures/Merit Badge/Fields of Interest related to STEM? Since Scouting has always had a STEM overtone, a fair amount of the Adventures/Merit Badges/Fields of Interest relate very directly to STEM activities.

What types of things do the boys do? Conduct experiments, design and/or build simple to complex machines, coding, make and decipher secret messages, investigate orbital mechanics/stars/planets, build rockets, boats and cars, study the environment and nature/animals/plants, make volcanoes, study weather and geology, collect rocks/fossils, design and build a marble roller coaster, learn about farming and the science of agriculture, science of sports, learn about STEM professions and famous people in STEM areas.

Are there activities or just talk? The Scouting STEM program should follow the EDGE method where topics are Explained and Demonstrated followed by Guidance and Enabling. So there is some element of teaching, but most of it should be guided activities. STEM activities should be geared toward holding Scouts' attention, which is best done through dynamic demonstrations and participation by ALL Scouts.

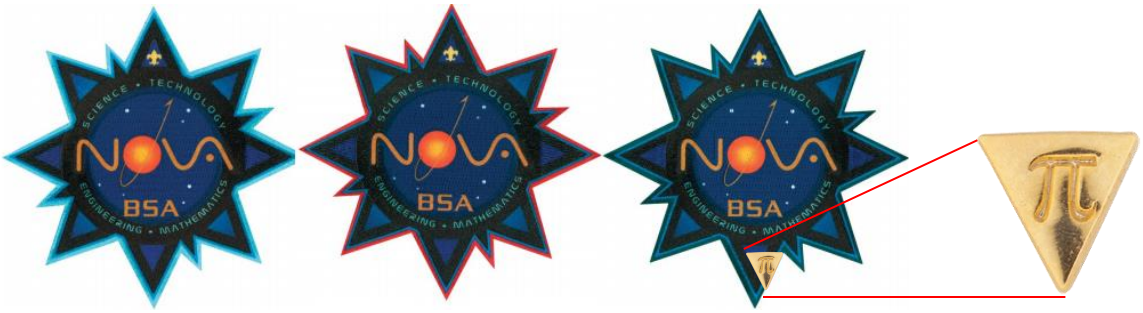
Should STEM be a boy led activity? For Boy Scouts and Venturers, there is a component of being boy led. Each of the SUPERNOVAS requires running a STEM activity for other Scouts to participate in. This is very important because the Cub Scouts SUPERNOVA requires participation in Boy Scout or Venturer led STEM activities if possible. Boy Scouts and Venturers will have the opportunity to have a boy led activity at the District event.

What do the Scouts get out of STEM? Scouts learn about STEM careers and fields of study and well as develop an appreciation for the STEM fields. Additionally, Scouts learn to think for themselves and how to apply the scientific method and critical thinking skills to everyday problems and challenges that they face. Also, it is really cool to launch rockets, build catapults, conduct chemistry experiments and study secret codes, etc.

Specifics of the BSA STEM Program:

What are the STEM awards? NOVA awards are the introductory STEM awards and specialize in particular Science, Technology, Engineering or Mathematics disciplines. Typically, NOVA

awards are one step above adventures or merit badges and 2 steps below rank advancement. The first NOVA award is the patch shown below. Subsequent NOVA awards are Pi pins that can be pinned onto the NOVA patch.



Cub Scout Nova | Boy Scout Nova | Venturer Nova | Pi Pin

SUPEROVA awards are more in depth and require the completion of one or more NOVA awards before beginning. SUPERNOVA awards require more detailed independent study including a project of some sort. Reports are required for the Boy Scout and Venture Scout SUPERNOVAS. SUPERNOVA awards are one step below rank advancement in complexity.

Dr. Luis W. Alvarez *Cub Scouts* | Dr. Charles H. Townes *Webelos* | **Dr. Bernard Harris** *Boy Scouts* | **Thomas Edison** *Boy Scouts* | **Dr. Sally Ride** *Venture Scouts* | **Wright Brothers** *Venture Scouts* | **Dr. Albert Einstein** *Venture Scouts*

Do boys have to finish each award in one year? Awards are multiyear unlike the rank advancements (Cub Scouts). However, they do have to be finished prior to promoting to the next level.

How difficult is the STEM program? The STEM program is not intended to be a difficult, but instead it is a method to expose Scouts to STEM related experiences. NOVAs and SUPERNOVAs range in difficulty and complexity and the challenges are also different for Scouts with different inclinations, ages and experiences. Any Scout is capable of earning any of the NOVAs or SUPERNOVAs for their program (i.e. Cubs, Boy Scouts, Venturers) with the dedicated support of their Counselors and Mentors. If Scouts earn NOVAs and SUPERNOVAs, that is awesome, but if they don't they are still likely to have fun participating.

Where do I find the NOVA and SUPERNOVA requirements?

https://www.scouting.org/stem/Awards.aspx

How to Help:

Why should parents participate? Scouting can only be successful with strong parent participation. The STEM potion of the program is even more so. This applies to all levels of the program. Thus, for Scouts to be successful, parents have to lend them a helping hand. From a purely rewarding point of view, there are few things a parent can do that is more rewarding than helping a child figure something out. The "aha" moment is really cool to see.

How can I get involved? All it takes to get involved is a desire to help. Being a counselor or mentor has no fixed duties other than to meet with and encourage Scouts in STEM activities. All it takes is a simple application (position code 52 for Supernova Counselors and position code 58 for Nova Mentors) and completion of Youth Protection training. However, there is a district level committee open to volunteers wanting to help out at a higher level.

Who can be mentors and counselors? Counselors can be any adult interested in supporting scouts through NOVA activities. Primarily, the role of Counselor is to listen to the Scout and discuss what the Scout has learned working on the NOVA award. This includes asking questions and verifying that the work has been completed. Mentors on the other hand should serve as guides to completing SUPERNOVAs and should have some training in one of the STEM areas as well as experience. Guiding Scouts includes evaluating independent activities, providing suggestions and overall helping the Scout learn something useful from their efforts. ***Under all circumstances, 2 deep leadership MUST be observed. NEVER meet one on one with a Scout. All counselors and mentors MUST be registered Scouters with the District (not the unit) with Youth Protection Training (~30 minutes on line). There is no registration fee.***

How much time does it take? Including STEM in a unit requires some time by Mentors and Counselors. Most of it is in the actual planning of an activity, gathering supplies and conducting the experiments. Usually, this is rather limited to one or maybe two activities a year. Additionally, Mentors and Counselors have to spend some time talking to the Scouts to ensure Scouts have an opportunity to earn the awards. District level support in the form of participation on the District STEM committee or support of the District STEM events would be much appreciated.

Should we use the EDGE method? The Scouting STEM program should follow the Explain, Demonstrate, Guide, Enable (EDGE) method where topics are thoroughly Explained with an emphasis on safety and Demonstrated to show how something works and point out the important factors followed by Guidance and Enabling as Scout move to conducting their own activities.

How do I know if something is too dangerous? NEVER let it be dangerous! The primary responsibility of STEM Counselors and Mentors is to ensure safety of the Scouts. Use the Guide to Safe Scouting to help determine safe activities. Always practice demonstrations/activities prior to sharing them with the Scouts. Consult with other Counselors, Mentors, the District STEM Committee or District STEM Chair if necessary. If there is any doubt or hesitation, be safe and table the activity until it can be conducted safely.

Incorporating STEM into Pack, Troops and Crews:

How do we support Scout STEM activities with everything else Scouts work on? Because STEM is already integrated into Scouting, most of the activity will not be extra effort. However, earning the NOVA and SUPERNOVA awards requires some activity outside of the traditional programs. For Cub Scouts, Den and Pack leaders need to evaluate the overall interests of their Scouts to determine if they want to include the extra efforts needed to complete NOVAs and SUPERNOVAs. For Boy Scouts and Venture Scouts, the Patrol Leadership Council (PLC) should be exposed to the program and allowed to decide if they want to include the STEM program in their troop activities. Under most conditions, most of the NOVA and SUPERNOVA awards will be given to individual Scouts wanting to pursue them outside of organized Den, Pack or Troop activities. This is where Counsellors and Mentors come in. It does take time to support individual activities.

How do we promote STEM activities? STEM is relatively easy to promote in Cub Scouts as parents are generally in favor of STEM activities and Cub Scouts will enjoy it as long as it isn't someone just talking. Usually, there will be one Pack meeting a year where no one is quite sure of what to do. Although, Cub Scout programs are usually planned out for the Pack meetings for the year, so it is best to promote Pack level STEM activities at the annual planning meeting. Den meetings after the Blue and Gold are great opportunities for the Scouts. Den leaders will also appreciate added ideas for them in this time frame. For troops, the STEM topic needs to be presented to the PLC during their planning sessions. Typically, suggesting an idea for one of the troop meetings is welcome by the Scouts looking for ideas for their troop activities.

How much does it cost to have a good STEM program? Cost is always a concern for Scout Units. An effective STEM activity can be run for only a few dollars (i.e. marshmallow catapults, chemistry, levers, water rockets, etc.) to tens of dollars (large catapults, electromagnets/electricity, air rockets, etc.) to hundreds of dollars (i.e. museum trips. museum overnights, speaker fees, etc.). The STEM Committee and Chair can help with low cost ideas.

What do you have to buy? Nothing is explicitly required, but eye protection and gloves can be good ideas depending on what is done. Pack assets such as water rocket launchers, ESTES rocket launchers, pinewood derby tracks, rain gutter regatta tracks, space derby tracks, candles, cups, napkins and plates can be helpful. Beyond that, each activity will have its own equipment requirements. Of course, buying the NOVA patches and pins and SUPERNOVA medallions.

District Support for STEM:

Is there someone in charge of the STEM program in the Alpine District? The Alpine District has created a STEM Chairman position to oversee the STEM activities at the District level, coordinate STEM counselors and mentors and to support units incorporating the STEM program into their activities. The current STEM Chair is Steven Stanley, steven_stanley@comcast.net. Additionally, a STEM Committee will be established to help with the STEM program. Volunteers for the Committee are always welcome.

Who do I contact for help? The STEM Chair, Steven Stanley, steven_stanley@comcast.net or the Alpine STEM committee.

Is the District going to have any activities to help incorporate STEM activities? The current plan is to start working on having a District event next Spring and to recruit volunteers to help put it on this year. The event will depend on how many mentors and counselors are willing to help put it on.

What are some ideas for STEM activities? Here are some ideas that hopefully can help get the ball rolling. Don't be afraid to research other activities on the net, contact people you know, contact the District Committee or Chairman. Just be sure to try out any activities prior to using them to make sure they are safe, you understand the principles to explain it and can help guide the activity.

Activity	Category	Type of Activity	Ages	Comments
Paper Airplane or helicopter launchers	SEM	Participation	Cubs	https://www.youtube.com/watch?v=jmK6tsAedUo
Musical instruments (air movement /percussion, vibration /strings, air vibration /wind instruments, etc., tin can telephones)	S	Participation	Cubs	This is a wide open area and there are endless illustrations of how soundwaves are created and propagate
Density gradients (different fluids/diff colors, stack the fluids and then "float" different seeds on different layers)	S	Demo Participation	Cubs	
Oobleck – 1 part water, 2 parts corn starch, food coloring. – Non-Newtonian fluid	S	Participation	Cubs	There are lots of cool ways to use this simple non-Newtonian fluid. Just do research so you can answer "Why?"
Da Vinci bridge – small scale for cubs, life size for boy scouts	E	Participation	Cubs Boys	https://www.youtube.com/watch?v=ksTe0dhvGdg
Simple Electric Motors – Lots of creative potential, but be careful of heating	STE	Demo Participation	All	https://www.youtube.com/watch?v=elFUJNodXps
Magnets	SEM	Participation	All	There are lots of potential activities that can be done with magnets. Looking on the net for ideas can be fruitful. This is a great topic for independent investigation.
Light bulbs/buzzers /electrical circuits	STE	Guided Participation	All	Creating circuits to investigate light bulbs, buzzers and other electrical gizmos can be fun. Independent investigation should be guided.

Rocket design	EM	Participation	All	Rockets come in many different forms and levels of activity. This is a great topic for independent investigation
Egg Drop contest/packaging	E	Participation	Cubs	Great activity! Contact the local fire department to see if they would be willing to drop the packages.
Electromagnets	ST	Participation	Cubs	Simple project that any cub can do. Just wind a wire a bunch of times around a nail and attach it to a battery can demonstrate the relationship between electricity and magnetism. Make sure the nail can be picked up with a magnet before wrapping it. Great activity for independent investigation.
Homemade Volcano	S	Participation	Cubs	https://www.youtube.com/watch?v=HgqebizvwNk
Homemade Batteries	STE	Participation	Cubs	Coin - https://www.youtube.com/watch?v=vIHfUJu3aKo, Potato - https://www.youtube.com/watch?v=noI7TmspMrM, Lemon - https://www.youtube.com/watch?v=DJmHgaCdgCs
Build a catapult	E	Demo Participation	All	Catapults can be made for all levels of activity. A Webelos den can make a large one for a Pack meeting, or a Troop can make one using lashings, dens or packs can make incredibly simple ones and have contests, Crews can make larger ones and enter Pumkin Chunkin' contests, etc.
Invite a speaker to a den, pack or troop meeting	STEM	Demo	All	Speakers can be great if they are engaging and encourage some form of participation. If there is no participation, Scouts will get antsy. Some examples are the Reptile Man, The Geologist, an Astronaut, a

				Rocket Scientist, etc.
Dancing Raisins	S	Demo	Cubs	https://www.youtube.com/watch?v=mEGCvj977_A
Levers	EM	Participation	Cubs	Have the cubs figure out how to lift the den leader with only to boards. What is the distance that the fulcrum needs to be from the load and the force?
Levitating magnets	S	Demo	Cubs Boys	Really neat but can be difficult to make work. https://www.youtube.com/watch?v=1RbsCiorwzI
Zip lock bag with water in it – poke holes in the bag with sharp pencils and see how many you can get through	S	Participation	Cubs	Demonstrates material properties of plastic as it deforms under load and seals around the bag. Better to do outside, just in case.
Static electricity (plastic rod electrified)	S	Participation	Cubs	https://www.youtube.com/watch?v=ViZNgU-Yt-Y
Simple magnetic train	STEM	Demo Participation	Cubs Boys	https://www.youtube.com/watch?v=IXeXcbvBPJw
Magnetized needle compass	S	Participation	Cubs	https://www.youtube.com/watch?v=emm5gJGI7JM
Magnet/battery on aluminum foil	S	Participation	Cubs	https://www.youtube.com/watch?v=XhIo25sb2-g
Slime	S	Participation	Cubs	https://www.youtube.com/watch?v=6I58j3YIlxI https://www.youtube.com/watch?v=1CwfDeHM0ss
Ping pong ball hair dryer	SE	Demo	Cubs	Turn on a hair dryer and hold it pointing up. Hold a ping pong ball in the flow and let go. It should levitate.
Water/Oil Lava lamp	S	Participation	Cubs	https://www.youtube.com/watch?v=nGA78ZT941o
Matchbox microphone	TE	Participation	Boys	https://www.youtube.com/watch?v=yj-wkw98j7Q
Refraction experiment	S	Demo	Cubs	https://www.youtube.com/watch?v=hbrH8dxSs70
Gobbstopper science – put in shallow tray of water	S	Participation	Cubs	https://www.youtube.com/watch?v=NISCx1cg8z8
Clean penny with lime	S	Participation	Cubs	https://www.youtube.com/watch?v=j-mKQ8pdGSA
Baking soda and vinegar rockets	SE	Participation	Cubs Boys	https://www.youtube.com/watch?v=lwiosotOlWU
Coin battery	ST	Participation	Cubs	https://www.youtube.com/wat

				ch?v=s3qJFgOWwdY Use older pennies that were made of copper (before 1982)
Plastic Milk	S	Participation	Cubs Boys	https://www.youtube.com/watch?v=VFvik_THcNQ
Build a trebuchet	EM	Participation	Boys Crews	https://www.youtube.com/watch?v=9-Hwxw4fgqk
Make a wind tunnel	SEM	Participation	Boys Crews	https://www.youtube.com/watch?v=qDQncRSlL8c
Make a Tesla Coil	STEM	Participation	Boys Crews	https://www.youtube.com/watch?v=LHCXqhhxGqA
Reubens Tube	SEM	Demo Participation	Boys Crews	https://www.youtube.com/watch?v=cnofCrAmV5I , https://www.youtube.com/watch?v=BbPgy4sHYTw , http://www.instructables.com/id/How-to-make-a-Rubens-Tube/
DC Motor	STEM	Participation	Boys Crews	https://www.youtube.com/watch?v=GX-ougup9YM
Solenoids	STEM	Participation	Boys Crews	https://www.youtube.com/watch?v=ueuiGtYWb08

Are there any Resources available to help with a STEM program?

- Online Nova Counselor/Supernova Mentor training
- Supernova Mentor application
- Volume = Length × Width × Height
- Other Scouting resources
- Greater St. Louis Area Council: http://www.stlbsa.org/programs/stem/Pages/STEM.aspx
- Northeastern Pennsylvania Council: http://www.nepabsa.org/advancement/stem-nova
- Baltimore Area Council: http://www.baltimorebsa.org/stem/47522
- Patriots' Path Council (summer/day camp): http://www.camps.ppbsa.org/camps/wheeler/stem.htm and http://www.camps.ppbsa.org/camps/somers/Backwoods_Engineering_Camp.htm
- Boy Scouts of America: http://www.scouting.org/stem.aspx
- US Scouting Service Project: http://usscouts.org/usscouts/advance/nova/index.asp
- Television Programs and Videos
  - PBS ("NOVA")
  - PBS Kids
  - Discovery Channel
  - Discovery Kids
  - Science Channel
  - National Geographic Channel
  - TED Talks (online videos)
  - History Channel
  - History Channel "Modern Marvels"
- Magazines
  - Discover Magazine
  - Popular Mechanics Magazine
  - Popular Science Magazine
  - Science Illustrated Magazine

- Air & Space Magazine
- Popular Astronomy Magazine
- Highlights for Kids Magazine
- Astronomy Magazine
- Science News
- Science News for Kids
- Sky & Telescope Magazine
- Natural History Magazine
- Robot Magazine
- Servo Magazine
- Nuts and Volts Magazine
- Scientific American Magazine
- National Geographic Magazine
- National Geographic Kids
- Kids Discover
- OWL Kids
- Odyssey Magazine

- Government Websites
  - NASA
  - NASA's Space Place
  - Energy Kids (US Dept of Energy)
  - USGS Education
  - Earthquakes for Kids
  - EPA for Students
- Other Websites
  - BBC Bitesize Science and Math for ages 8-11
  - BBC Bitesize Science and Math for ages 11-14
  - How to Calculate Your Horsepower
  - Six Simple Machines
  - Projectile Motion
  - Types of Levers
  - 19 Super Cool Science Experiments for Kids – (5 minute crafts on YouTube)
  - Hoopla Kids Lab