



Integrating STEM into Scouting Programs

Science, Technology, Engineering, and Math (STEM)

Prepared for the 2020 Chief Seattle PTC



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Welcome

400 Level Course

$$\text{PROGRAM} = \int_{\text{NOW}}^{\infty} \text{STEM dActivity}$$



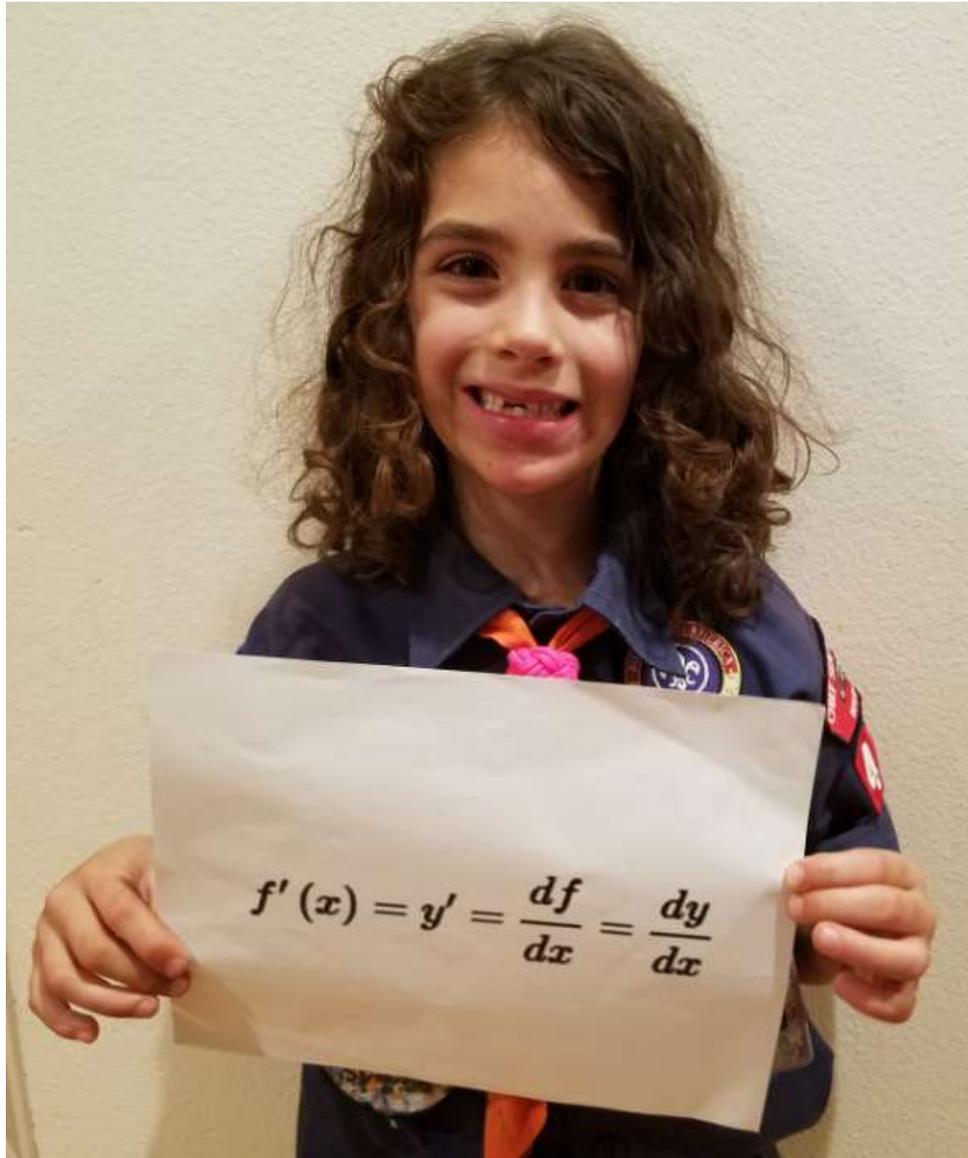


Prerequisite Coursework:

300 Level: Pre-Calculus for Cub Scouts



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About Patrick Montemerlo

- Licensed Professional Civil Engineer in FL, WA, CO, and TX specializing in Bridges, Structures and Rail.
- BS and MS in Civil Eng. University of New Mexico
 - Computer Programming
 - Graduate Research in Inflatable Telescope Lenses
- Camp Staffer including PennState STEM Camps
- Arrow of Light, Eagle Scout w/ 8 Palms
- Competed in International Science Fair



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About Melanie Violette

- Aeronautical Engineer
- Continued Operational Safety Program Manager for Federal Aviation Administration
- PhD in Engineering Mechanics, University of Texas at Austin
 - Graduate Research in Composite Materials
- Assistant Scoutmaster, Troop 676
- The instructors met at Wood Badge.

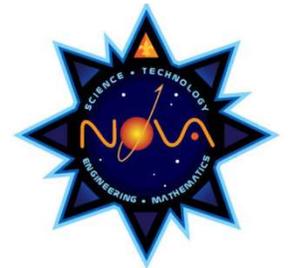


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Discussion:

What are our conceptions of the Scouting Program?

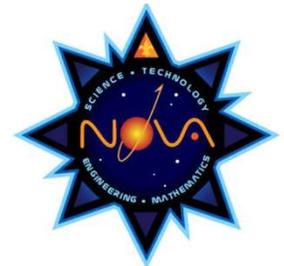
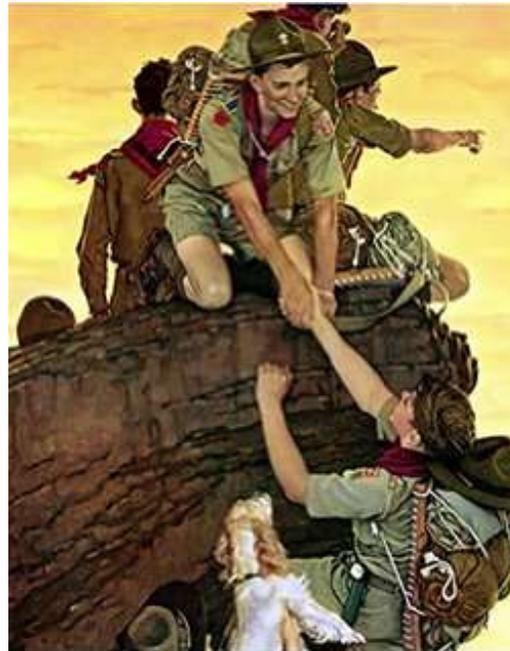


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What are our conceptions of the Scouting Program?

- We are an outdoor/civic/leadership program
- Cub Scouts – Arts and Crafts
- We do:
 - Wilderness survival
 - Knots/Lashings
 - First Aid
 - Camping
- Advancement to Eagle



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How about these guys?



Neil Armstrong, Eagle Scout



Bill Gates, Life Scout

- **Peter Agre**, biologist who received 2003 Nobel Prize in Chemistry (Eagle Scout, Class of 1964)
- **Buzz Aldrin**, second man to walk on the moon
- **Neil Armstrong**, astronaut and first man to walk on the moon (Eagle Scout, Class of 1947)
- **Lee Berger**, National Geographic explorer and paleoanthropologist (Eagle Scout, Class of 1983)
- **Guion Bluford**, first African-American in space (Eagle Scout)
- **Thomas Cech**, chemist who received 1989 Nobel Prize in Chemistry (Eagle Scout, Class of 1962)
- **Roger Chaffee**, astronaut who was killed in the Apollo 1 mission (Eagle Scout, Class of 1951)
- **Charles Duke**, astronaut and 10th man to walk on the moon (Eagle Scout, Class of 1946)
- **Philo T. Farnsworth**, inventor of the modern television (Eagle Scout, Class of 1932)
- **Steve Fossett**, record-setting aviator (Eagle Scout, Class of 1957)
- **Jim Lovell**, astronaut who was commander of Apollo 13 mission (Eagle Scout, Class of 1943)
- **William Moerner**, physicist who received 2014 Nobel Prize in Chemistry (Eagle Scout, Class of 1967)
- **Ellison Onizuka**, astronaut who died in the Space Shuttle Challenger explosion (Eagle Scout, Class of 1964)
- **Paul Siple**, Antarctic explorer who coined the term “wind chill” (Eagle Scout, Class of 1924)
- **E. O. Wilson**, researcher, two-time Pulitzer Prize winner and the world’s top ant expert (Eagle Scout, Class of 1944)



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Baden-Powell and Science

There is not a lot out there about BP and science

- Father – Died when BP was three years old
 - English mathematician
 - Put forward advanced ideas of evolution
- Godfather – Named after Robert Stephenson
 - Railway and Civil Engineer
- Brother – Baden Baden-Powell
 - Helped Build Royal Aeronautical Society
 - Passion for Flight – Built kites, gliders and eventually a powered plane



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BSA Vision Statement

BSA will prepare every eligible youth in America to become a responsible participating citizen and leader who is guided by the Scout Oath and Law.



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What is STEM?

Science

Technology

Engineering

Math

STEM



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Why STEM?

(From the BSA)

We live in a time of great opportunity. The spirit of innovation can help us overcome challenges and ensure a prosperous and secure future. To seize this opportunity, **we must position ourselves at the cutting edge of scientific discovery and technological innovation.**

Yet our country is falling behind in science, technology, engineering and mathematics. This is why many professionals and educators in science, technology, engineering, and mathematics believe the United States should do more now than ever to encourage students to enter STEM-related fields. These experts say **our young people need strong STEM skills to compete in the world market.** We must work together to cultivate the next generation of critical thinkers and innovators.





Why STEM?

(From the Instructor)

- It Teaches us Critical Thinking and Decision-Making Skills.
- It can help creativity.
- It provides opportunities for all Scouts who might not have exposure.
- It creates interest.
- It opens up opportunities.





How do we integrate STEM?

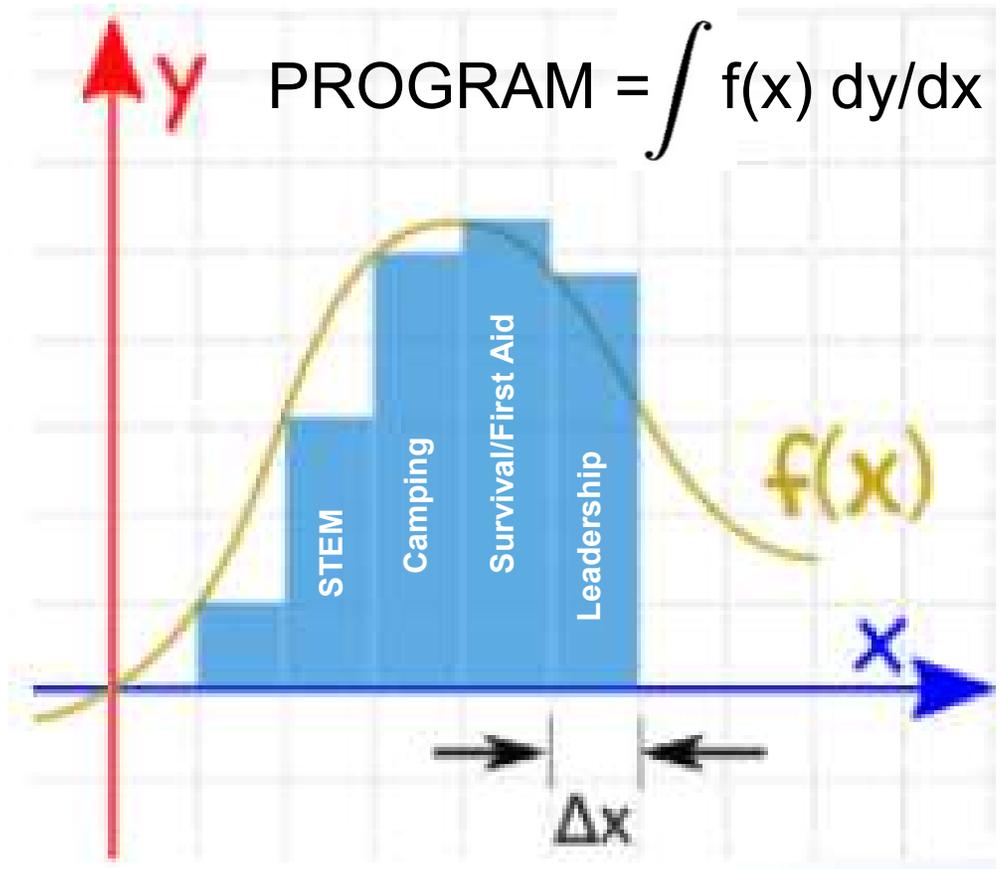


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An integral calculates the area defined by an equation and set of boundary conditions by summing smaller areas

Just like an integral, our program is the sum of its parts.



If our result is to create an engaging program for all youth, we need to provide everyone something that they enjoy and can learn from.





What's already out there?

**You don't have to look far...
It is embedded in the program**



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STEM—Science, Technology, Engineering and Mathematics

STEM is part of an initiative the Boy Scouts of America has taken on to encourage the natural curiosity of youth members and their sense of wonder about these fields through existing programs.

From archery to welding, Scouts can't help but enjoy the wide range of STEM-related activities.

To support this initiative, the BSA developed the STEM Nova Awards program so that youth members have fun and receive recognition for their efforts.





Advancement



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ScoutsBSA Merit Badges

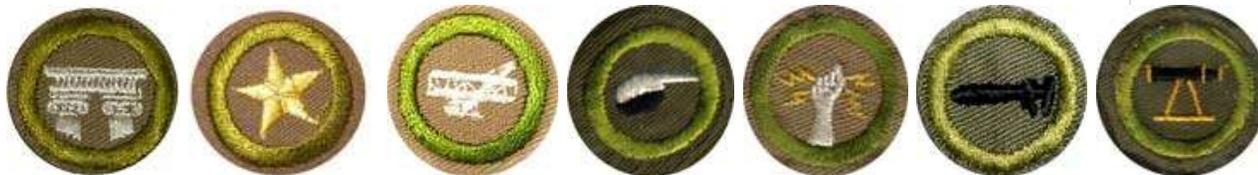


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Merit badges have always included STEM

- The original 57 merit badges introduced in 1911 included many that today we would consider STEM merit badges, such as:
 - Architecture, Astronomy, Aviation, Chemistry, Electricity, Machinery, and Surveying.
- Over the last century, hundreds of merit badges have been STEM-related, from Aeronautics to Zoology.





STEM Merit Badges in ScoutsBSA

Nova-Related Merit Badges that you can find at Camp

- Archery
- Astronomy
- Athletics
- Canoeing
- Chess
- Farm Mechanics
- Motorboating
- Orienteering
- Rifle Shooting
- Robotics
- Shotgun Shooting
- Small-Boat Sailing
- Space Exploration
- Weather

Supernova-Related Merit Badges that you can find at Camp

- Astronomy
- Bird Study
- Environmental Science
- Farm Mechanics
- Fish and Wildlife Management
- Forestry
- Gardening
- Geocaching
- Geology
- Insect Study
- Mammal Study
- Nature
- Oceanography
- Plant Science
- Pulp and Paper
- Reptile and Amphibian Study
- Scuba Diving
- Soil and Water Conservation
- Weather
- Welding





STEM Merit Badges in ScoutsBSA

- Composite Materials
- Cooking
- Digital Technology
- Drafting
- Energy
- Engineering
- Graphic Arts
- Inventing
- Nuclear Science
- Programming
- Railroading
- Robotics
- Space Exploration
- Surveying
- Traffic Study
- Weather





Cub Scouts Adventures



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STEM Adventures in Cub Scouts

Cub Scouts and Webelos Scouts

Nova-related Adventure Loops for Wolves

- Air of the Wolf
- Code of the Wolf
- Collections and Hobbies
- Digging in the Past
- Finding Your Way
- Germs Alive!
- Grow Something
- Motor Away
- Paws of Skill
- Spirit of the Water

Nova-related Adventure Loops for Bears

- A Bear Goes Fishing
- Baloo the Builder
- Bear Picnic
- Beat of the Drum
- Critter Care
- Forensics
- Make it Move
- Marble Madness
- Robotics
- Super Science

Nova-related Adventures for Webelos and Arrow of Light Scouts

- Adventures in Science
- Art Explosion
- Build It
- Earth Rocks!
- Engineering
- Fix It
- Game Design
- Into the Wild
- Into the Woods
- Looking Back
- Looking Forward
- Maestro!
- Movie Making
- Project Family

Supernova-Related Adventure Loops for Wolves and Bears

- Wolf Cub Scouts
 - Code of the Wolf
 - Call of the Wild
- Bear Cub Scouts
 - Make it Move
 - Forensics

Supernova-Related Adventures for Webelos and Arrow of Light Scouts

- Adventures in Science
- Engineer
- Build It
- First Responder
- Into the Wild
- Into the Woods

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Awards



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Cub Scouts, Scouts BSA, Venturing NOVA Awards



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NOVA Awards

- NOVA awards recognize proficiency in STEM
 - Similar to merit badges.
- They are offered at every level of Scouting:
 - Cub Scouts
 - Scouts BSA
 - Venturing



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Why the name “Nova”?

- Nova means “new.”
- In Astronomy, a Nova is when one star pulls material from its neighbor, and then explodes.
 - The Nova appears temporarily as a new star where the old one was.
 - The Nova is thousands of times brighter.
- A Supernova is when a massive star collapses on itself, and then explodes.



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Really, Really Bright!



Supernova 1994D
outshines the nearby
galaxy!

<https://apod.nasa.gov/apod/ap981230.html>

<https://imagine.gsfc.nasa.gov/science/objects/supernovae1.html>

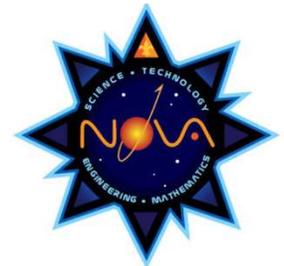


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Scouts BSA NOVA Awards

Science	Technology	Engineering	Math
Shoot!	Start Your Engines!	Whoosh!	Designed to Crunch
Let it Grow!	Hello World	Up and Away	
Splash!		Next Big Thing	
Mendel's Minions			



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SUPERNOVA Awards



SUPERNOVA Awards challenge those who like STEM to learn even more.

Scouts BSA can earn two awards:

- Dr. Bernard Harris Award
- Thomas Edison Award



Dr. Harris



Mr. Edison





SUPERNOVA Awards



- The Supernova awards recognize superior achievement in STEM fields.
- A Scout may complete the merit badges and Nova Awards any time after joining Scouts BSA, but must be First Class or higher to be eligible for the Supernova Awards.
- <https://www.scouting.org/stem-nova-awards/awards/scouts-bsa-supernova-awards/>



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Does STEM Stop at Advancement and Awards - NOVA?



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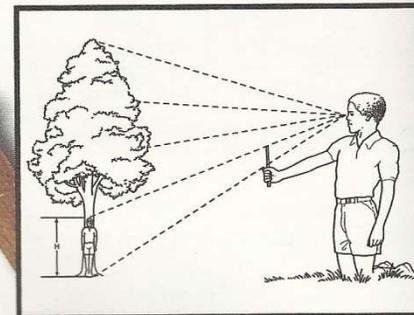


More than STEM Advancement: STEM is part of many Scouting activities!

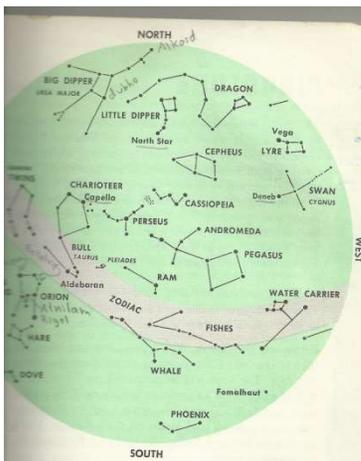


MEASURING HEIGHTS

Here are some simple ways to measure a tree's height or to estimate the elevations of towers, waterfalls, cliffs, and walls:



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2. W
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3. N
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How do we teach/learn?

Socratic Method

Learning through discussion and debate

Have you ever asked a Den of Cub Scouts how something works and watched them debate the answer?



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How do we teach/learn?

Scientific Method

Learning through exploration

1. Make an Observation
2. State a Purpose/ Ask a Question?
3. Research
4. Formulate a Hypothesis
5. Conduct an Experiment
6. Analyze Data
7. Form a Conclusion
8. Think about what comes next



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How do we integrate STEM?

Listen for the first two points of the Scientific Method

Have you ever heard a Scout say “Oh, that’s interesting... I wonder why that happens?”

1. Make an Observation
2. State a Purpose/ Ask a Question?

Curious minds are exercising STEM activates without even knowing it sometimes.



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How do we integrate STEM?

Respond to initiate the activity

4. Formulate a Hypothesis

Ask the group, “Why do you think that happens?”

Hypothesis:

A supposition or proposed explanation made on the basis of limited evidence as a starting point for further investigation

AKA – it’s an educated guess...





How do we integrate STEM?

Create the Activity

2. Research
4. Experiment

In Cub Scouts, research may be done more at the adult level

Create an experiment or activity to learn more





Examples of STEM Opportunities



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Campfire

- What is fire?
- What do you need to have a fire?
- Observe temperature, heat, color
- Combustion
- Solid state transitions of a S'more





Music

- Let's talk about STEAM
- Stringed instruments and vibration
- How does sound come out of a bugle
- Instruments and materials engineering



Donald in Mathmagic Land -1959



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Stomp Rockets

- Pressure, Weight
- Materials
- Geometry, Flight paths





Model Rockets

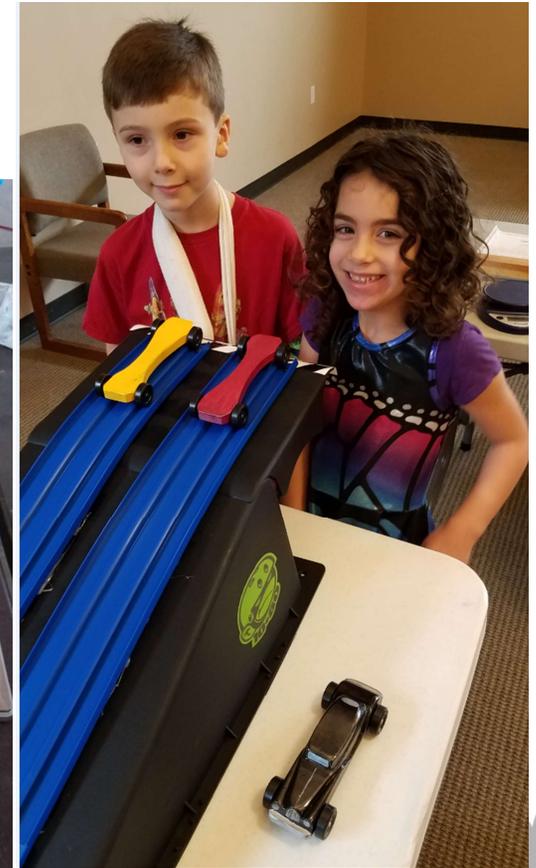
- Thrust, Combustion
- Electricity, Circuits
- Calculus
- Parachute Performance vs Survivability





Pinewood Derby

- Weight & distribution
- Axle Spacing
- Angle of Track
- Height of Track



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Raingutter Regatta

- Aerodynamics
- Friction/Fluid Resistance
- Buoyancy
- Size of Scout
- Mechanical Thrust
- Sail Design

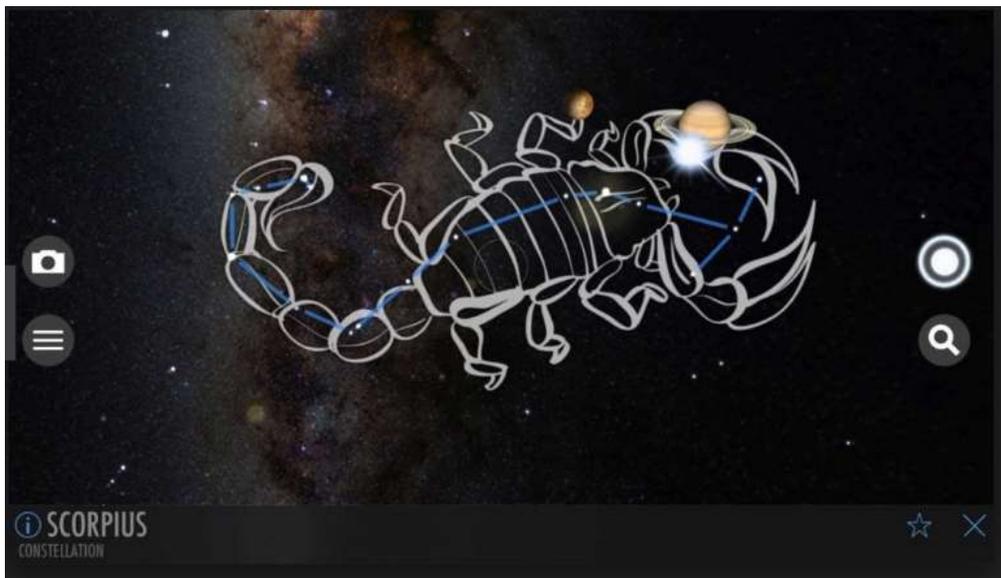


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BSA Astronomy MB

- All you need is a clear night and a telephone
- Apps like SkyView (not SkyNet....). They turn you into a facilitator.



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BSA Composite Materials MB



A carbon fiber bridge can hold 4,000 x its weight!





Other Ideas

- Geocaching
- Robotics/Programming
- Cooking
- Chemistry
- Natural Science





Put the Outing Back in Scouting

Plan a Field Trip

- Museum of Flight
- Aquarium
- Living Computer Museum
- Pacific Science Center
- Planetarium
- Hands On Museums



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Breakdown of a Task into Stem Elements using the OA



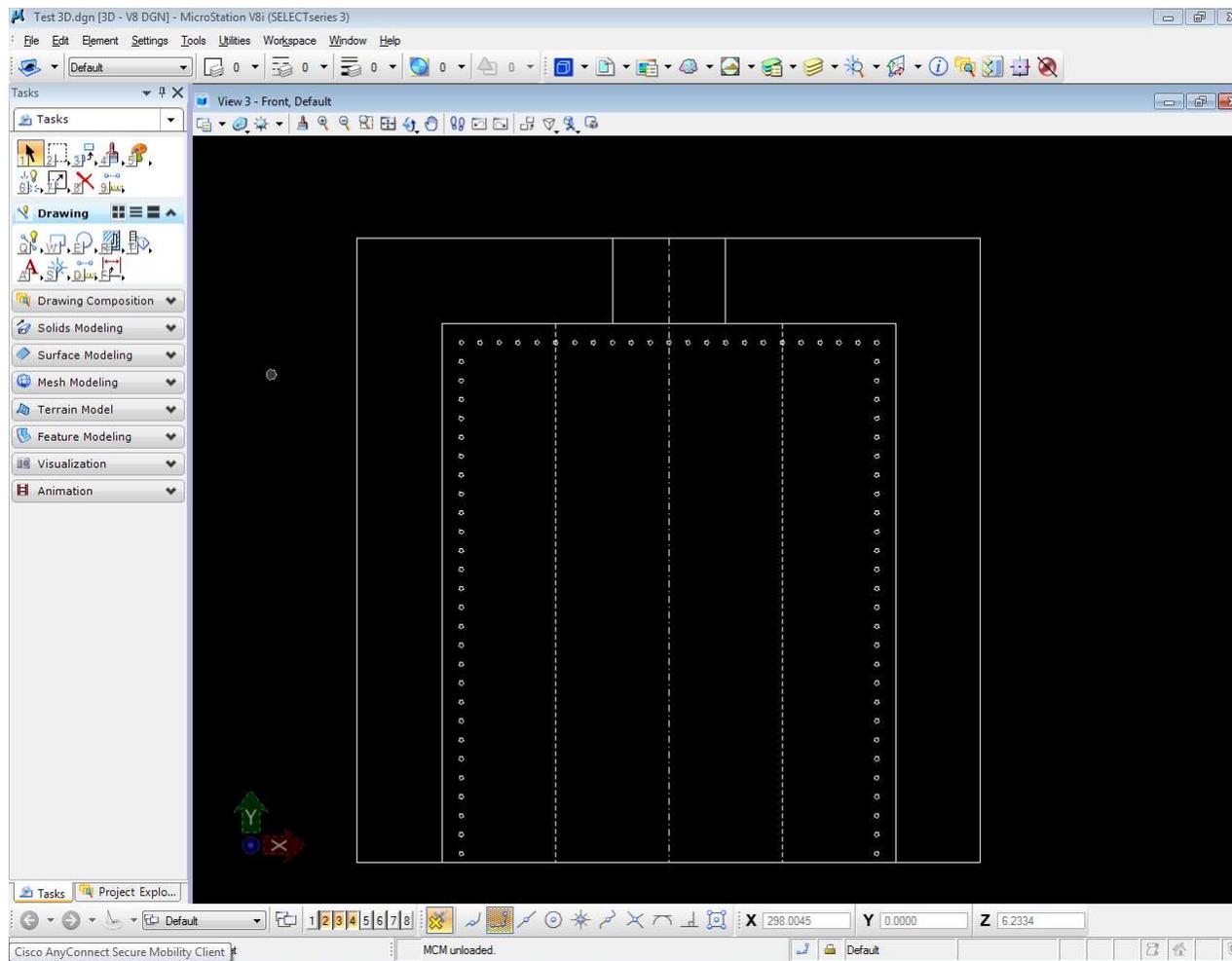
- Chapter is building a new set of Button Blankets
- Is this a STEM Activity?



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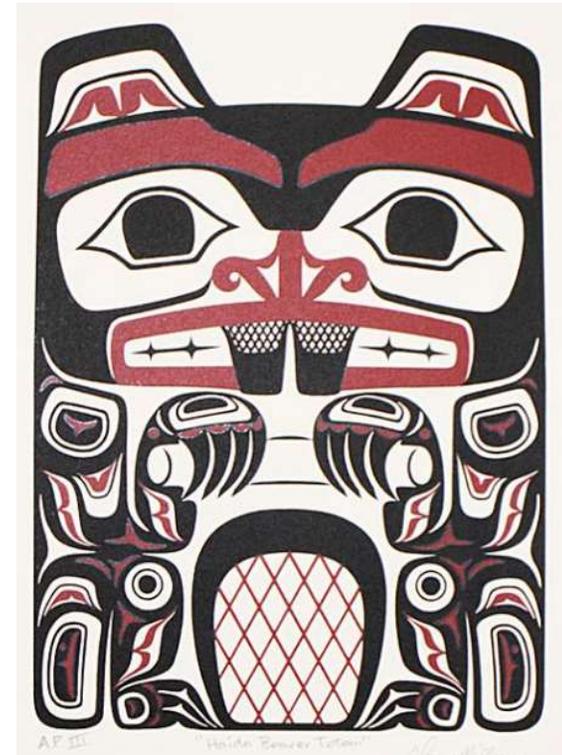
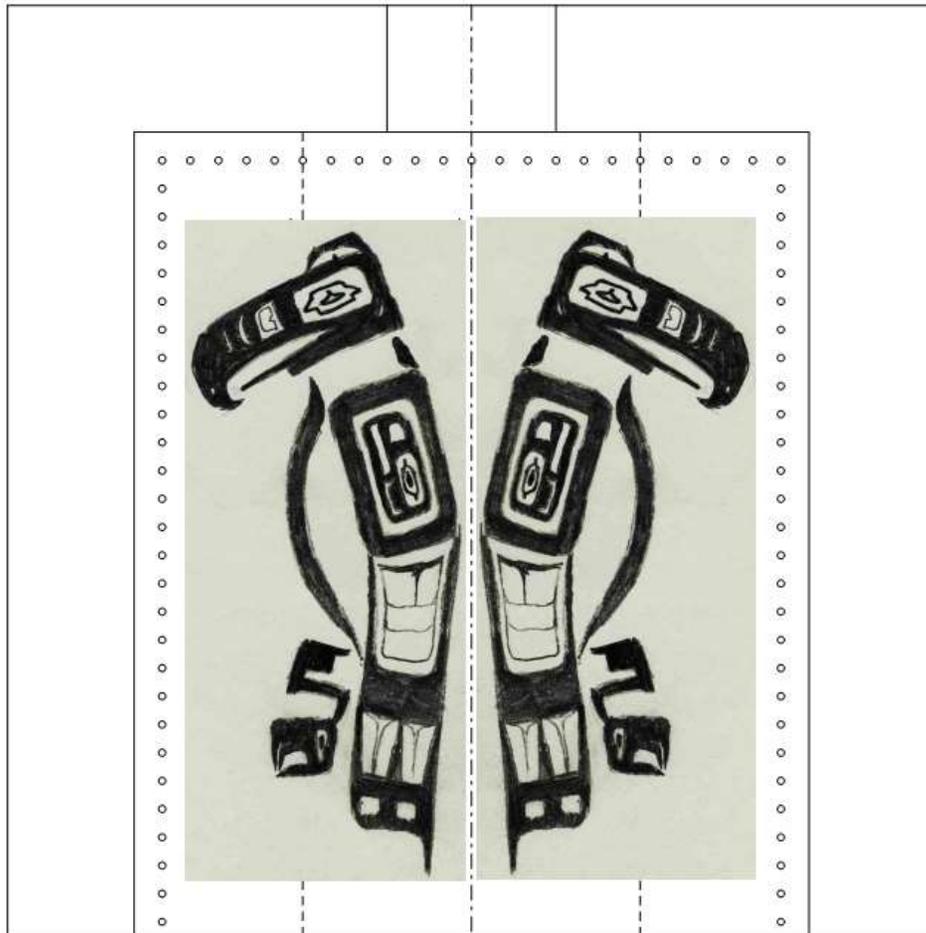
Computer Aided Drafting (CAD)



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Graphic Design and Layout



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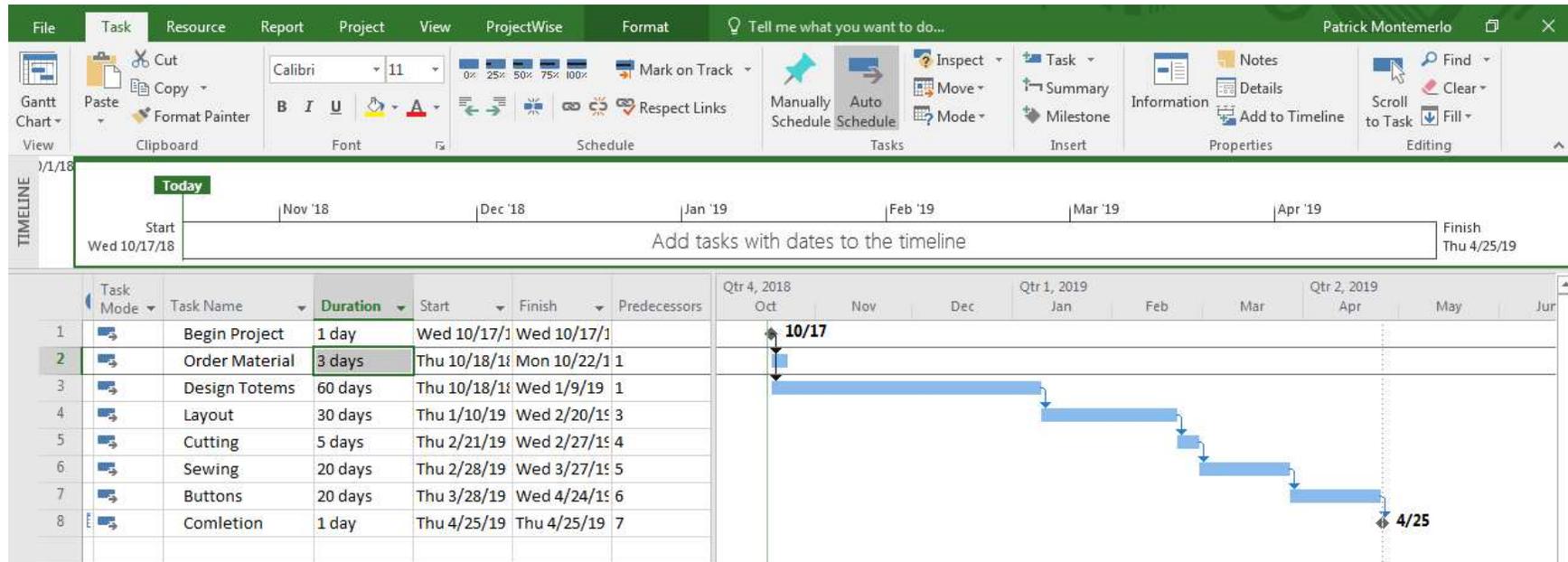
Electric Motors



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Scheduling Using Technology



- Critical Path
- Resource Loading/Availability
- Predecessors





Group Discussion:

How have you seen STEM
Integrated into Scouting?

What do you do in your programs?



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Questions?



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Think STEM!



www.scouting.org/stem

www.scouting.org/stem

<http://www.facebook.com/NOVA-Award-BSA>



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