

Important please visit this site for the most updated requirements:  
<http://www.scouting.org/stem/Awards/CubScout.aspx>

# CUB SCOUT NOVA AWARDS GUIDEBOOK



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<http://www.scouting.org/stem/Awards/CubScout.aspx>



BOY SCOUTS OF AMERICA®





## Letter From Dr. Bernard Harris

When I was 13, I was struck by the grandeur of Apollo 11 (the first flight of humans to the moon) and the boldness of two men walking on the moon for the first time. I overcame the challenges of my childhood to achieve success as a physician, NASA astronaut, and entrepreneur. Education was my launching pad.

America has long prided itself as a nation of dreamers, a land where everyone can strive for a better life, a place where grand achievements like attending top-notch universities and missions to the moon, and inventions like personal computers and the Internet spring forth to create new prosperity. The Boy Scouts of America has provided you with an opportunity to enhance your STEM knowledge and experience with the Nova awards. These awards, while providing hands on experiences, also connect with other Scout accomplishments.

We must not lose the will to pursue daring new goals, encourage Scouts like you to dream, and equip them with the educational tools to pursue their aspirations. Our future depends on it.

Go for your Nova and Supernova awards. Go, BSA!

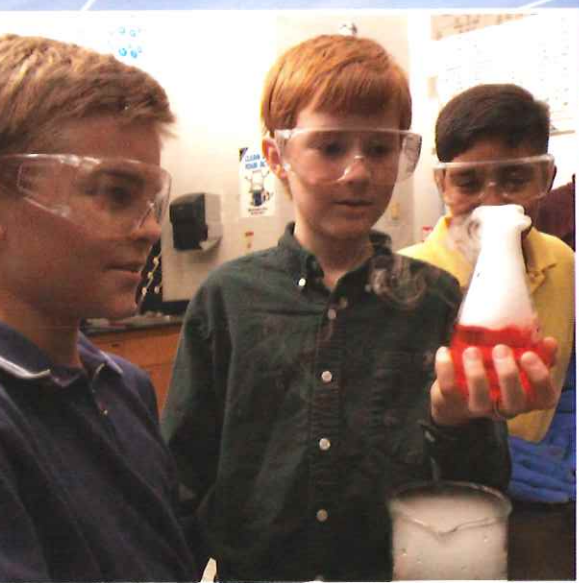
Dr. Bernard Harris





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# Introduction

Welcome to the *Cub Scout Nova Awards Guidebook!*

The Nova Awards program is Scouting's newest and most exciting adventure. The word "STEM" focuses on **S**cience, **T**echnology, **E**ngineering, and **M**athematics. Cub Scouts throughout the country, just like you, can explore the wonders of different STEM fields as they work toward a Nova or Supernova award. In fact, Dr. Bernard Harris, a former astronaut and Cub Scout as a youth, developed his interest in space exploration as a young boy.

Cool experiments, awesome field trips, and fun activities are just waiting for you to dive in. If you are a Wolf, Bear, or Webelos Scout, get started now on the Nova awards ride of your life!

Tigers are not eligible for these awards but may enjoy STEM-related pack activities.

## Structure of the Program

This is the time to set the stage for a Cub Scout's lifetime of interest and curiosity about STEM fields. The Nova and Supernova awards are available to Wolf, Bear, and Webelos Scouts. Counselors and mentors should understand that the awards are optional and meant to be earned only after a Cub Scout has achieved his rank.

There are multiple Nova awards; one for each of the STEM areas is included in the books, and each Cub Scout can earn all awards. Completion of any Nova award earns the Cub Scout the right to wear the Nova award patch. Completion of each additional Nova award is recognized by a pi ( $\pi$ ) pin placed on the patch. Each of these awards builds on STEM-related Cub Scout adventures, involves hands-on activities, and often includes a field trip. The four Nova awards for Cub Scouts included in this book are:

- Science Everywhere
- Tech Talk
- Swing!
- 1-2-3 Go!

The others are online only at [www.scouting.org/stem](http://www.scouting.org/stem).

There are two Supernova awards. The Cub Scout Supernova award can be earned by Wolf or Bear Cub Scouts. The Webelos Supernova award can be earned by Webelos Scouts. Each boy may earn both Supernova awards, as long as he is registered in the appropriate program at the time he completes the requirements.

The Supernova awards recognize superior achievement in the STEM fields and require significantly more effort by the Cub



Scout than the Nova awards. For all Supernova awards, a mentor, who serves much like a Boy Scout's merit badge counselor, is required. Completion of a Supernova award earns the Cub Scout or Webelos Scout the right to wear the Supernova award medal. Each of these awards involves STEM-related Cub Scout adventures and extensive independent work. The Supernova awards are:

- Dr. Luis W. Alvarez Supernova Award (for Cub Scouts)
- Dr. Charles H. Townes Supernova Award (for Webelos Scouts)

## Guidebook Resources

The *Cub Scout Nova Awards Guidebook* has a built-in support system of counselor pages for adults to guide Cub Scouts as they fulfill requirements for each award. The counselor section, which includes basic information and resource suggestions about many of the requirements, begins on page 48. There is also website support at <http://www.scouting.org/stem.aspx>, which will be regularly updated.

With this guidebook, adults can help provide fun and rewarding STEM experiences for Cub Scouts that support their achievement of Nova and Supernova awards. More importantly, counselors take part in helping them build big dreams for their future.

Effective June 1, 2015, the rank requirements for Cub Scouts are changing (see [www.scouting.org/programupdates](http://www.scouting.org/programupdates) for these new requirements). Cub Scouts currently working on the Nova awards or one of the Supernova awards have two options:

Complete the award no later than December 31, 2015, using the requirements as published in the previous *Cub Scout Nova Awards Guidebook*, No. 34032, OR complete the award using the requirements published in this 2015 printing.





# Cub Scout Nova Awards

To earn the Cub Scout Nova awards, you must be a Wolf, Bear, or Webelos Scout who is active with a den. With your parent's and unit leader's help, you must select a unit-approved counselor who is a registered Scouter. Nova counselors can be any registered adult age 21 or older. They must be registered under the nonunit position and no fee is required. The Nova counselor code is 58. You may choose your parent or unit leader as long as there is another adult in your unit aware you are working on the award who is also a registered Nova counselor.

## A Note to the Counselor

The Cub Scout Nova awards allow a Scout to look at science, technology, engineering, and mathematics (STEM) in everyday life.

All requirements should be conducted using the highest level of safety protocol and always under the supervision of a qualified, responsible adult.

**Tigers are not eligible to earn the Cub Scout Nova awards.**





# Science Everywhere

This module is designed to help you explore how science affects your life each day.

1. Choose A *or* B *or* C and complete ALL the requirements.
  - A. Watch an episode or episodes (about one hour total) of a show about anything related to science. Then do the following:
    - (1) Make a list of at least two questions or ideas from what you watched.
    - (2) Discuss two of the questions or ideas with your counselor.

Some examples include—but are not limited to—shows found on PBS (“NOVA”), Discovery Channel, Science Channel, National Geographic Channel, TED Talks (online videos), and the History Channel. You may choose to watch a live performance or movie at a planetarium or science museum instead of watching a media production. You may watch online productions with your counselor’s approval and under your parent’s supervision.

- B. Read (about one hour total) about anything related to science. Then do the following:
- (1) Make a list of at least two questions or ideas from what you read.
  - (2) Discuss two of the questions or ideas with your counselor.

Books on many topics may be found at your local library. Examples of magazines include but are not limited to *Odyssey*, *KIDS DISCOVER*, *National Geographic Kids*, *Highlights*, and *OWL* or [owlkids.com](http://owlkids.com).

- C. Do a combination of reading and watching (about one hour total) about anything related to science. Then do the following:
- (1) Make a list of at least two questions or ideas from what you read and watched.
  - (2) Discuss two of the questions or ideas with your counselor.
2. Complete ONE adventure from the following list. (Choose one that you have not already done.) Discuss with your counselor what kind of science, technology, engineering, or math was used in the adventure.

<b>Wolf Cub Scouts</b>	Adventures in Coins
	Collections and Hobbies
	Digging in the Past
	Germes Alive!
	Grow Something
<b>Bear Cub Scouts</b>	A Bear Goes Fishing
	Bear Picnic
	Critter Care

**Webelos Scouts**    Camper  
Earth Rocks!  
Maestro!

3. Act like a scientist! Explore EACH of the following:

A. With your counselor, choose a question you would like to investigate.

Here are some examples only (you may get other ideas from your adventure activities):

- (1) Why do rockets have fins? Is there any connection between the feathers on arrows and fins on rockets?
- (2) Why do some cars have spoilers? How do spoilers work?
- (3) If there is a creek or stream in your neighborhood, where does it go? Does your stream flow to the Atlantic or the Pacific ocean?

With your parent's or guardian's permission and assistance, you may want to use an online mapping application to follow the streams and rivers to the ocean. Keep track of the names of the streams, lakes, and rivers connecting your stream to the ocean. Is it possible for you to find out the name of your watershed? *Paddle-to-the-Sea* by Holling C. Holling is a fun book on this topic.

- (4) Is the creek or stream in your neighborhood or park polluted?



You can do a stream sample to find out what kinds of things are living in the water and under the rocks. Some things can survive in polluted water; others can live only in clean water. You can discover if a stream is polluted by finding out what lives there.

- (5) What other activity can you think of that involves some kind of scientific questions or investigation?
- B. With your counselor, use the scientific method/process to investigate your question. Keep records of your question, the information you found, how you investigated, and what you found out about your question.

You may do 3B with another Cub Scout if you would like, but you need to do and record your own work.

- C. Discuss your investigation and findings with your counselor.
- 4. Visit a place where science is being done, used, or explained, such as one of the following: zoo, aquarium, water treatment plant, observatory, science museum, weather station, fish hatchery, or any other location where science is being done, used, or explained.



- A. During your visit, talk to someone in charge about science.
  - B. Discuss with your counselor the science done, used, or explained at the place you visited.
5. Discuss with your counselor how science affects your everyday life.

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# Tech Talk

This module is designed to help you explore how technology affects your life each day.

1. Choose A or B or C and complete ALL the requirements.
  - A. Watch an episode or episodes (about one hour total) of a show about anything related to technology. Then do the following:
    - (1) Make a list of at least two questions or ideas from what you watched.
    - (2) Discuss two of the questions or ideas with your counselor.

Some examples include—but are not limited to—shows found on PBS (“NOVA”), Discovery Channel, Science Channel, National Geographic Channel, TED Talks (online videos), and the History Channel. You may choose to watch a live performance or movie at a planetarium or science museum instead of watching a media production. You may watch online productions with your counselor’s approval and under your parent’s supervision.

- B. Read (about one hour total) about anything related to technology. Then do the following:
- (1) Make a list of at least two questions or ideas from what you read.
  - (2) Discuss two of the questions or ideas with your counselor.

Books on many topics may be found at your local library. Examples of magazines include but are not limited to *Odyssey*, *KIDS DISCOVER*, *National Geographic Kids*, *Highlights*, and *OWL* or [owlkids.com](http://owlkids.com).

- C. Do a combination of reading and watching (about one hour total) about anything related to technology. Then do the following:
- (1) Make a list of at least two questions or ideas from what you read and watched.
  - (2) Discuss two of the questions or ideas with your counselor.
2. Complete ONE adventure from the following list. (Choose one that you have not already done.) Discuss with your counselor what kind of science, technology, engineering, or math was used in the adventure.

**Wolf Cub Scouts** Finding Your Way  
Motor Away

**Bear Cub Scouts** Make It Move  
A World of Sound

**Webelos Scouts** Build It  
Fix It  
Movie Making

3. Explore EACH of the following:

A. Look up a definition of the word *technology* and discuss the meaning with your counselor.

B. Find out how technology is used in EACH of the following fields:

(1) Communication

(2) Business

(3) Construction

(4) Sports

(5) Entertainment

C. Discuss your findings with your counselor.

4. Visit a place where technology is being designed, used, or explained, such as one of the following: an amusement park, a police or fire station, a radio or television station, a newspaper office, a factory or store, or any other location where technology is being designed, used, or explained.

- A. During your visit, talk to someone in charge about the following:
    - (1) The technologies used where you are visiting
    - (2) Why the organization is using these technologies
  - B. Discuss with your counselor the technology that is designed, used, or explained at the place you visited.
5. Discuss with your counselor how technology affects your everyday life.



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# Swing!

This module is designed to help you explore how engineering and simple machines called levers affect your life each day.

1. Choose *A or B or C* and complete *ALL* the requirements.
  - A. Watch an episode or episodes (about one hour total) of a show about anything related to motion or machines. Then do the following:
    - (1) Make a list of at least two questions or ideas from what you watched.
    - (2) Discuss two of the questions or ideas with your counselor.

Some examples include—but are not limited to—shows found on PBS (“NOVA”), Discovery Channel, Science Channel, National Geographic Channel, TED Talks (online videos), and the History Channel. You may choose to watch a live performance or movie at a planetarium or science museum instead of watching a media production. You may watch online productions with your counselor’s approval and under your parent’s supervision.

- B. Read (about one hour total) about anything related to motion or machines. Then do the following:
- (1) Make a list of at least two questions or ideas from what you read.
  - (2) Discuss two of the questions or ideas with your counselor.

Books on many topics may be found at your local library. Examples of magazines include but are not limited to *Odyssey*, *KIDS DISCOVER*, *National Geographic Kids*, *Highlights*, and *OWL* or [owlkids.com](http://owlkids.com).

- C. Do a combination of reading and watching (about one hour total) about anything related to motion or machines. Then do the following:
- (1) Make a list of at least two questions or ideas from what you read and watched.
  - (2) Discuss two of the questions or ideas with your counselor.

2. Complete ONE adventure from the following list. (Choose one that you have not already done.) Discuss with your counselor what kind of science, technology, engineering, or math was used in the adventure.

**Wolf Cub Scouts** Motor Away

Paws of Skill

**Bear Cub Scouts** Baloo the Builder

A Bear Goes Fishing

**Webelos Scouts** Adventures in Science

Engineer

Sportsman

3. Explore EACH of the following.

A. Levers

- (1) Make a list or drawing of the three types of levers. (A lever is one kind of simple machine.)

- (2) Show:

1. How each lever works
2. How the lever in your design will move something
3. The class of each lever
4. Why we use levers

- B. On your own, design, including a drawing, sketch, or model, ONE of the following:

- (1) A playground fixture that uses a lever
- (2) A game or sport that uses a lever
- (3) An invention that uses a lever

Be sure to show how the lever in your design will move something.

C. Discuss your findings with your counselor.

4. Do the following:

A. Visit a place that uses levers, such as a playground, carpentry shop, construction site, restaurant kitchen, or any other location that uses levers.

B. Discuss with your counselor the equipment or tools that use levers in the place you visited.

Visitations to places like carpentry shops, construction sites, restaurant kitchens, etc., will require advance planning by the counselor. The counselor should call ahead to make arrangements, and make plans to have appropriate supervision of all Scouts.

The site will very likely have rules and instructions that must be followed. The counselor should help ensure that all the participants are aware of and follow those rules. This may include safety procedures and other instructions.

5. Discuss with your counselor how engineering and simple machines affect your everyday life.



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# 1-2-3 Go!

This module is designed to help you explore how math affects your life each day.

1. Choose A or B or C and complete ALL the requirements.
  - A. Watch an episode or episodes (about one hour total) of a show that involves math or physics. Then do the following:
    - (1) Make a list of at least two questions or ideas from what you watched.
    - (2) Discuss two of the questions or ideas with your counselor.

Math and physics are used in almost every kind of invention, including cars, airplanes, and telescopes. Math also includes cryptography, the use of secret codes.

Some examples include—but are not limited to—shows found on PBS (“NOVA”), Discovery Channel, Science Channel, National Geographic Channel, TED Talks (online videos), and the History Channel. You may choose to watch a live performance or movie at a planetarium or science museum instead of watching a media production. You may watch online productions with your counselor’s approval and under your parent’s supervision.

B. Read (about one hour total) about anything that involves math or physics. Then do the following:

- (1) Make a list of at least two questions or ideas from what you read.
- (2) Discuss two of the questions or ideas with your counselor.

Books on many topics may be found at your local library. Examples of magazines include but are not limited to *Odyssey*, *KIDS DISCOVER*, *National Geographic Kids*, *Highlights*, and *OWL* or [owlkids.com](http://owlkids.com).

C. Do a combination of reading and watching (about one hour total) about anything that involves math or physics. Then do the following:

- (1) Make a list of at least two questions or ideas from what you read and watched.
- (2) Discuss two of the questions or ideas with your counselor.

2. Complete ONE adventure from the following list. (Choose one that you have not already done.) Discuss with your counselor what kind of science, technology, engineering, or math was used in the adventure.

**Wolf Cub Scouts**    Code of the Wolf

**Bear Cub Scouts**    Robotics

**Webelos Scouts**    Game Design

3. Explore TWO options from A *or* B *or* C and complete ALL the requirements for those options. Keep your work to share with your counselor. The necessary information to make your calculations can be found in a book or on the Internet. (See the Helpful Links box for ideas.) You may work with your counselor on these calculations.
- A. Choose TWO of the following places and calculate how much you would weigh there.
- (1) On the sun or the moon
  - (2) On Jupiter or Pluto
  - (3) On a planet that you choose
- B. Choose ONE of the following and calculate its height:
- (1) A tree
  - (2) Your house
  - (3) A building of your choice
- C. Calculate the volume of air in your bedroom. Make sure your measurements have the same units—all feet or all inches—and show your work.

$$\text{Volume} = \text{Length} \times \text{Width} \times \text{Height}$$

#### 4. Secret Codes

A. Look up, then discuss with your counselor each of the following:

- (1) Cryptography
- (2) At least three ways secret codes or ciphers are made
- (3) How secret codes and ciphers relate to mathematics

B. Design a secret code or cipher. Then do the following:

- (1) Write a message in your code or cipher.
- (2) Share your code or cipher with your counselor.

5. Discuss with your counselor how math affects your everyday life.

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## Helpful Links

You may choose other links if preferred.

“Your Weight On Other Planets”: Essortment

Website: [www.essortment.com/all/weightonplan\\_rvrp.htm](http://www.essortment.com/all/weightonplan_rvrp.htm)

“Your Weight in Space”: Intrepid Sea, Air & Space Museum

Website: [www.intrepidmuseum.org/Education/Teacher-Resources/documents/Space\\_9-12Post.aspx](http://www.intrepidmuseum.org/Education/Teacher-Resources/documents/Space_9-12Post.aspx)

“How to Calculate Volume of a Room”: eHow

Website: [www.ehow.com/how\\_2266390\\_calculate-volume-room.html](http://www.ehow.com/how_2266390_calculate-volume-room.html)

“CryptoKids”: National Security Agency

Website: [www.nsa.gov/kids](http://www.nsa.gov/kids)

“Cryptology for Kids”: Purdue University Center for Education and Research in Information Assurance and Security

Website: [www.cerias.purdue.edu/education/k-12/teaching\\_resources/lessons\\_presentations/cryptology.html](http://www.cerias.purdue.edu/education/k-12/teaching_resources/lessons_presentations/cryptology.html)

“How to Create Secret Codes and Ciphers”: wikiHow

Website: [www.wikihow.com/Create-Secret-Codes-and-Ciphers](http://www.wikihow.com/Create-Secret-Codes-and-Ciphers)



# Cub Scout Supernova Award

To earn the Cub Scout Supernova award, you must be a Bear or Wolf Cub Scout who is active with a den. With your parent's and unit leader's help, you must select a council-approved mentor who is a registered Scouter. Supernova mentors must be 21 or older and be subject matter experts in a STEM (science, technology, engineering, mathematics) field and be registered under the Supernova Mentor position code 52. This is a nonunit position and requires no fee. In addition to the BSA Adult Registration form, mentors must complete the Supernova Awards Mentor Information application. You may NOT choose your parent. You may choose your unit leader as long as the mentor is working with more than one youth.

# A Note to the Mentor

The Cub Scout Supernova award recognizes superior achievement by a Cub Scout in the fields of science, technology, engineering, and mathematics (STEM).

All experiments or projects should be conducted using the highest level of safety protocol and always under the supervision of a qualified, responsible adult.

**Tigers are not eligible to earn the Cub Scout Supernova award.**

Although it is not a requirement, it is recommended that you earn at least two of the four Nova awards for Cub Scouts before earning the Dr. Luis W. Alvarez Supernova Award.

## **Dr. Luis W. Alvarez Supernova Award**

### *For Cub Scouts*

This Supernova award can be earned by Cub Scouts like you who want to soar in science.

### **Requirements**

1. Complete both of the adventures appropriate for your rank.

<b>Wolf Cub Scouts</b>	Air of the Wolf Code of the Wolf
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<b>Bear Cub Scouts</b>	Make it Move Super Science
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2. Complete the following adventure appropriate for your rank.

<b>Wolf Cub Scouts</b>	Call of the Wild
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<b>Bear Cub Scouts</b>	Forensics OR Marble Madness
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3. Find interesting facts about Dr. Luis W. Alvarez using resources in your school or local library or on the Internet (with your parent's or guardian's permission and guidance). Then discuss what you learn with your mentor, including answers to the following questions: What very important award did Dr. Alvarez earn? What was his famous theory about dinosaurs?
4. Find out about three other famous scientists, technology innovators, engineers, or mathematicians approved by your mentor. Discuss what you learned with your mentor.
5. Speak with your teacher(s) at school (or your parents if you are home-schooled) OR one of your Cub Scout leaders about your interest in earning the Cub Scout Supernova award. Ask them why they think math and science are important in your education. Discuss what you learn with your mentor.
6. Participate in a science project or experiment in your classroom or school OR do a special science project approved by your teacher. Discuss this activity with your mentor.
7. Do ONE of the following:
  - A. Visit with someone who works in a STEM-related career. Discuss what you learned with your mentor.
  - B. Learn about a career that depends on knowledge about science, technology, engineering, or mathematics. Discuss what you learned with your mentor.

8. Learn about the scientific method (or scientific process). Discuss this with your mentor, and include a simple demonstration to show what you learned.
9. Participate in a Nova- or other STEM-related activity in your Cub Scout den or pack meeting that is conducted by a Boy Scout or Venturer who is working on his or her Supernova award. If this is not possible, participate in another Nova- or STEM-related activity in your den meeting, pack meeting, or local council.
10. Submit an application for the Cub Scout Supernova award to the district STEM or advancement committee for approval.



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# Webelos Scout Supernova Award

To earn the Webelos Scout Supernova award, you must be a Webelos Scout who is active with a den. With your parent's and unit leader's help, you must select a council-approved mentor who is a registered Scouter. Supernova mentors must be 21 or older, be subject matter experts in a STEM (science, technology, engineering, mathematics) field, and be registered under the new Supernova Mentor position code 52. This is a nonunit position and requires no fee. In addition to the BSA Adult Registration form, mentors must complete the Supernova Awards Mentor Information application. You may NOT choose your parent. You may choose your unit leader as long as the mentor is working with more than one youth.

If you earned the Cub Scout Supernova award, you may not use the same activities or requirements used to earn the Dr. Luis W. Alvarez Supernova Award.

## A Note to the Mentor

The Webelos Scout Supernova award recognizes superior achievement by a Webelos Scout in the fields of science, technology, engineering, and mathematics (STEM).

All experiments or projects should be conducted using the highest level of safety protocol and always under the supervision of a qualified, responsible adult.

Although it is not a requirement, it is recommended that you earn at least two of the four Nova awards for Cub Scouts before earning the Dr. Charles H. Townes Supernova Award.

### **Dr. Charles H. Townes Supernova Award**

#### *For Webelos Scouts*

This Supernova award can be earned by Webelos Scouts like you.

#### **Requirements**

1. Complete the following Webelos adventures: Adventures in Science, Engineer, and Scouting Adventure.
2. Complete three of the following adventures: Build It, Building a Better World, Castaway, First Responder, Into the Wild, and Into the Woods.
3. Find interesting facts about Dr. Charles H. Townes using resources in your school or local library or on the Internet (with your parent's or

guardian's permission and guidance). Then discuss what you learned with your mentor, including answers to the following questions:  
What very important award did Dr. Townes earn?  
What was Dr. Townes' most famous invention?

4. Find out about five other famous scientists, technology innovators, engineers, or mathematicians approved by your mentor. Discuss what you learned with your mentor.
5. Speak with your teacher(s) at school (or your parents if you are home-schooled) OR one of your Cub Scout leaders about your interest in earning the Webelos Scout Supernova award. Ask them why they think math and science are important in your education. Discuss what you learn with your mentor.
6. Participate in a science project or experiment in your classroom or school. Discuss this activity with your mentor.
7. Do ONE of the following:
  - A. Visit with someone who works in a STEM-related career. Discuss what you learned with your mentor.
  - B. Learn about a career that depends on knowledge about science, technology, engineering, or mathematics. Discuss what you learned with your mentor.
8. Under the direct supervision of your mentor, do an experiment that shows how the scientific method (or scientific process) is used. Prepare a short report on the results of your experiment for your mentor.

9. Participate in a Nova- or other STEM-related activity in your Webelos Scout den or pack meeting that is conducted by a Boy Scout or Venturer who is working on his or her Supernova award. If this is not possible, participate in another Nova- or STEM-related activity in your den meeting, pack meeting, or local council.
10. Submit an application for the Webelos Scout Supernova award to the district STEM or advancement committee for approval.



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# A Guide for Nova Award Counselors and Supernova Award Mentors

## **Flight Plan to Success**

Thank you for serving our youth as they embark on an exploration of science, technology, engineering, and mathematics, or STEM. Your role is crucial to their success in completing the Nova and Supernova activities and in discovering that science is fun and worth the effort, and the awards are attainable. Earning these awards will inspire a new passion for STEM fields that will impact their lives—and yours—for years to come.

## The Importance of STEM

Many professionals in science, technology, engineering, and math believe the United States should do more to encourage students to enter these fields. It's our best opportunity to boost the spirit of innovation. It's what we need to help ensure this country continues on an upward journey.

In the past few years, a number of studies have shown U.S. students are growing increasingly weaker in STEM-related topics\*. We can all work to reverse this trend.

- In 2009, just 34 percent of U.S. eighth-graders were rated proficient or higher in a national math assessment, and more than 25 percent scored below the basic level.
- In an international exam given in 2006, U.S. high school students ranked 21st out of 30 industrialized nations in science and 25th in math.
- In 2010, only 43 percent of U.S. high school graduates were ready for college work in math and 29 percent were ready in science.

To remain competitive in the world economy, the United States must cultivate the next generation of critical thinkers and innovators. Experts say that our young people need STEM-related skills to compete in the world of tomorrow, where most jobs will require a basic understanding of math and science.

Ten-year employment projections by the U.S. Department of Labor show that of the 20 fastest-growing occupations projected for 2014, 15 of them require significant mathematics or science preparation.

## What Is Nova?

The Nova awards are designed to enhance interest in the STEM fields while making it fun for youth to learn about these fields. Scouting and the Nova awards nurture and help develop the natural curiosity of children and encourage their sense of wonder. The activities and requirements were designed to keep youth interested and show relevance with society.

Through field testing with hundreds of units and thousands of youth members, we have developed a program to enhance the Scouting experience and grow the Scout. The Nova awards allow Scouts to discover some of the basic principles of STEM. The program gives them a chance to experience science, technology, engineering, and math in fun and interesting ways.

You will see how the activities excite and encourage a sense of wonder in youth. They can't help but enjoy themselves, and their enthusiasm will rub off on you, too. Scouts may complete any Nova award with a parent or unit leader's guidance as long as the adult is registered as a Nova counselor.

The series of Nova awards integrates many existing advancements from Scouting

e BSA has a  
website that  
supports the  
Nova Awards  
program. Visit  
[www.scouting.org/stem.aspx](http://www.scouting.org/stem.aspx).

The Supernova awards challenge Scouting youth who have a greater interest in the STEM fields to experiment, understand the outcomes of these experiments, and present their findings to their Supernova mentor. Just like merit badge counselors, Supernova mentors must be approved by the local council. Use this counselor section to help youth and parents understand the STEM modules that are available.

The Nova Awards program helps youth to “Be Prepared. For Life.”

Successful counselors and mentors will work hard to help youth meet the Nova and Supernova requirements. They will foster in young people a lifelong curiosity about science and understanding of how STEM fields affect just about every aspect of their lives. Why is this so important? Because science encourages students to ask questions and make connections as to how the world works. Strength in STEM fields gives them a deeper understanding of our world, a greater appreciation of its beauty and complexity, and the ability to solve problems necessary for a secure future.

### **Steppingstones to the Supernova Awards**

Our goal is to entice our Scouts to begin exploring STEM topics and to build on their interest with progressively more challenging activities. The Nova Awards program has two distinct difficulty levels:

1. STEM-related activities and Nova awards are designed to be fun. The outcome of the Nova awards should focus on encouraging future



exploration in STEM fields. We want to build confidence and communicate that career opportunities in STEM fields are attainable, fulfilling, and interesting.

As such, Nova activities are fairly basic and designed to spark interest in one or all of the awards. They are straightforward to complete and have a quick “reward” of the Nova patch for the first module earned and a pi ( $\pi$ ) pin to attach to the Nova patch for each additional module earned. The Nova award in each module can be accomplished fairly easily in a few weeks.

2. Supernova activities and awards require a deeper level of understanding and effort. While Supernova awards are designed to be more difficult than the Nova awards, the focus is to build on the simple STEM topics with activities that will result in greater learning and an increasing complexity in the youth’s knowledge. Completing the requirements takes more work and includes some research. Most Supernova activities will take several weeks or months to complete.

Both Nova and Supernova requirements build on advancement from the Cub Scout and Boy Scout programs (STEM-related adventures and merit badges). The Boy Scout and Venturer Nova and Supernova requirements share some similarities, although requirements have been modified for Venturing.

## **Adult Roles: Nova Counselor and Supernova Mentor**

The Nova Awards program is fairly simple as stated above, and more along the lines of completing an adventure or merit badge. We use the word “counselor” for the adult working with the Nova candidates. Parents and unit leaders may serve as Nova counselors even if they have little or no background in STEM (although of course they do need to understand the material well enough to help the youth with questions).

Because the Supernova program is more complex, it will require a deeper and longer-term association between the adult and youth. As such, we designate the adult role as “mentor” to signify the relationship between adult and youth. A “mentor” is ideally someone who has successfully negotiated a STEM career path or has other subject matter expertise (such as hobbies or other special training), and is willing to share accumulated wisdom and experience. The adult will work closely with the youth for a number of weeks or months, and will likely provide significant input and guidance to Supernova candidates. The Supernova mentor must NOT be a parent. The mentor may be a unit leader if the unit leader is working with more than one youth.

## Youth Protection Guidelines

All Nova counselors and Supernova mentors must be registered with the Boy Scouts of America and must have current Youth Protection training and certification. Meetings must follow Youth Protection guidelines, with at least two Scouts or adults present at any meetings.

## A Word About Youth Protection

Child abuse is a serious problem in our society, and unfortunately, it can occur anywhere, even in Scouting. Youth safety is of paramount importance to Scouting. For that reason, the BSA continues to create barriers to abuse beyond what have previously existed in Scouting.

The Boy Scouts of America places the greatest importance on providing the most secure environment possible for our youth members. To maintain such an environment, the BSA has developed numerous procedural and leadership selection policies, and provides parents and leaders with numerous online and print resources for the Cub Scout, Boy Scout, and Venturing programs.

### **The BSA requires Youth Protection training for all registered leaders.**

New leaders are required to complete Youth Protection training. To take the training online, go to [www.MyScouting.org](http://www.MyScouting.org) and establish an account using the member number you receive when you register for BSA membership. If you take the training online before you obtain a member number, be sure to return to MyScouting and enter your number for training record credit. Your BSA local council also provides training on a regular basis if you cannot take it online. For more information, refer to the back of the BSA adult membership application, No. 524-501.

Youth Protection training must be taken every two years—regardless of position. If a volunteer does not meet the BSA's Youth Protection training requirement at the time of recharter, the volunteer will not be reregistered.

We encourage all adults, including all parents, to take the BSA's Youth Protection training.

To find out more about the Youth Protection policies of the Boy Scouts of America and how to help Scouting keep your family safe, see the *Parent's Guide* in any of the Cub Scouting or Boy Scouting handbooks, or go to <http://www.scouting.org/Training/YouthProtection.aspx>.

*Revised October 2011*

### **Age-Appropriate Expectations**

Young people undergo profound developmental changes as they grow, including progression in their ability to think and reason. It is critical that you understand this and that you do not expect behaviors and outcomes that exceed their developmental readiness. At the same time, don't underestimate their abilities or make things too easy!

The goal is to encourage youth to stretch and grow, yet not frustrate them or turn them off to STEM activities by making it too hard. We have tried to address this within the scope of the requirements for each age group, but you will be the one assessing your youth's readiness. Remember—Nova activities are supposed to be fun and an introduction, whereas Supernova activities will require more effort and perseverance, as well as critical thinking.



Critical thinking goes beyond just coming up with an answer. It is the “identification and evaluation of evidence to guide decision making. A critical thinker uses broad in-depth analysis of evidence to make decisions and communicate his/her beliefs clearly and accurately.” Source: The Critical Thinking Co.™

Each award is available to a wide range of youth members—from ages 8 to 10 for Cub Scouts, 11 to 17 for Boy Scouts, and 14 to 20 (or 13 with the completion of the eighth grade) for Venturers. It is important that you understand the developmental differences between various ages. The awards have been designed to take this into account. You should be aware of age-related capabilities, as well as recognize that academic and extracurricular backgrounds will also differ.

How do you know what is expected at any given age? There can be a very broad range of abilities and knowledge among youths of the same age. Some of this may depend on where they live, their school system, or their socioeconomic background. A useful link to age-specific benchmarks may be found at [www.project2061.org/publications/bsl/online](http://www.project2061.org/publications/bsl/online). The information presented here may alert you to something you might not have known about the way youth reason.

The potential for a young person to learn and do is continuous and gradual, and young people may aspire to develop the skills necessary to earn the Nova and Supernova awards. The best advice is to know the youth you are working with.

## **Counseling and Mentoring Sessions**

There is no set number of required counseling or mentoring sessions, although a preliminary meeting with the youth is a good idea for setting expectations and answering questions. There is also no time limit for completion (other than aging out of a specific program). You and the Scout will determine the time frame for completing the award.

After completion, Scouts will fill out their Supernova application (one is not necessary for the Nova awards). Please help ensure that the youth is properly recognized in a timely manner, as we do with all advancement and awards in Scouting.

## **Group Size**

You may work with only one youth, or you may assist a group of youth members. It is imperative that EACH youth do ALL of the work for every requirement. This can be a challenge to monitor if the group is too large. We recommend no more than a den- or patrol-size group (maximum of eight to 10). Of course you may mentor more youths than this—just don't have them all present at the same time, so that each individual gets the full benefit of your attention.



## **Expected Outcomes**

With your help, each youth who attempts to earn the Nova and Supernova awards will emerge with a basic understanding of the material in the requirements. This may be an introduction to a field that the youth would never otherwise be exposed to, or may be a deeper exploration of fields in which the youth already has an interest. He or she will see how these relate to everyday life and how STEM fields are everywhere. We expect to see greater confidence and the excitement to tackle subjects that were once intimidating. With your help, our youth will be equipped to tackle new challenges in STEM fields.

## **Nova/Supernova Requirements**

We have provided some specifics to the “answers” for some of the Nova requirements to help you in your role as counselor or mentor. However, these are by no means complete. We encourage you to use whatever resources you have available to expand your—and your youth’s—thinking, knowledge, and enthusiasm for STEM fields.

An online resource for the Nova and Supernova Awards program is available at [www.scouting.org/stem.aspx](http://www.scouting.org/stem.aspx). It includes Frequently Asked Questions, new activities, ideas, and more. Be sure to check this resource, as materials will be regularly updated and enhanced.



Science  
helps people  
understand how  
the world around  
them works.

## Science Everywhere

This module is designed to help the Scout explore how science affects his life each day.

1. Choose A *or* B *or* C and complete ALL the requirements.
  - A. Watch an episode or episodes (about one hour total) of a show about anything related to science. Then do the following:
    - (1) Make a list of at least two questions or ideas from what you watched.
    - (2) Discuss two of the questions or ideas with your counselor.

Some examples include—but are not limited to—shows found on PBS (“NOVA”), Discovery Channel, Science Channel, National Geographic Channel, TED Talks (online videos), and the History Channel. You may choose to watch a live performance or movie at a planetarium or science museum instead of watching a media production. You may watch online productions with your counselor’s approval and under your parent’s supervision.

B. Read (about one hour total) about anything related to science. Then do the following:

- (1) Make a list of at least two questions or ideas from what you read.
- (2) Discuss two of the questions or ideas with your counselor.

Books on many topics may be found at your local library. Examples of magazines include but are not limited to *Odyssey*, *KIDS DISCOVER*, *National Geographic Kids*, *Highlights*, and *OWL* or [owlkids.com](http://owlkids.com).

C. Do a combination of reading and watching (about one hour total) about anything related to science. Then do the following:

- (1) Make a list of at least two questions or ideas from what you read and watched.
- (2) Discuss two of the questions or ideas with your counselor.

2. Complete ONE adventure from the following list. (Choose one that you have not already done.) Discuss with your counselor what kind of science, technology, engineering, or math was used in the adventure.

**Wolf Cub Scouts**    Adventures in Coins  
                             Collections and Hobbies  
                             Digging in the Past  
                             Germs Alive!  
                             Grow Something

<b>Bear Cub Scouts</b>	A Bear Goes Fishing Bear Picnic Critter Care
<b>Webelos Scouts</b>	Camper Earth Rocks! Maestro!

## **Wolf Cub Scouts**

**Adventures in Coins:** Coin weight experiment uses scientific method. Coins are inherent in our monetary system. Coin rubbings would be “technology.”

**Collections and Hobbies:** Collections are based on organizing items in common. “Analysis” of common elements is inherent in scientific method.

**Digging in the Past:** Paleontology and geology

**Germes Alive!:** Biology

**Grow Something:** Biology and living things

## **Bear Cub Scouts**

**A Bear Goes Fishing:** Ecology and biology

**Bear Picnic:** Nutrition and biology

**Critter Care:** Understanding how to care for a critter helps a Scout learn about the biological needs of the pet.

## **Webelos Scouts**

**Camper:** Ecology

**Earth Rocks!:** Geology

**Maestro!:** Science and music connect through sound waves and materials chosen to create musical instruments. Additionally, music is closely connected to math.



3. Act like a scientist! Explore EACH of the following:

- A. With your counselor, choose a question you would like to investigate.

Here are some examples only (you may get other ideas from your adventure activities):

- (1) Why do rockets have fins? Is there any connection between the feathers on arrows and fins on rockets?

Arrow feathers and rocket fins serve the same purpose—they provide aerodynamic stability during flight through the atmosphere.

- (2) Why do some cars have spoilers? How do spoilers work?

In theory, spoilers on cars use Bernoulli's principle in the opposite way that an airplane does. An airplane wing is designed for the air to flow faster over the top of it than under it; this is how it creates lift. A spoiler on a car is designed to force the air to move more quickly under the spoiler than over the spoiler; this pushes the car down to give the wheels more traction and increased stability. The faster the car goes, the faster the air moves under the spoiler and the more anti-lift is generated, which provides more stability.

Without a spoiler, the only way to increase stability would be to increase the weight of the car. However, increasing the weight of the car increases its inertia, causing problems at corners and turns. Designers of spoilers have to balance the anti-lift with the drag created by using a spoiler.

You may find the following page at PhysLink.com helpful:  
[www.physlink.com/education/askexperts/ae496.cfm](http://www.physlink.com/education/askexperts/ae496.cfm).

- (3) If there is a creek or stream in your neighborhood, where does it go? Does your stream flow to the Atlantic or the Pacific ocean?

With your parent's or guardian's permission and assistance, you may want to use an online mapping application to follow the streams and rivers to the ocean. Keep track of the names of the streams, lakes, and rivers connecting your stream to the ocean. Is it possible for you to find out the name of your watershed? *Paddle-to-the-Sea* by Holling C. Holling is a fun book on this topic.

- (4) Is the creek or stream in your neighborhood or park polluted?

You can do a stream sample to find out what kinds of things are living in the water and under the rocks. Some things can survive in polluted water; others can live only in clean water. You can discover if a stream is polluted by finding out what lives there.



Many states have stream studies based on macroinvertebrate identification and populations. Some states use data collected by volunteers for incorporation into stream quality reports. With permission from his parent or guardian, have your Scout check the Internet or with your state's natural resources department for more information.

## Helpful Link

"About Macroinvertebrates": Volunteer Stream Monitoring: A Methods Manual. U.S. Environmental Protection Agency (available on KrisWeb)

Website: [www.krisweb.com/aqualife/insect.htm](http://www.krisweb.com/aqualife/insect.htm)

- (5) What other activity can you think of that involves some kind of scientific questions or investigation?

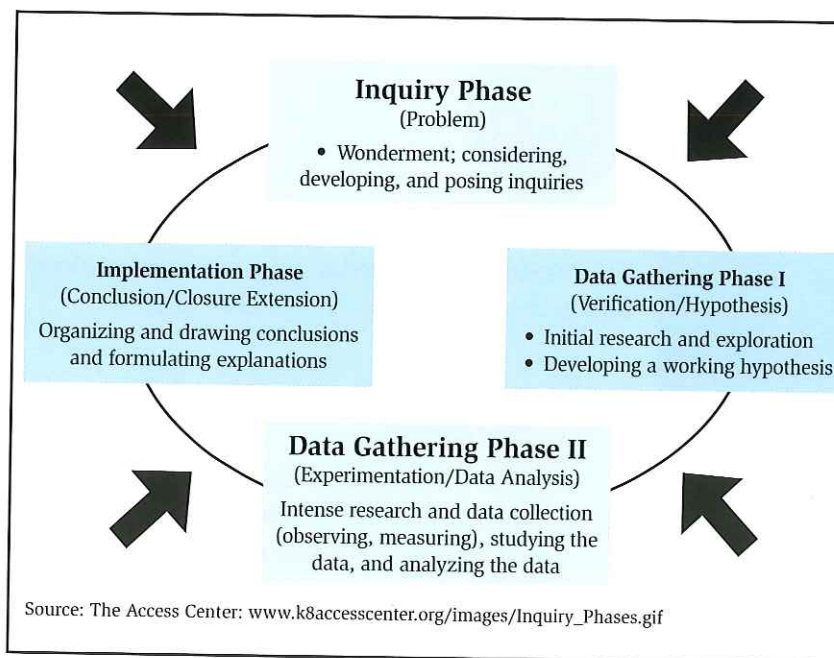
Cub Scout may  
to 3B with  
another Cub  
out if he would  
ke, but they  
ach need to do  
nd record their  
wn work.

- B. With your counselor, use the scientific method/process to investigate your question. Keep records of your question, the information you found, how you investigated, and what you found out about your question.

Your youth may use either the list or the diagram to help them investigate their question.

## Scientific Method

- **Problem or question:** What are you trying to find out?
- **Information and/or research:** What do you already know about the problem? What have others done about the problem or question?
- **Hypothesis:** What do you think is the answer to your question?
- **Procedure or experimental setup:** How will you find the answer to your question and test your hypothesis?
- **Data and analysis:** What did you find out by doing your experiment? This includes charts, graphs, and any results.
- **Conclusion:** What did you find to be the answer to your question? If you did not find the answer, why not? How could you find out or expand on the answer(s) you discovered? Communicate your findings.



- C. Discuss your investigation and findings with your counselor.
4. Visit a place where science is being done, used, or explained, such as one of the following: zoo, aquarium, water treatment plant, observatory, science museum, weather station, fish hatchery, or any other location where science is being done, used, or explained.
- A. During your visit, talk to someone in charge about science.
- B. Discuss with your counselor the science done, used, or explained at the place you visited.
5. Discuss with your counselor how science affects your everyday life.

Technology is the use of tools, machines, or scientific knowledge to solve problems, such as computer technology. The use of technology can help people control, adapt to, and change their environments.



## Tech Talk

This module is designed to help the Scout explore how technology affects his life each day.

1. Choose A or B or C and complete ALL the requirements.
  - A. Watch an episode or episodes (about one hour total) of a show about anything related to technology. Then do the following:
    - (1) Make a list of at least two questions or ideas from what you watched.
    - (2) Discuss two of the questions or ideas with your counselor.

Some examples include—but are not limited to—shows found on PBS (“NOVA”), Discovery Channel, Science Channel, National Geographic Channel, TED Talks (online videos), and the History Channel. You may choose to watch a live performance or movie at a planetarium or science museum instead of watching a media production. You may watch online productions with your counselor’s approval and under your parent’s supervision.

Many boys will watch episodes on airplanes, space flight, computers, and other high-tech products.

- B. Read (about one hour total) about anything related to technology. Then do the following:
- (1) Make a list of at least two questions or ideas from what you read.
  - (2) Discuss two of the questions or ideas with your counselor.

Books on many topics may be found at your local library. Examples of magazines include but are not limited to *Odyssey*, *KIDS DISCOVER*, *National Geographic Kids*, *Highlights*, and *OWL* or [owlkids.com](http://owlkids.com).

- C. Do a combination of reading and watching (about one hour total) about anything related to technology. Then do the following:
- (1) Make a list of at least two questions or ideas from what you read and watched.
  - (2) Discuss two of the questions or ideas with your counselor.
2. Complete ONE adventure from the following list. (Choose one that you have not already done.) Discuss with your counselor what kind of science, technology, engineering, or math was used in the adventure.

**Wolf Cub Scouts** Finding Your Way

Motor Away

**Bear Cub Scouts** Make It Move

A World of Sound

**Webelos Scouts** Build It

Fix It

Movie Making



## Wolf Cub Scouts

**Finding Your Way:** Map and compass are technologies that have been utilized for centuries.

**Motor Away:** Using technology or applying science to improve wing or boat design

## Bear Cub Scouts

**Make It Move:** Using technology to make items move

**A World of Sound:** Application of science (or using technology) to make musical instruments

## Webelos Scouts

**Build It:** Using tools to create a specific project

**Fix It:** Using technology to improve or “fix” the surrounding world

**Movie Making:** Using a digital product to create a movie

3. Explore EACH of the following:

A. Look up a definition of the word *technology* and discuss the meaning with your counselor.

Technology is defined as the application of science, utilizing the scientific method to achieve a commercial or industrial objective or the electronic and digital products that are considered as a group. Technology is very closely aligned with engineering.

B. Find out how technology is used in EACH of the following fields:



- (1) Communication
- (2) Business
- (3) Construction
- (4) Sports
- (5) Entertainment

C. Discuss your findings with your counselor.

4. Visit a place where technology is being designed, used, or explained, such as one of the following: an amusement park, a police or fire station, a radio or television station, a newspaper office, a factory or store, or any other location where technology is being designed, used, or explained.

- An amusement park: Computers, rides, entry gates, and camera monitors
- A police or fire station: Computers, vehicles, rescue equipment, sirens, Jaws of Life, fingerprint ink, handcuffs, and hoses
- A radio or television station: Computers, printers, broadcast equipment, fax machines, and telephones
- A newspaper office: Computers, printers, rollers, folding machines, telephones, and recording and voice recognition devices
- A factory or store: Computers, cash registers, scanning equipment, lights, machinery, and vehicles
- Any location where technology is being designed, used, or explained. (Be creative—technology is used everywhere.)

- A. During your visit, talk to someone in charge about the following:
    - (1) The technologies used where you are visiting
    - (2) Why the organization uses these technologies
  - B. Discuss with your counselor the technology that is designed, used, or explained at the place you visited.
- 5 Discuss with your counselor how technology affects your everyday life.



## Swing!

This module is designed to help the Scout explore how simple machines called levers affect his life each day.

1. Choose A or B or C and complete ALL the requirements.
  - A. Watch an episode or episodes (about one hour total) of a show about anything related to motion or machines. Then do the following:
    - (1) Make a list of at least two questions or ideas from what you watched.
    - (2) Discuss two of the questions or ideas with your counselor.

Engineering is considered the application of scientific and mathematical principles to create the design, manufacture, and operation of structures, machines, processes, and systems. Engineering is very closely aligned with technology.

Some examples include—but are not limited to—shows found on PBS (“NOVA”), Discovery Channel, Science Channel, National Geographic Channel, TED Talks (online videos), and the History Channel. You may choose to watch a live performance or movie at a planetarium or science museum instead of watching a media production. You may watch online productions with your counselor’s approval and under your parent’s supervision.

B. Read (about one hour total) about anything related to motion or machines. Then do the following:

- (1) Make a list of at least two questions or ideas from what you read.
- (2) Discuss two of the questions or ideas with your counselor.

Books on many topics may be found at your local library. Examples of magazines include but are not limited to *Odyssey*, *KIDS DISCOVER*, *National Geographic Kids*, *Highlights*, and *OWL* or [owlkids.com](http://owlkids.com).

C. Do a combination of reading and watching (about one hour total) about anything related to motion or machines. Then do the following:

- (1) Make a list of at least two questions or ideas from what you read and watched.
- (2) Discuss two of the questions or ideas with your counselor.

2. Complete ONE adventure from the following list. (Choose one that you have not already done.) Discuss with your counselor what kind of science, technology, engineering, or math was used in the adventure.

<b>Wolf Cub Scouts</b>	Motor Away Paws of Skill
<b>Bear Cub Scouts</b>	Baloo the Builder A Bear Goes Fishing
<b>Webelos Scouts</b>	Adventures in Science Engineer Sportsman

## Wolf Cub Scouts

**Motor Away:** Application of scientific principles to create a better boat or plane design

**Paws of Skill:** Levers are used in many sports, including baseball, golf, and tennis.

## Bear Cub Scouts

**Baloo the Builder:** Using a lever (crowbars, pliers, screwdrivers, hammer, etc.)

**A Bear Goes Fishing:** Using a lever (a fishing rod)

## Webelos Scouts

**Adventures in Science:** Rockets, motion on playground, and creating circuits are all part of engineering.

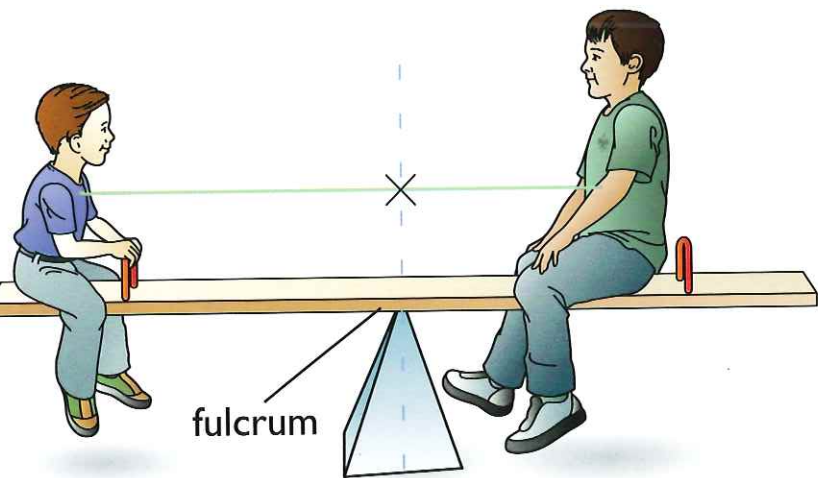
**Engineer:** Entire adventure deals with engineering.

**Sportsman:** Levers are used in many sports, including baseball, golf, and tennis.

Explore EACH of the following.

### A. Levers

- (1) Make a list or drawing of the three types of levers. (A lever is one kind of simple machine.)
- (2) Show:
  1. How each lever works
  2. How the lever in your design will move something
  3. The class of each lever
  4. Why we use levers



The seesaw is a simple (class 1) lever.

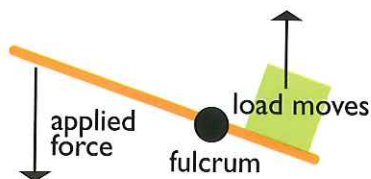


A lever is a rigid bar that turns around a fulcrum, or fixed point. The force—a push or a pull that is applied to the lever—is called the effort. The farther the effort is from the fulcrum, the easier it is to use the lever. What the lever moves is called the load or the resistance. Levers can change the direction of motion, make it easier to move something, or cause something to move a greater distance. There are three classes, or types, of levers.

**Class 1 lever**—The fulcrum is located between the effort and the load. The load always pushes down because of its weight. The force applied will push up on the load.

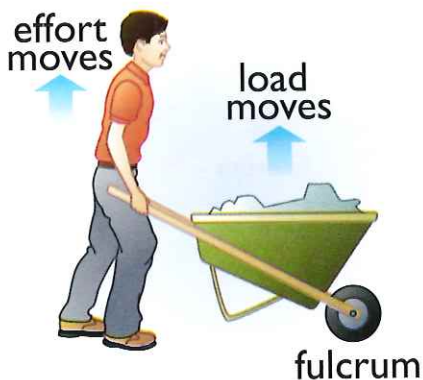
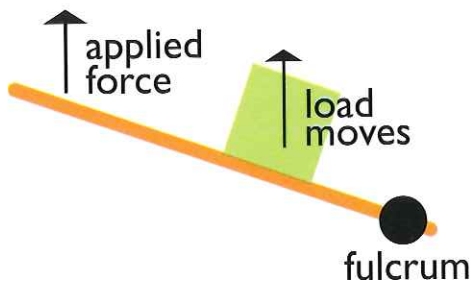
In a class 1 lever, you push down. Even though you are pushing down because of its weight, the load will be lifted up. Also in a class 1 lever, you apply force in the direction opposite the direction you want the object to move. Depending on where the fulcrum is placed, a class 1 lever can make the load either move more easily or move a greater distance. Examples of class 1 levers include seesaws, crowbars, scissors, and pliers.

## CLASS 1 LEVER

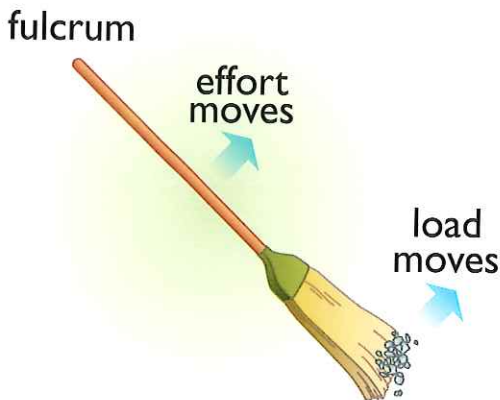
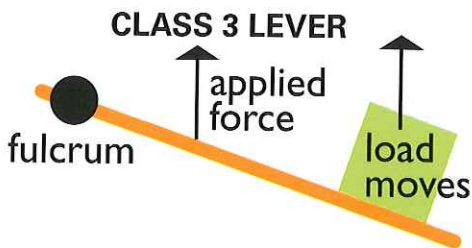


Class 2 lever—The fulcrum is at one end, the effort is at the other end, and the load is in the middle. The effort and the load move in the same direction. In a class 2 lever, the load pushes down, but you lift up to lift up the load. A class 2 lever makes an object easier to move. Examples of class 2 levers include wheelbarrows, catapults, bottle openers, screwdrivers, nutcrackers, staplers, and wheelbarrows.

### CLASS 2 LEVER



**Class 3 lever**—The fulcrum is at one end, and the effort is applied between the fulcrum and the load. In a class 3 lever, you push in the direction you want the load to move. A class 3 lever makes an object harder to move but moves the object a much greater distance than the effort moves, such as a hammer driving a nail. Because the load end moves faster than the effort (it has to travel farther during the same amount of time), the load gains speed, such as swinging a baseball bat or golf club. Many sporting activities use class 3 levers, such as baseball bats, tennis rackets, canoe paddles, golf clubs, and fishing poles. Other examples of class 3 levers include the human arm, brooms, shovels, tweezers, and staple removers.



B. On your own, design, including a drawing, sketch, or model, ONE of the following:

- (1) A playground fixture that uses a lever
- (2) A game or sport that uses a lever
- (3) An invention that uses a lever

Be sure to show how the lever in your design will move something.

C. Discuss your findings with your counselor.

Levers can be used to:

- Make things easier to move—A small force applied over a large distance results in a large force moving a small distance (class 1 levers where the applied force is farther away from the fulcrum than the load, and class 2 levers).
- Change the direction of the applied force (class 1 levers).
- Increase the distance an object moves—A large force applied over a small distance moves the load a large distance. (This happens with class 3 levers and class 1 levers where the fulcrum is closer to the applied force than the load.)

4. Do the following:

A. Visit a place that uses levers, such as a playground, carpentry shop, construction site, restaurant kitchen, or any other location that uses levers.

- Playground—Seesaws (class 1), swings (class 2), and sandbox shovels (class 3)
- Carpentry shop—hammers (class 3; the hammer's claw is a class 1)
- Construction site—crowbar (class 1, pliers (class 1), backhoe (class 1; see <http://leo.koppel.ca/backhoe/levers.html>), shovel (class 3)
- Restaurant kitchen—can opener (class 1), spoons and forks (class 3), bottle opener (class 2)

Bats, clubs, rackets, paddles, and fishing poles are class 3 levers.

Visitations to places like carpentry shops, construction sites, restaurant kitchens, etc., will require advance planning by the counselor. The counselor should call ahead to make arrangements, and make plans to have appropriate supervision of all Scouts. The site will very likely have rules and instructions that must be followed. The counselor should help ensure that all the participants are aware of and follow those rules. This may include safety procedures and other instructions.

- B. Discuss with your counselor the equipment or tools that use levers in the place you visited.
5. Discuss with your counselor how engineering and simple machines affect your everyday life.

## Helpful Links

Technologystudent.com

Website: [www.technologystudent.com/forcmom/lever1.htm](http://www.technologystudent.com/forcmom/lever1.htm)

Leo Koppel's website

Website: <http://leo.koppel.ca/backhoe/levers.html>



NOTES:



## 1-2-3 Go!

This module is designed to help the Scout explore how math affects his life each day.

1. Choose A *or* B *or* C and complete ALL the requirements.
  - A. Watch an episode or episodes (about one hour total) of a show that involves math or physics. Then do the following:
    - (1) Make a list of at least two questions or ideas from what you watched.
    - (2) Discuss two of the questions or ideas with your counselor.

Math and physics are used in almost every kind of invention, including cars, airplanes, and telescopes. Math also includes cryptography, the use of secret codes.

Some examples include—but are not limited to—shows found on PBS (“NOVA”), Discovery Channel, Science Channel, National Geographic Channel, TED Talks (online videos), and the History Channel. You may choose to watch a live performance or movie at a planetarium or science museum instead of watching a media production. You may watch online productions with your counselor’s approval and under your parent’s supervision.

B. Read (about one hour total) about anything that involves math or physics. Then do the following:

- (1) Make a list of at least two questions or ideas from what you read.
- (2) Discuss two of the questions or ideas with your counselor.

Books on many topics may be found at your local library. Examples of magazines include but are not limited to *Odyssey*, *KIDS DISCOVER*, *National Geographic Kids*, *Highlights*, and *OWL* or [owlkids.com](http://owlkids.com).

C. Do a combination of reading and watching (about one hour total) about anything that involves math or physics. Then do the following:

- (1) Make a list of at least two questions or ideas from what you read and watched.
- (2) Discuss two of the questions or ideas with your counselor.

2. Complete ONE adventure from the following list. (Choose one that you have not already done.) Discuss with your counselor what kind of science, technology, engineering, or math was used in the adventure.

**Wolf Cub Scouts** Code of the Wolf

**Bear Cub Scouts** Robotics

**Webelos Scouts** Game Design

## Wolf Cub Scouts

**Code of the Wolf:** Working with numbers, logic, and math

## Bear Cub Scouts

**Robotics:** Working with logic

## Webelos Scouts

**Game Design:** Working with logic

3. Explore TWO options from A *or* B *or* C and complete ALL the requirements for those options. Keep your work to share with your counselor. The necessary information to make your calculations may be found in a book or on the Internet. (See the Helpful Links box for ideas.) You may work with your counselor on these calculations.
  - A. Choose TWO of the following places and calculate how much you would weigh there.
    - (1) On the sun or the moon

Earth weight (in pounds)  $\times$  28 (27.97) = Sun weight

Earth weight (in pounds)  $\times$  0.166 = Moon weight

## (2) On Jupiter or Pluto

Earth weight (in pounds)  $\times$  2.36 = Jupiter weight

Pluto is no longer considered a planet because it is so small. Pluto is now considered a planetoid. A human would weigh less on Pluto than on Earth's moon.

Earth weight (in pounds)  $\times$  0.059 = Pluto weight

## (3) On a planet that you choose

Earth weight (in pounds)  $\times$  0.378 = Mercury weight

Earth weight (in pounds)  $\times$  0.907 = Venus weight

Earth weight (in pounds)  $\times$  1.000 = Earth weight

Earth weight (in pounds)  $\times$  0.377 = Mars weight

Earth weight (in pounds)  $\times$  2.36 = Jupiter weight

Earth weight (in pounds)  $\times$  0.916 = Saturn weight

Earth weight (in pounds)  $\times$  0.889 = Uranus weight

Earth weight (in pounds)  $\times$  1.12 = Neptune weight

Very young Cub Scouts may not be familiar with decimal numbers yet, or may be familiar with decimal numbers only up to one or two places after the decimal point. Feel free to round a given gravity multiplier to the tenths or hundredths place if this will help a Cub Scout complete the activity on his own. Alternatively, one can avoid decimals entirely by thinking in terms of ratios; for example, every 10 pounds on Earth equals about 9 pounds on Venus, so a child who weighs 60 pounds on Earth will weigh about 54 pounds on Venus.

B. Choose ONE of the following and calculate its height:

- (1) A tree
- (2) Your house
- (3) A building of your choice

Step 1—On a sunny day, choose a tree that casts a clear shadow. Trees and other tall objects that stand by themselves are easiest to work with.

Step 2—Hold a 12-inch ruler perpendicular to the ground, right next to the tree.

Step 3—Measure the shadow of the ruler in inches, and record the measurement. Call this measurement A.

Step 4—Measure the shadow of the tree in feet, and record the measurement. Call the tree shadow measurement B.

Step 5—Multiply measurement B by 12, then divide that answer by measurement A. The result is the height of the tree in inches.



- C. Calculate the volume of air in your bedroom. Make sure your measurements have the same units—all feet or all inches—and show your work.

Volume = Length  $\times$  Width  $\times$  Height

The answer will be in cubic feet or cubic inches ( $\text{ft}^3$  or  $\text{in}^3$ ).

#### 4. Secret Codes

- A. Look up, then discuss with your counselor each of the following:

(1) Cryptography

One of the earliest recorded uses of cryptography, the practice of hiding information, was when Roman leader Julius Caesar (100 B.C. to 44 B.C.) used a substituted letter code to hide information. Cryptography has been very useful during wars for transmitting information without revealing it to the enemy (unless the code is broken). The major use of cryptography today is with computers, especially in finance and electronic data transmissions. ATM cards, computer passwords, and personal identification numbers depend on cryptography.

(2) At least three ways secret codes or ciphers are made

A code is a symbol or signal used to represent or communicate something else. A cipher is a way to make a secret message by changing or rearranging the letters in the message. Codes replace words, phrases, or sentences with groups of letters or numbers; ciphers rearrange or substitute letters. Examples of codes and ciphers include but are not limited to:

- Transposition ciphers: Rearrange the letters in a word.
- Book code/dictionary code: Use two copies of the same book (dictionaries work best). For each word in the code, give the page number, (and column number for a dictionary), row number, and word number. Usually it is best to use two or three digits for each coded word, using zeros as placeholders.
- Letter shifts: Shift every letter in the alphabet a set number of places.
- Number substitutions: Assign every letter a number. This can be combined with letter shifts.
- Keyboard ciphers: Using a keyboard, shift a set number of places.
- Date shift ciphers: Use a date to create a letter shift.
- Stacked ciphers: Combine two or more codes and/or ciphers

- (3) How secret codes and ciphers relate to mathematics

Many ciphers can be broken by using what is called frequency analysis. For example, the letter “e” is the most frequently used letter in the English language. Ciphers are pairs of algorithms, rules or a set of rules to solve a problem, used to encrypt and decrypt information (make information unreadable or readable). Since the early 20th century, cryptography has made a much more extensive use of mathematics, including information theory, computational complexity, statistics, number theory, and abstract algebra.

- B. Design a secret code or cipher. Then do the following:
- (1) Write a message in your code or cipher.
  - (2) Share your code or cipher with your counselor.
5. Discuss with your counselor how math affects your everyday life.

## Helpful Links

You may choose other links if preferred.

“Your Weight On Other Planets”: Essortment

Website: [www.essortment.com/all/weightonplan\\_rvrp.htm](http://www.essortment.com/all/weightonplan_rvrp.htm)

“How to Calculate Volume of a Room”: eHow

Website: [www.ehow.com/how\\_2266390\\_calculate-volume-room.html](http://www.ehow.com/how_2266390_calculate-volume-room.html)

“CryptoKids”: National Security Agency

Website: [www.nsa.gov/kids](http://www.nsa.gov/kids)

“Cryptology for Kids”: Purdue University Center for Education and Research in Information Assurance and Security

Website: [www.cerias.purdue.edu/education/k-12/teaching\\_resources/lessons\\_presentations/cryptology.html](http://www.cerias.purdue.edu/education/k-12/teaching_resources/lessons_presentations/cryptology.html)

Micaiah's website

Website: [http://ndmicaiah.roxer.com/page\\_2](http://ndmicaiah.roxer.com/page_2)

“The Secret World of Codes and Code Breaking”: University of Cambridge NRICH

Website: <http://nrich.maths.org/2197>

“How to Create Secret Codes and Ciphers”: wikiHow

Web page: [www.wikihow.com/Create-Secret-Codes-and-Ciphers](http://www.wikihow.com/Create-Secret-Codes-and-Ciphers)

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