

MY NOVA COUNSELORS:

MY SUPERNOVA
MENTORS:

SCIENCE
TECHNOLOGY
ENGINEERING
MATHEMATICS



TROOP 110
BOY SCOUT NOVA AND
SUPERNOVA WORKBOOK



NAME _____

PATROL _____

The Boy Scouts of America's NOVA Awards program incorporates learning with cool activities and exposure to science, technology, engineering and mathematics for Cub Scouts, Boy Scouts, and Venturers. The hope is that the requirements and activities for earning these awards stimulates interest in STEM-related fields and shows how science, technology, engineering and mathematics apply to everyday living and the world around them. Counselors and mentors help bring this engaging, contemporary, and fun program to life for youth members.

THE NOVA AWARDS

There are four Nova awards for Boy Scouts. Each award covers one component of STEM—Science, Technology, Engineering, or Mathematics.

Boy Scout Nova awards: Shoot!, Start Your Engines, Whoosh!, and Designed to Crunch. For their first Nova award, Scouts earn the distinctive Nova award patch. After that, a Scout can earn three more Nova awards, each one recognized with a separate pi (π) pin-on device that attaches to the patch. The patch and the three devices represent each of the four STEM topics—science, technology, engineering, and mathematics.

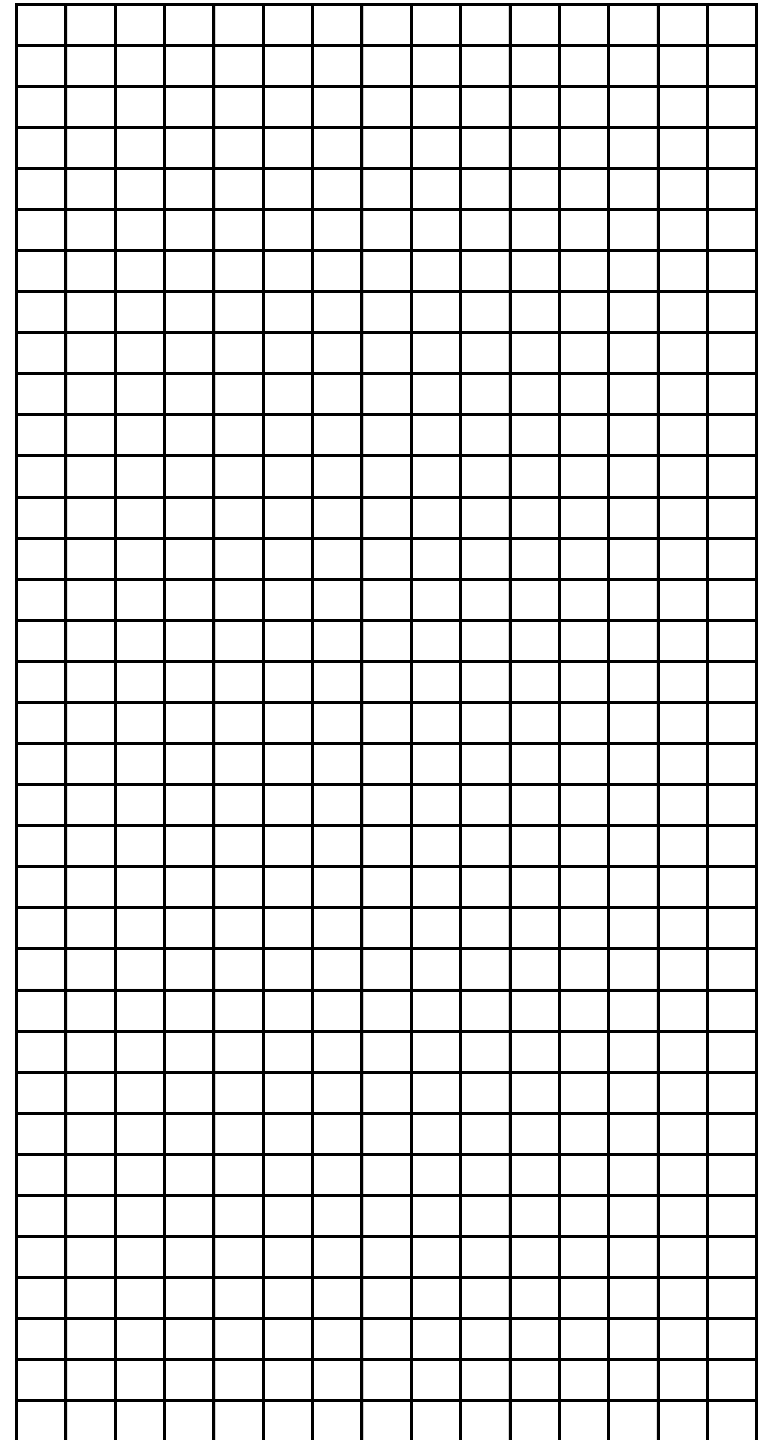
THE SUPERNOVA AWARDS

The Supernova awards have more rigorous requirements than the Nova awards. The requirements and activities were designed to motivate youth and recognize more in-depth, advanced achievement in STEM-related activities.

For Boy Scouts: Dr. Bernard Harris Supernova Bronze Award and Thomas Edison Supernova Silver Award

For earning the Supernova award, Scouts receive a medal and certificate: each Troop determines how this medal is purchased.

All requirements may be found in the Nova awards guidebooks, available through local Scout shops and may be tracked in this workbook. The requirements can be completed with a parent or an adult leader as the counselor (for the Nova awards) or mentor (for the Supernova awards). Each guidebook includes a section for the counselor and mentor.





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 about three hours total of science-related shows or documentaries that involve projectiles, aviation, weather, astronomy, or space technology. Then do the following:

____ 1. Make a list of at least five questions or ideas from the show(s) 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 three hours total) about projectiles, aviation, space, weather, astronomy, or aviation or space technology. Then do the following::

____ 1. Make a list of at least two questions or ideas from each article.

____ 2. Discuss two of the questions or ideas with your counselor

Examples of magazines include—but are not limited to—Odyssey, Popular Mechanics, Popular Science, Science Illustrated, Discover, Air & Space, Popular Astronomy, Astronomy, Science News, Sky & Telescope, Natural History, Robot, Servo, Nuts and Volts, and Scientific American.

____ C. Do a combination of reading and watching (about three hours total). Then do the following:

____ 1. Make a list of at least two questions or ideas from each article or show.

____ 2. Discuss two of the questions or ideas with your counselor.



BOY SCOUT SUPERNOVA AWARD

THOMAS EDISON SUPERNOVA AWARD

- ___ 1. Earn the Dr. Bernard Harris Supernova Award.
- ___ 2. Complete ONE additional Boy Scout Nova award for a total of four. (Note: This may be done at any time after becoming a Boy Scout.)
- ___ 3. Earn FOUR additional Supernova-approved merit badges from the list provided, other than the four earned while working on the Harris Supernova Award for a total of eight. (Note: These may be earned at any time after becoming a Boy Scout.)
- ___ 4. Complete TWO additional Supernova activity topics, one each in the two STEM areas NOT completed for the Harris Supernova Award. (Note: The intent is that upon completion of the Edison Supernova Award the Scout will have completed one Supernova activity topic in each of the four STEM areas.)
- ___ 5. Participate in a local, state, or national science fair or mathematics competition OR any other equally challenging STEM-oriented competition or workshop approved by your mentor. An example of this would be an X-Prize type competition. (Note: The intent is that upon completion of the Edison Supernova Award, the Scout will have participated in two such events.)
- ___ 6. Working with your mentor, organize and present a Nova award or other STEM-related program to a Cub Scout den or pack meeting. Be sure to receive approval from the appropriate unit leader. If a Cub Scout den or pack is not available, your presentation may be given to another youth group, such as your troop or at your place of worship. (Note: The intent is that upon completion of the Edison Supernova Award the Scout will have completed two such presentations.)
- ___ 7. Research a scientific, technical, engineering, or mathematical breakthrough or invention of the past 100 years that has affected our society in a meaningful way and present your hypothesis on how it might further affect our society during your lifetime. Present either a 30-minute oral report or a 1,500-word written report to your mentor.
- ___ 8. Submit an application to the district or council Nova or advancement committee for approval.

SUPERNOVA MENTOR:

NOVA SCIENCE - SHOOT! (3)



- ___ B. Discover. Explain to your counselor the difference between escape velocity (not the game), orbital velocity, and terminal velocity. Then answer TWO of the following questions. (With your parent's or guardian's permission, you may explore websites to find this information.)
 - ___ 1. Why are satellites usually launched toward the east, and what is a launch window?
 - ___ 2. What is the average terminal velocity of a skydiver? (What is the fastest you would go if you were to jump out of an airplane?)
 - ___ 3. How fast does a bullet, baseball, airplane, or rocket have to travel in order to escape Earth's gravitational field? (What is Earth's escape velocity?)
- ___ 4. Choose A or B and complete ALL the requirements.
 - ___ A. Visit an observatory or a flight, aviation, or space museum.
 - ___ 1. During your visit, talk to a docent or person in charge about a science topic related to the site.
 - ___ 2. Discuss your visit with your counselor.
 - ___ B. Discover the latitude and longitude coordinates of your current position. Then do the following:
 - ___ 1. Find out what time a satellite will pass over your area. (A good resource to find the times for satellite passes is the Heavens Above website at www.heavens-above.com .)
 - ___ 2. Watch the satellite using binoculars. Record the time of your viewing, the weather conditions, how long the satellite was visible, and the path of the satellite. Then discuss your viewing with your counselor.
- ___ 5. Choose A or B or C and complete ALL the requirements.
 - ___ A. Design and build a catapult that will launch a marshmallow a distance of 4 feet. Then do the following:
 - ___ 1. Keep track of your experimental data for every attempt. Include the angle of launch and the distance projected.



NOVA SCIENCE - SHOOT! (4)

____2. Make sure you apply the same force every time, perhaps by using a weight to launch the marshmallow. Discuss your design, data, and experiments—both successes and failures - with your counselor.

____ B. Design a pitching machine that will lob a softball into the strike zone. Answer the following questions, then discuss your design, data, and experiments - both successes and failures—with your counselor.

____1. At what angle and velocity will your machine need to eject the softball in order for the ball to travel through the strike zone from the pitcher’s mound?

____2. How much force will you need to apply in order to power the ball to the plate?

____3. If you were to use a power supply for your machine, what power source would you choose and why?

____C. Design and build a marble run or roller coaster that includes an empty space where the marble has to jump from one part of the chute to the other. Do the following, then discuss your design, data, and experiments—both successes and failures—with your counselor.

____1. Keep track of your experimental data for every attempt. Include the vertical angle between the two parts of the chute and the horizontal distance between the two parts of the chute.

____2. Experiment with different starting heights for the marble. How do the starting heights affect the velocity of the marble? How does the starting height affect the jump distance?

____6. Discuss with your counselor how science affects your everyday life.

NOVA COUNSELOR:

DATE OF COMPLETION: _____

BOY SCOUT SUPERNOVA AWARD

DR. BERNARD HARRIS SUPERNOVA BRONZE AWARD



____8. Review the scientific method (you may know this as the scientific process) and note how scientists establish hypotheses, theories, and laws. Compare how the establishment of "facts" or "rules" using the scientific method differs from the establishment of "facts" or "rules" in other environments, such as legal, cultural, religious, military, mathematical, or social environments. Then do the following:

____A. Choose a modern scientific subject with at least two competing theories on the subject and learn as much as possible about each theory.

____B. Analyze the competing theories, decide which one is most convincing to you, and explain why to your mentor.

____C. Make a presentation to your mentor that describes the controversy, the competing theories, and your conclusions about how the scientific method can or cannot contribute to the resolution of the controversy.

Submit a [Supernova award application](#) to the district or council Nova or advancement committee for approval.

SUPERNOVA MENTOR:

SUPERNOVA ACTIVITY TOPIC #1:

SUPERNOVA ACTIVITY TOPIC #2:

DATE OF COMPLETION: _____



BOY SCOUT SUPERNOVA AWARD

DR. BERNARD HARRIS SUPERNOVA BRONZE AWARD

- ____ 1. Complete any three of the Boy Scout Nova awards. (Note: These may be done at any time after becoming a Boy Scout.)
- ____ 2. Earn the Scholarship merit badge.
- ____ 3. Earn four of the Supernova approved merit badges from the above list. (Note: These may be earned at any time after becoming a Boy Scout.)
- ____ 4. Complete TWO Supernova activity topics, one each in two different STEM areas.

A Supernova activity topic is a two-part, hands-on, high-level activity related to one of the STEM fields. Part 1 involves research, preparation, set up, coordination, and/or organization. Part 2 involves analysis and reflection, culminating in the creation of a report in any one of the available format options. See the "Supernova Activity Topics" chapter.

- ____ 5. Participate in a local, state, or national science fair or mathematics competition OR in any equally challenging STEM-oriented competition or workshop approved by your mentor. An example of this would be an X-Prize type competition.
- ____ 6. Do ONE of the following:
 - ____ A. With your parent's permission and your mentor's approval, spend at least one day "shadowing" a local scientist or engineer and report on your experience and what you learned about STEM careers to your mentor.
 - ____ B. Learn about a career that is heavily involved with STEM. Make a presentation to your mentor about what you learned.
- ____ 7. Working with your mentor, organize and present a Nova award or other STEM-related program to a Cub Scout den or pack meeting. Be sure to receive approval from the appropriate unit leader and agree on a time and place for the presentation. If a Cub Scout den or pack is not available, your presentation may be given to another youth group, such as your troop or at your place of worship.

NOVA TECHNOLOGY - START YOUR ENGINES (1)



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 about three hours total of technology-related shows or documentaries that involves transportation or transportation technology. Then do the following:
 - ____ 1. Make a list of at least two questions or ideas from each show.
 - ____ 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 three hours total) about transportation or transportation technology. Then do the following:
 - ____ 1. Make a list of at least two questions or ideas from each article.
 - ____ 2. Discuss two of the questions or ideas with your counselor.

Examples of magazines include—but are not limited to—Odyssey, Popular Mechanics, Popular Science, Science Illustrated, Discover, Air & Space, Popular Astronomy, Astronomy, Science News, Sky & Telescope, Natural History, Robot, Servo, Nuts and Volts, and Scientific American.

- ____ C. Do a combination of reading and watching (about three hours total). Then do the following:
 - ____ 1. Make a list of at least two questions or ideas from each article or show.
 - ____ 2. Discuss two of the questions or ideas with your counselor.



NOVA TECHNOLOGY - START YOUR ENGINES (2)

____ 2. Complete ONE merit badge from the following list. (Choose one that you have not already used toward another Nova award.) After completion, discuss with your counselor how the merit badge you earned uses technology. Automotive Maintenance, Aviation, Canoeing, Cycling, Drafting, Electricity, Energy, Farm Mechanics, Motorboating, Nuclear Science, Railroad, Small-Boat Sailing, Space Exploration, Truck Transportation.

____ 3. Do ALL of the following.

____ A. Using the requirements from the above list of merit badges:

____ 1. Tell your counselor the energy source(s) used in these merit badges.

____ 2. Discuss the pros and cons of each energy source with your counselor.

____ B. Make a list of sources of energy that may be possible to use in transportation.

____ C. With your counselor:

____ 1. Discuss alternative sources of energy.

____ 2. Discuss the pros and cons of using alternative energy sources.

____ 4. Design and build a working model vehicle (not from a kit).

____ A. Make drawings and specifications of your model vehicle before you begin to build.

____ B. Include one of the following energy sources to power your vehicle (do not use gasoline or other combustible fuel source): solar power, wind power, or battery power.

____ C. Test your model. Then answer the following questions:

____ 1. How well did it perform?

____ 2. Did it move as well as you thought it would?

____ 3. Did you encounter problems? How can these problems be corrected?

____ D. Discuss with your counselor:

____ 1. Any difficulties you encountered in designing and building your model

____ 2. Why you chose a particular energy source



NOVA MATHEMATICS - DESIGNED TO CRUNCH (5)

____ 3. Report your results on NASA's Student Observation Network website and see how your data compares to others.

____ 4. Do ALL of the following.

____ A. Investigate your calculator and explore the different functions.

____ B. Discuss the functions, abilities, and limitations of your calculator with your counselor. Talk about how these affect what you can and cannot do with a calculator. (See your counselor for some ideas to consider.)

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

NOVA COUNSELOR:

DATE OF COMPLETION: _____



NOVA MATHEMATICS- DESIGNED TO CRUNCH (4)

____ D. Attend a football game or watch one on TV. (This is a fun activity to do with a parent or friend!) Keep track of the efforts of your favorite team during the game. (Make sure you write down your data and calculations.) Calculate your team's statistics using the following as examples:

- ____ 1. Kicks/punts
 - ____ a. Kickoff—Kick return yards
 - ____ b. Punt—Number, yards
 - ____ c. Field goals—Attempted, percent completed, yards
 - ____ d. Extra point—Attempted, percent completed
- ____ 2. Offense
 - ____ a. Number of first downs
 - ____ b. Forward passes—Attempted, percent completed, total length of passes, longest pass, number and length of passes caught by each receiver, yardage gained by each receiver after catching a pass
 - ____ c. Running plays—Number, yards gained or lost for each run, longest run from scrimmage line, total yards gained or lost, and number of touchdowns
- ____ 3. Defense—Number of quarterback sacks, interceptions turnovers, and safeties

Share your calculations with your counselor, and discuss your conclusions about your team's strengths and weaknesses.

____ E. How starry are your nights? Participate in a star count to find out. This may be done alone but is more fun with a group. Afterward, share your results with your counselor.

- ____ 1. Visit NASA's Student Observation Network website at <http://www.nasa.gov/audience/foreducators/son/energy/starcount/> for instructions on performing a star count.
- ____ 2. Do a star count on five clear nights at the same time each night.



NOVA TECHNOLOGY - START YOUR ENGINES (3)

- ____ 3. Whether your model met your specifications
- ____ 4. How you would modify your design to make it better
- ____ 5. Discuss with your counselor how technology affects your everyday life.

NOVA COUNSELOR:

DATE OF COMPLETION: _____



NOVA ENGINEERING - WHOOSH! (1)

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

- ____ 1. Choose A or B or C and complete ALL the requirements.
- ____ A. Watch about three hours total of engineering-related shows or documentaries that involve motion or motion-inspired technology. Then do the following:
- ____ 1. Make a list of at least five questions or ideas from the show(s) 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. One example is the NOVA Lever an Obelisk page on ancient Egypt and the use of levers, available at

www.pbs.org/wgbh/nova/egypt/raising/lever.html

Examples of magazines include—but are not limited to—Odyssey, Popular Mechanics, Popular Science, Science Illustrated, Discover, Air & Space, Popular Astronomy, Astronomy, Science News, Sky & Telescope, Natural History, Robot, Servo, Nuts and Volts, and Scientific American.

- ____ B. Read (about three hours total) about motion or motion-inspired technology. Then do the following:
- ____ 1. Make a list of at least two questions or ideas from each article.
 - ____ 2. Discuss two of the questions or ideas with your counselor.
- ____ C. Do a combination of reading and watching (about three hours total). Then do the following:
- ____ 1. Make a list of at least two questions or ideas from each article or show.
 - ____ 2. Discuss two of the questions or ideas with your counselor.



NOVA MATHEMATICS- DESIGNED TO CRUNCH (3)

Haplosciences.net

Website: <http://onlinephys.com/labpower1.html>

- ____ 1. How does your horsepower compare to the power of a horse?
- ____ 2. How does your horsepower compare to the horsepower of your favorite car?
- Share your calculations with your counselor, and discuss what you learned about horsepower.
- ____ B. Attend at least two track, cross-country, or swim meets.
- ____ 1. For each meet, time at least three racers. (Time the same racers at each meet.)
 - ____ 2. Calculate the average speed of the racers you timed. (Make sure you write down your data and calculations.)
 - ____ 3 Compare the average speeds of your racers to each other, to the official time, and to their times at the two meets you attended.

Share your calculations with your counselor, and discuss your conclusions about the racers' strengths and weaknesses.

- ____ C. Attend a soccer, baseball, softball, or basketball game. Choose two players and keep track of their efforts during the game. (Make sure you write down your data and calculations.) Calculate their statistics using the following as examples:
- ____ 1. Soccer—Goals, assists, corner kicks, keeper saves, fouls, offsides
 - ____ 2. Baseball or softball—Batting average, runs batted in, fielding statistics, pitching statistics
 - ____ 3 Basketball—Points, baskets attempted, rebounds, steals, turnovers, and blocked shots
- Share your calculations with your counselor, and discuss your conclusions about the players' strengths and weaknesses.



NOVA MATHEMATICS- DESIGNED TO CRUNCH (2)

____C. Read at least three articles (about three hours total) about physics, math, modeling, or cryptography. You may wish to read about how technology and engineering are changing sports equipment, how and why triangles are used in construction, bridge building, engineering, climate and/or weather models, how banks keep information secure, or about the stock market. Then do the following:

- ____1. Make a list of at least two questions or ideas from each article.
- ____2. Discuss two of the questions or ideas with your counselor.

Examples of magazines include—but are not limited to—Odyssey, Popular Mechanics, Popular Science, Science Illustrated, Discover, Air & Space, Popular Astronomy, Astronomy, Science News, Sky & Telescope, Natural History, Robot, Servo, Nuts and Volts, and Scientific American.

____D. Do a combination of reading, watching, or researching (about three hours total). Then do the following:

- ____1. Make a list of at least two questions or ideas from each article, website, or show.
- ____2. Discuss two of the questions or questions with your counselor.

____2. Complete ONE merit badge from the following list. (Choose one that you have not already used toward another Nova award.) After completion, discuss with your counselor how the merit badge you earned uses mathematics: American Business, Chess, Computers, Drafting, Entrepreneurship, Orienteering, Personal Management, Radio, Surveying, Weather.

____3. Choose TWO from A or B or C or D or E and complete ALL the requirements. (Write down your data and calculations to support your explanation to your counselor. You may use a spreadsheet. Do not use someone else's data or calculations.)

- ____A. Calculate your horsepower when you run up a flight of stairs.

Helpful Links

"How to Calculate Your Horsepower": wikiHow Website: <http://www.wikihow.com/Calculate-Your-Horsepower>



NOVA ENGINEERING - WHOOSH! (2)

____2. Choose ONE merit badge from the following list. (Choose one you have not already used for another Nova award.) After completion, discuss with your counselor how the merit badge you earned uses engineering: Archery, Aviation, Composite Materials, Drafting, Electronics, Engineering, Inventing, Model Design and Building, Railroading, Rifle Shooting, Robotics, Shotgun Shooting.

- ____3. Do ALL of the following:
 - ____A. Make a list or drawing of the six simple machines.
 - ____B. Be able to tell your counselor the name of each machine and how each machine works.

Helpful Link

"Six Simple Machines": ConstructionKnowledge.net - Website: http://www.constructionknowledge.net/general_technical_knowledge/general_tech_basic_six_simple_machines.php

____C. Discuss the following with your counselor:

- ____1. The simple machines that were involved with the motion in your chosen merit badge (Hint: Look at the moving parts of an engine to find simple machines.)
- ____2. The energy source causing the motion for the subject of your merit badge
- ____3. What you learned about motion from earning your merit badge

____4. Choose A or B and complete ALL the requirements.

____A. Visit an amusement park. Then discuss the following with your counselor:

- ____1. The simple machines present in at least two of the rides
- ____2. The forces involved in the motion of any two rides

____B. Visit a playground. Then discuss the following with your counselor:

- ____1. The simple machines present in the playground equipment
- ____2. The forces involved in the motion of any two playground fixtures



NOVA ENGINEERING - WHOOSH! (3)

5. Do the following:
- ___A. On your own, design one of the following and include a drawing or sketch: an amusement park ride OR a playground fixture OR a method of transportation.
 - ___B. Discuss with your counselor:
 - ___1. The simple machines present in your design
 - ___2. The energy source powering the motion of your creation
6. Discuss with your counselor how engineering affects your everyday life.

NOVA COUNSELOR:

DATE OF COMPLETION: _____



NOVA MATHEMATICS- DESIGNED TO CRUNCH (1)

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

- ___1. Choose A or B or C or D and complete ALL the requirements.
- ___A. Watch about three hours total math-related shows or documentaries that involve scientific models and modeling, physics, sports equipment design, bridge building, or cryptography. Then do the following:
 - ___1. Make a list of at least five questions or ideas from the show(s) 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. Research (about three hours total) several websites (with your parent's or guardian's permission) that discuss and explain cryptography or the discoveries of people who worked extensively with cryptography. Then do the following:
 - ___1. List and record the URLs of the websites you visited and the major topics covered on the websites you visited. (You may use the copy and paste function—eliminate the words—if you include your sources.)
 - ___2. Discuss with your counselor how cryptography is used in the military and in everyday life and how a cryptographer uses mathematics.

Helpful Link

"The Mathematics of Cryptology": University of Massachusetts Website: <http://www.math.umass.edu/~gunnells/talks/crypt.pdf>