Nova - Whoosh!

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CHAPTER

ONE

WELCOME TO *WHOOSH!*

This Nova award explores how engineering affects your life each day

Note: Learn more aboout engineering with this excellent PBS video.

Warning: When completing this Award both the youth and involved adult leaders must obey all rules of Safe Scouting. This includes (1) Completing Cyber Chip training prior to starting this activity and (2) **ALWAYS** involve at least 2 adults in all your communications with a leader, including online. If you send an email to your counselor, always add the address of another adult leader or a parent/guardian. Never reply to a message sent by an adult leader unless another adult has been copied on the email. Report any issue to your parents/guardians!

1.1 Instructions

1. Identify a **Nova Counselor** either within your unit, district, or council.
2. This site provides you a platform for learning and you can easily follow all requirements using the navigation menu on the left.
3. Once you have identified a Counselor, you can start working on requirements.
4. The most important aspect in any scientific endeavor is to **properly document progress**. This will be done, here, using a google sheet as described in more details below.

1.2 Documenting your progress

0. You can use the template below to report completion. To work on this Nova Award, you can also use a detailed worksheet provided by the BSA. Click here to have access. The file below is used to record approval.
1. A template worksheet can be found here. This is a *Google document*. **You will not be able to modify it until you make your own copy as I will now describe for you.**
2. Once you have opened the file on google doc, go to `File` → `Make a Copy`.
3. Save the file with the following name: *Nova_designed_to_crunch_FIRSTNAME_LASTNAME*
4. You will use that file to enter your progress and share with your counselor.
5. **You can share your own copy of the worksheet with your counselor using the following procedure.**
    a) Click on the SHARE button on the top-right.

b) Click on “get link”.

c) Send the link to your counselor.

Note: This document provides you a guide to complete the Nova award! All requirements are marked with the following symbol: $\boxed{\mathbb{REQ} \rightsquigarrow}$. In addition, a number of fun *Additional Challenges* are provided in boxes for your entertainment.

1.3 If you have any question

Contact your counselor or your scoutmaster! If you have questions about the program, contact Vincent Meunier by email (as usual, make sure you copy an additional adult to all your communications with a leader!).

CHAPTER

TWO

REQUIREMENT #1: RESEARCH AND READING

Note: What is **Engineering**?

Engineering is the branch of science and technology concerned with the design, building, and use of engines, machines, and structures.

Engineering is the application of science and math to solve problems. Engineers figure out how things work and find practical uses for scientific discoveries. Scientists and inventors often get the credit for innovations that advance the human condition, but it is engineers who are instrumental in making those innovations available to the world (definition adapted from this website.)

There are different types of engineering, and we will discuss more about them in this module. Specialty areas include:

- Mechanical engineering
- Electrical engineering
- Civil engineering
- Aerospace engineering
- Nuclear engineering
- Structural engineering
- Biomedical engineering
- Computer engineering
- Industrial engineering
- Environmental engineering

Fig. 1: A good engineer is a good problem solver! This requires a good knowledge of math and science, along with creativity! (Image copied from this website.)

$\boxed{\mathbb{REQ} \rightsquigarrow}$ 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.

Tip: 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 here.

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

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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.

Attention: Once you have completed this requirement, make sure you document it in your worksheet!

CHAPTER

THREE

REQUIREMENT #2: MERIT BADGE

$\boxed{\mathbb{REQ} \rightsquigarrow}$ Complete ONE merit badge from the following list. (Choose one that 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
- Mining in Society
- Model Design and Building
- Railroading
- Rifle Shooting
- Robotics
- Shotgun Shooting

Attention: Once you have completed this requirement, make sure you document it in your worksheet!


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CHAPTER

FOUR

REQUIREMENT #3: SIMPLE MACHINES

Tip: Scientists *versus* Engineers

Many people think there are no differences between a scientist and an engineer, whilst others think the two careers are completely separate from one another. Generally speaking, science is the study of the physical world, which engineering applies scientific knowledge to design processes, structures and equipment.

- Scientists observe the world, while engineers focus on creating. Both field require observation and analysis, though engineering deals with creating and working on already existing creations.
- Engineering is more specific than science. Engineering deals with a variety of issues and topics, but it is narrowed down to the study of how things work. Science is a much broader subject.
- Science creates questions. Engineering creates answers. In general, science deals with observing and coming up with theories, whilst engineering helps to put these theories to the test.

  This *tip* was adapted from the excellent website. Check it out to learn more on the difference between scientists and engineers!

$\boxed{\mathbb{REQ} \rightsquigarrow}$ 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.

> **Tip:** Helpful Link "Six Simple Machines": ConstructionKnowledge.net Website.

C. Discuss the following with your counselor:

(1) The simple machines that were involved with the motion in your chosen merit badge

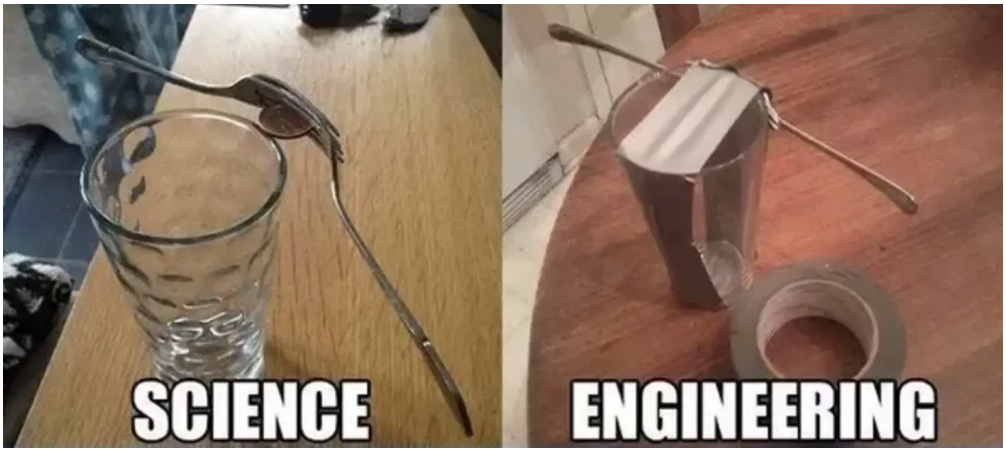
> **Tip:** Look at the moving parts of an engine to find simple machines.

(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

Additional Challenge

Consider the following quote from the famous physicist Freeman Dyson (1923 – 2020) wrote, "*A good scientist is a person with original ideas. A good engineer is a person who makes a design that works with as few original ideas as possible. There are no prima donnas in engineering.*" Perform some research to explain this quote. You can interview scientists and engineers and ask their opinion. Do you agree with Dyson's words?



Science understands how the sum of forces make the forks stable on the glass of water, thus shedding light on Newton's law. Engineer, in contrast, aims at making sure the forks remain stable. Of course this picture is somewhat unfair to engineers as their solutions are usually much more… ingenious! This picture was copied from this website.

One good source of information is this website where the different roles of scientists and engineers are discussed in the specific area of optics.

However remember: **There is considerable overlap between science and engineering, so you will find scientists who design and construct equipment and engineers who make important scientific discoveries**.

Attention: Once you have completed this requirement, make sure you document it in your worksheet!

CHAPTER

FIVE

REQUIREMENT #4: VISIT

$\boxed{\mathbb{REQ} \rightsquigarrow}$ 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

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Note: The Ferris Wheel

The Ferris Wheel is considered one of the greatest engineering wonders in the world. The first Ferris Wheel was created by Pittsburgh, Pennsylvania engineer, George W. Ferris, in 1893. He graduated from Rensselaer Polytechnic Institute in Troy, New York, in the class of 1881 with a degree in Civil Engineering. The wheel is supported by two 140-foot steel towers and connected by a 45-foot axle — the largest single piece of forged steel ever made at that time. You can lean more about it by visiting the following engineerng4kids.com *website <https://engineering4kids.org/2019/01/27/ferris-wheel-2/>__*.

Fig. 1: This image was obtained from the Smithsonian Magazine website where the history of the Ferris wheel is discussed.

Note: **The Eiffel Tower** The Eiffel Tower is a wrought-iron lattice tower on the Champ de Mars in Paris, France. It is named after the engineer Gustave Eiffel, whose company designed and built the tower.

Picture of the Eiffel Tower, obtained from Wikipedia. Visit that website for more information! The website provides the following fun facts: The tower is 324 metres (1,063 ft) tall, about the same height as an 81-storey building, and the tallest structure in Paris. Its base is square, measuring 125 metres (410 ft) on each side. During its construction, the Eiffel Tower surpassed the Washington Monument to become the tallest man-made structure in the world, a title it

held for 41 years until the Chrysler Building in New York City was finished in 1930.

Note: The Atomium

The Atomium was constructed for the first post-war universal world exhibition (EXPO 1958) The nine spheres represent an iron crystal magnified 165 billion times. They represent the faith one had in the power of science and moreover in nuclear power. The Atomium offers today: a surrealistic walk through tubes and spheres. Many people get confused, due in large part to the choice of the name of the structure. Indeed, the *Atomium* is really a representation of a collection of 9 atoms, forming a piece of iron crystal where atomas are regulalry arranged on a lattice.

The Easy Sciecnce for Kids website provides lots of information on this landmark structure from Brussels, Belgium. (1) The diameter of each sphere is 18 meters; (2) The distance between the spheres is about 30 meters; (3) The total height of the structure is 102 meters and the total mass is 2,400 tons; (4) There is a restaurant at the top sphere that has a capacity for 140 guests; (5) It was not originally designed to be a permanent structure.

Attention: Once you have completed this requirement, make sure you document it in your worksheet!

CHAPTER

SIX

REQUIREMENT #5: DESIGN

$\boxed{\mathbb{REQ} \rightsquigarrow}$ 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

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Note: The Engineerng Design Process

Engineering design is an iterative process used to identify problems and develop and improve solutions. Visit the excellent website sponsored by the National Academy of Engineering. Also, watch the short video below!

Attention: Once you have completed this requirement, make sure you document it in your worksheet!

CHAPTER

SEVEN

REQUIREMENT #6: ENGINEERING @ LIFE

$\boxed{\mathbb{REQ} \rightsquigarrow}$ Discuss with your counselor how engineering affects your everyday life.

Additional Challenge

You can find loads of fun projects to complete online. In particular, check out this blog where many fun science and engineering activities are proposed. For instance, check out the activity on how gears work!

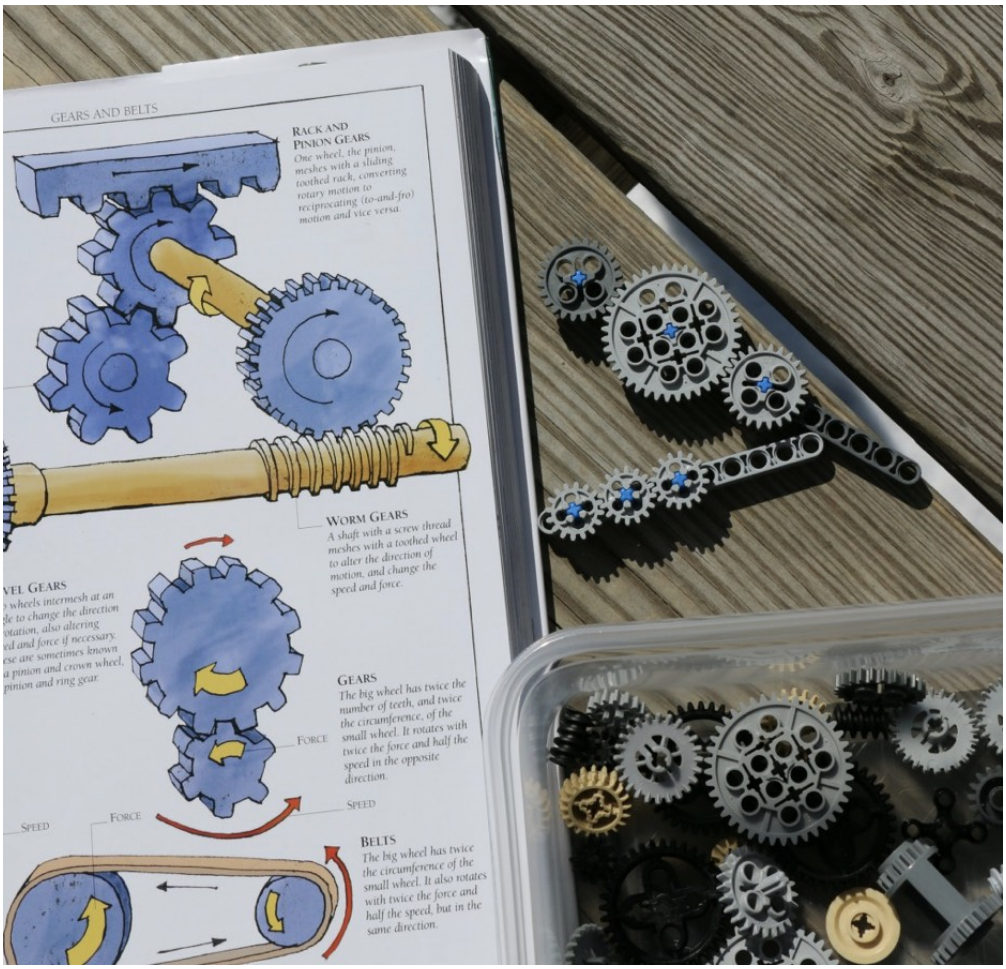


Fig. 1: Image obtained from https://blogshewrote.org/stem-activities-for-teens/.

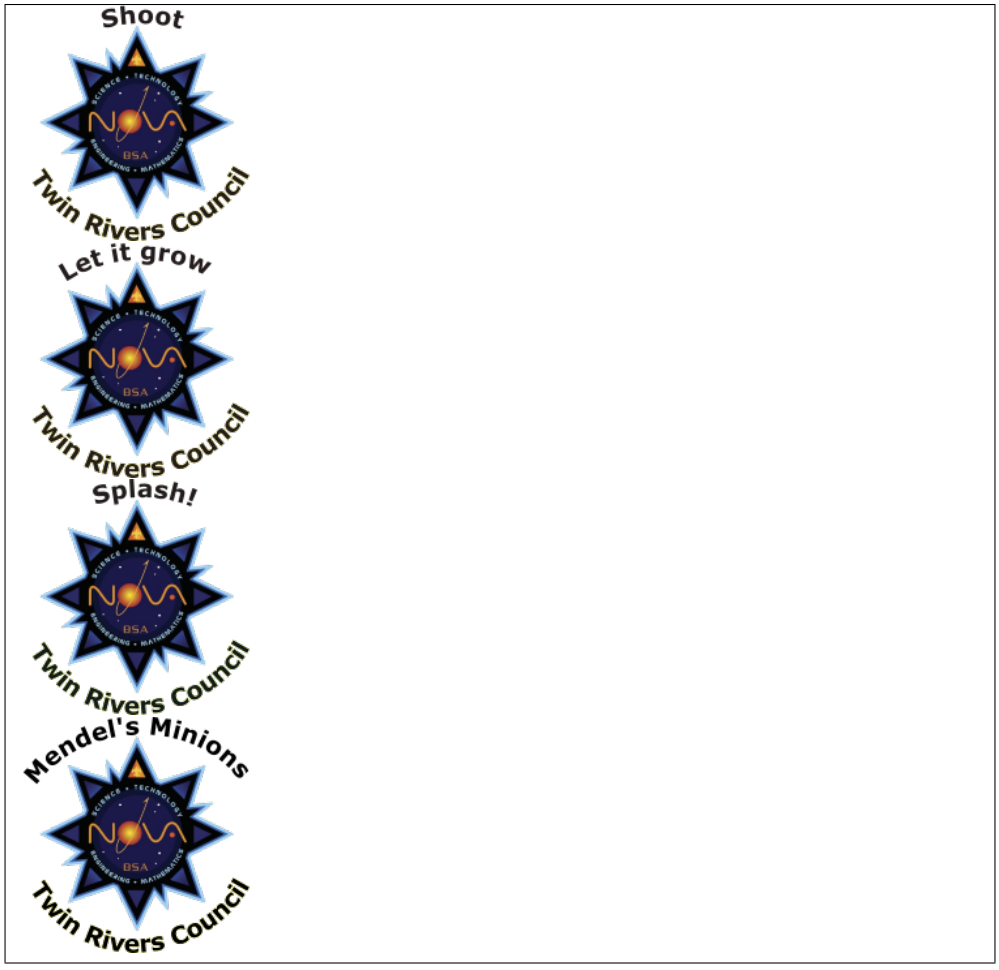
Attention: Once you have completed this requirement, make sure you document it in your worksheet!

CHAPTER

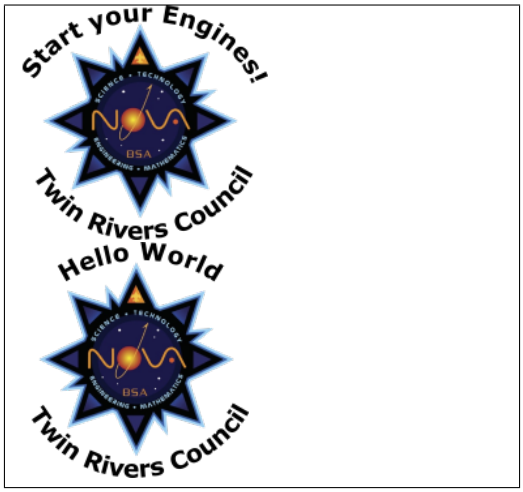
EIGHT

OTHER NOVA MODULES IN THIS SERIES

Science



Technology



Engineering

Math


Designed to crunch
Twin Rivers Council
SCIENCE • TECHNOLOGY
ENGINEERING • MATHEMATICS
BSA

CHAPTER

NINE

ABOUT THE AUTHOR

These pages were written by Vincent Meunier, the Chair of the STEM committee of Twin Rivers Council in New York State.

Vincent Meunier is a Professor of physics at Rensselaer Polytechnic Institute. If you have any questions, feel free to contact him by email.

Note: Most of the material used here was obtained from a number of external scouting sources, including scouting.org

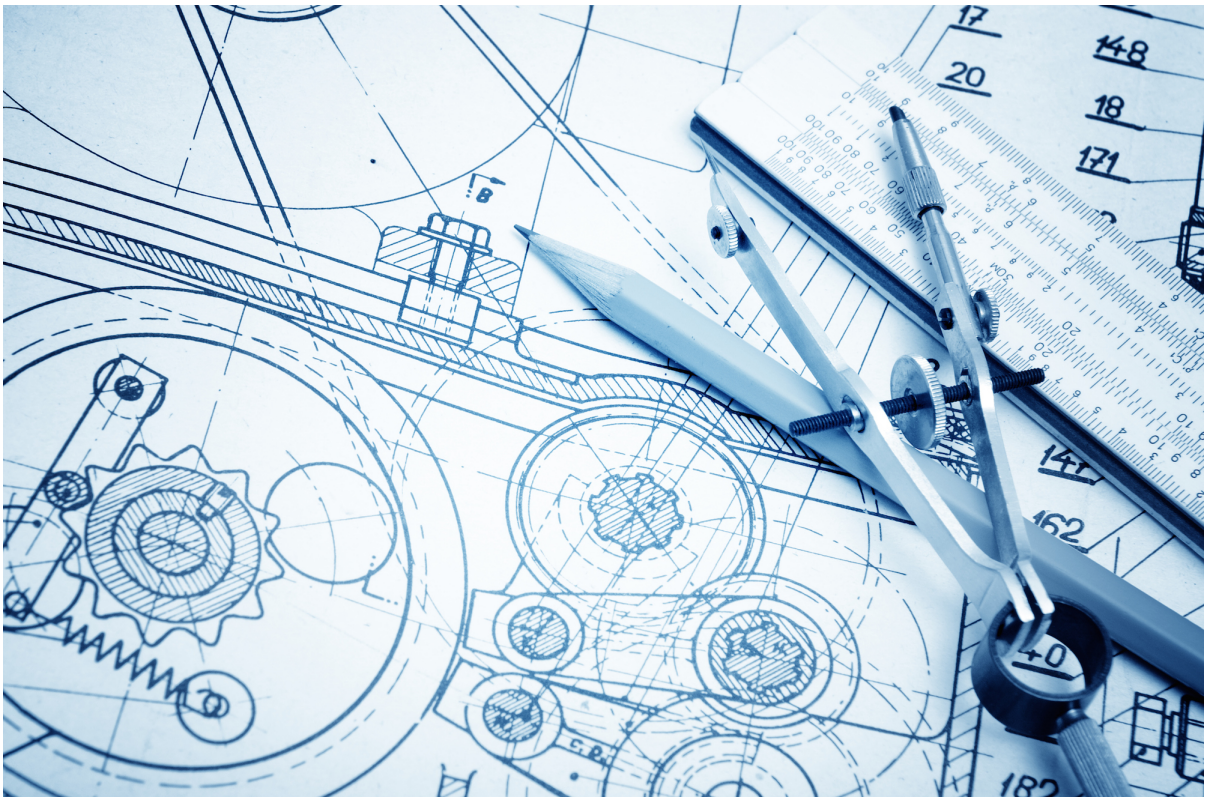


Fig. 1: Image copied from this website.