

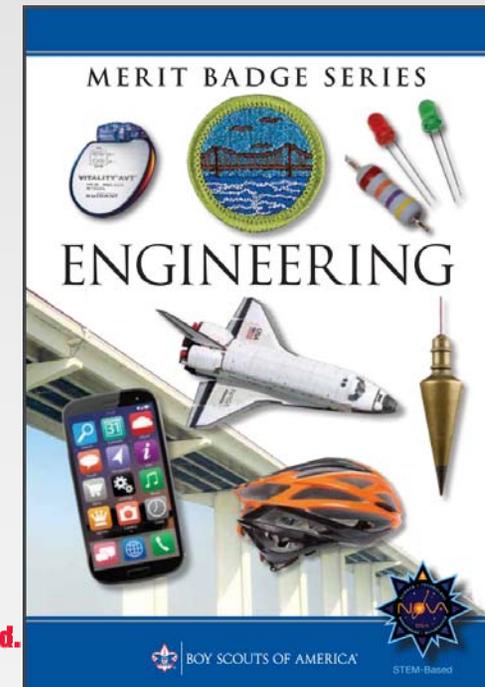


BOY SCOUTS OF AMERICA®
VIRGINIA HEADWATERS COUNCIL

Engineering Merit Badge PART ONE



Eric Cutright, SM Troop 1028/9, June 2020



Prepared.



SCOUTS BSA: TROOP 1028/1029



Engineering Merit Badge

VAHC Online Class June 2020



Day 1 – Overview of Requirements, Introduction to Engineering, Systems Engineering Approach to Problem Solving (5)

- Homework 1: Just Roll With It - Engineer a BB-8 Droid !! (1)

Day 2 – Types of Engineers (3), Engineering Design

- Showcase: Scout homework pictures
- Homework 2: Best Patrol Gear Ever – Engineer a Portable “Bridge” !! (5b)

Day 3 – Triumphs/Disasters in Engineering (2), Professional Engineers (7), Code of Ethics (8), Computer Design (2 - if time)

- Showcase: Scout homework pictures
- Homework 3: Yo! Don't be an Energy Hog !! (6b, plus your choice of another #6)

Day 4 – Careers in Engineering (9), Engineer Interview (4) (yikes, it's me!)

- Showcase: Scout homework pictures
- Homework 4: Whoa, What a Cool / Fun Career !! (9)





The Plan for Today

Part One – Introduction



- Overview of Merit Badge Requirements
- What is an Engineer?
- Systems Engineering Approach to Problem Solving (Requirement 5)
- Day 1 Homework:
Just Roll With It - Engineer a BB-8 Droid !! (1)

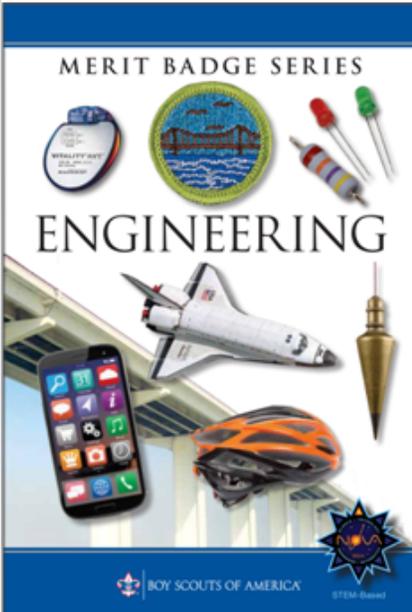


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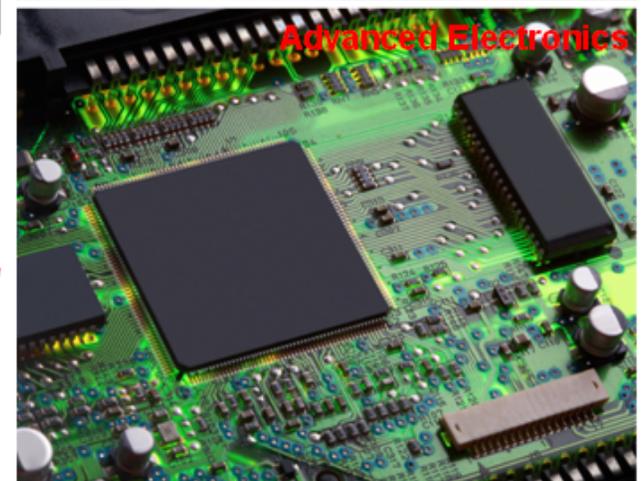
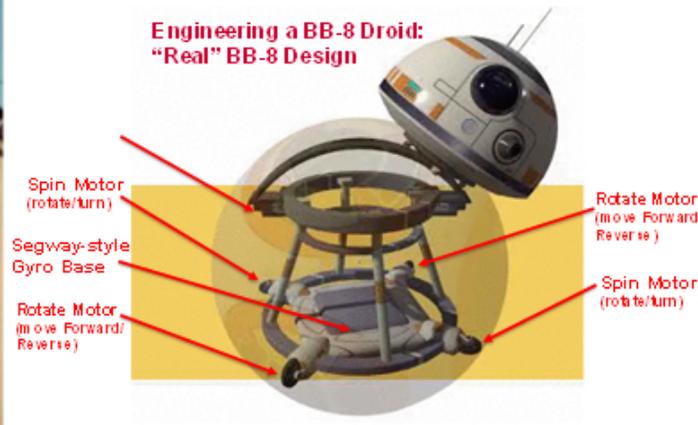




Here's a Sneak Peek of our Awesome Engineering Week!



Engineering a BB-8 Droid: "Real" BB-8 Design





Overview of Current MB Requirements (as of June 2020)



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Engineering MB Reqts – 1/5



1. **(Mr. Eric's homework)** Select a manufactured item in your home (such as a toy or an appliance) and, under adult supervision and with the approval of your counselor, investigate how and why it works as it does. Find out what sort of engineering activities were needed to create it. Discuss with your counselor what you learned and how you got the information.
2. Select an engineering achievement that has had a major impact on society. Using resources such as the Internet (with your parent's permission), books, and magazines, find out about the engineers who made this engineering feat possible, the special obstacles they had to overcome, and how this achievement has influenced the world today. Tell your counselor what you learned.
3. Explain the work of six types of engineers. Pick two of the six and explain how their work is related.





Engineering MB Reqts – 2/5



4. Visit with an engineer (who may be your counselor or parent) and do the following:

- a. Discuss the work this engineer does and the tools the engineer uses.
- b. Discuss with the engineer a current project and the engineer's particular role in it.
- c. Find out how the engineer's work is done and how results are achieved.
- d. Ask to see the reports that the engineer writes concerning the project.
- e. Discuss with your counselor what you learned about engineering from this visit.

5. Do ONE of the following:

- a. Use the systems engineering approach to make step-by-step plans for your next campout. List alternative ideas for such items as program schedule, campsites, transportation, and costs. Tell why you made the choices you did and what improvements were made.
- b. (Mr. Eric's homework) Make an original design for a piece of patrol equipment. Use the systems engineering approach to help you decide how it should work and look. Draw plans for it. Show the plans to your counselor, explain why you designed it the way you did, and explain how you would make it



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Engineering MB Reqts – 3/5



6. Do TWO of the following:

- a. Transforming motion. Using common materials or a construction set, make a simple model that will demonstrate motion. Explain how the model uses basic mechanical elements like levers and inclined planes to demonstrate motion. Describe an example where this mechanism is used in a real product.
- b. (Mr. Eric's homework) Using electricity. Make a list of 10 electrical appliances in your home. Find out approximately how much electricity each uses in one month. Learn how to find out the amount and cost of electricity used in your home during periods of light and heavy use. List five ways to conserve electricity.
- c. Understanding electronics. Using an electronic device such as a mobile telephone or portable digital media player, find out how sound travels from one location to another. Explain how the device was designed for ease of use, function, and durability.
- d. Using materials. Do experiments to show the differences in strength and heat conductivity in wood, metal, and plastic. Discuss with your counselor what you have learned.
- e. Converting energy. Do an experiment to show how mechanical, heat, chemical, solar, and/or electrical energy may be converted from one or more types of energy to another. Explain your results. Describe to your counselor what energy is and how energy is converted and used in your surroundings.



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Engineering MB Reqs – 4/5



6. Do TWO of the following (continued):

- f. Moving people. Find out the different ways people in your community get to work. Make a study of traffic flow (number of vehicles and relative speed) in both heavy and light traffic periods. Discuss with your counselor what might be improved to make it easier for people in your community to get where they need to go.
- ~~g. Building an engineering project. Enter a project in a science or engineering fair or similar competition. (This requirement may be met by participation on an engineering competition project team.) Discuss with your counselor what your project demonstrates, the kinds of questions visitors to the fair asked, and how well you were able to answer their questions.~~

We will do 6b as homework, but you will need to pick one more from 6a, or 6c – 6g on your own!

Note that 6g is not recommended under current COVID-19 conditions.



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Engineering MB Reqts – 5/5



7. Explain what it means to be a registered Professional Engineer (P.E.). Name the types of engineering work for which registration is most important.
8. Study the Engineer's Code of Ethics. Explain how it is like the Scout Oath and Scout Law.
9. Find out about three career opportunities in engineering. Pick one and research the education, training, and experience required for this profession. Discuss this with your counselor, and explain why this profession might interest you.





What is an Engineer ?



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What is an Engineer ?



- **Engineers are creative designers who apply principles of physics and science to develop products or processes to improve everyday life**
 - The work of engineers affects every part of our lives – at home, at school, and at work
 - We have engineers to thank when we use the escalators at the shopping mall, watch TV on the latest flat-panel display, take videos on the latest iPhone, or get scanned for diseases with the latest imaging equipment at the hospital
- **There are many different fields of engineering and areas for specialization (more tomorrow!)**





Studying Engineering: Do you have what it takes?



- “Required” skills and interests for Engineering
 - Math
 - Science
 - 3D visualization / shapes
 - Writing / communication (more later)
 - Creative thinking, thinking outside of the box
 - Ability to see the big picture and not get lost in details
 - Designing new things
 - Working as part of a team
 - Computer skills
- If you absolutely hate any of the above then Engineering may not be right for you !!





Engineering: Oh snap – why writing and communication?



- **Writing and communication are HUGE parts of almost every engineering career**
 - You have to write requirements, detailed design, and testing documentation for every engineering project so that other engineers will clearly understand it and agree with you
 - You often have to “pitch” your ideas to your team, boss, or clients to get funding to work on new projects or design new things
 - Must be able to write well and speak well to do this effectively !!
 - Poor writing or communication erodes confidence in your engineering skills even if you are an amazing engineer !!
- **A sales pitch like this will not get you anywhere:**
 - Me project is gud it works wheel nice, gimme money to deezin it



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Systems Engineering Approach to Problem Solving (Requirement 5)



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Systems Engineering Approach to Problem Solving



1. Make a plan showing approach, resources, required tools, and schedule
2. Describe the project requirements
3. Plan the project's activities and task schedules
4. Conduct research – get ideas
5. Develop the best ideas for alternative solutions
6. Analyze the best ideas and compare them
7. Select the best idea
8. Perform the construction or solution of the project
9. Check the solution





Engineering Design – Key Highlights and Skills



- **Requirements-based design is a critical key**
 - Be sure you have comprehensively specified what your system is supposed to do BEFORE you design it
 - Remember, a wrong requirement means a wrong design !
- **Break a big problem into small pieces**
 - Don't get overwhelmed, manage a complex design by "compartmentalization" into small solvable parts
 - Engineering design is an iterative process
- **Some key skills (besides all the math and computers): drawing, organization, record-keeping, written and spoken communication, teamwork**
- **Engineers use lots of tools (especially computers!)**

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Day 1 Homework: Star Wars The Force Awakens Engineering Project (Req't 1)



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Star Wars The Force Awakens Engineering Project



- I'm going to take you WAAAAY back to November 2014 to a certain galaxy far, far, away
- This was the first teaser trailer for Star Wars The Force Awakens (Episode VII):
https://www.youtube.com/watch?v=erLk59H86ww&list=PL148kCvXk8pD4i6tww4roNV1R_oAceb-5&feature=player_embedded
- When you watch it, think like an engineer – what catches your eye?





Star Wars The Force Awakens Engineering Project



- **BB-8, duh! This was my immediate thought process in order:**
 1. (Yelling and screaming in excitement) that is the coolest most awesomely amazing spunky droid that I have ever seen
 2. That is the dumbest and most impossible design for a droid that I have ever seen, that could never be built – I start laughing
 3. Two seconds later I stop laughing. Hmmm, wait a minute, what if ? (a lot of excited math and technological considerations ensue)
- **A few months later, the real BB-8 rolled onto the stage at a comic show and interacted with the host, and I was captivated!!**
- **In 2015, I was one of the first in the US to buy this (seriously - no joke!), our Engineering MB project for this week:**
https://www.youtube.com/watch?v=-1Y2WfcCb4M&feature=player_embedded





Day 1 Homework: Just Roll With It - Engineer a BB-8 Droid

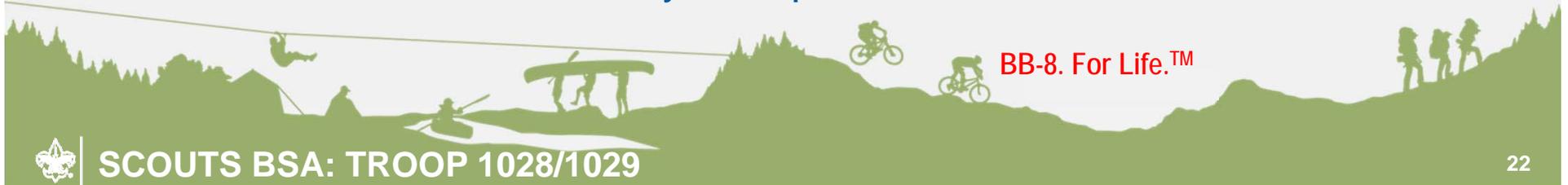




Day 1 Homework: Just Roll With It - Engineer a BB-8 Droid



- **Define the set of requirements**
 - What functions should BB-8 perform?
 - What features/technology will he need to perform these functions?
- **Make a rough design schematic**
 - What do you think BB-8 would look like inside?
 - What makes him move?
 - His outside is totally smooth – how does he get traction?
 - How would you control his movement?
 - How does his head stay on top?



BB-8. For Life.™





Day 1 Homework: Just Roll With It - Engineer a BB-8 Droid



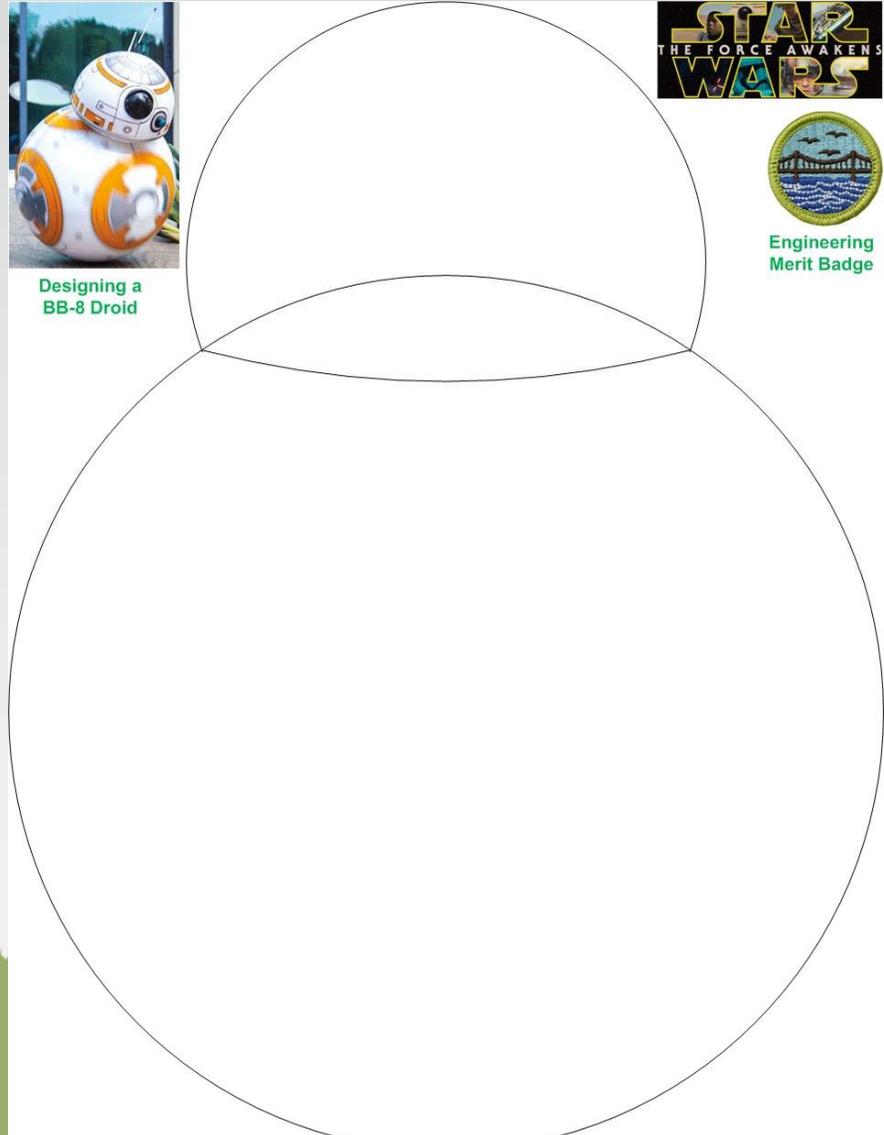
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Designing a BB-8 Droid: Specify the Requirements and Required Technology



Engineering Merit Badge

Designing a BB-8 Droid



#	Design Requirement	Approach/Required Technology



Day 1 Homework: Just Roll With It - Engineer a BB-8 Droid



- The instructions and sheet to record your homework can be found in two ways:
 - Navigate from our home page, via “Earning Merit Badges” drop down:
www.troop1028.org
 - or go directly there:
www.troop1028.org/engineering-merit-badge.html
- File:
 - BB8 Requirement 1 Homework Day 1.pdf



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End of Day 1!!



Questions??

Hmmm, questions
have you ??



Yoda. For Life.™

