Engineering Merit Badge
PART TWO
Eric Cutright, ASM Troop 1028, Oct - Dec 2015
Engineering Merit Badge Plan
October - December 2015

Your Troop 1028 Merit Badge Counselor
Eric Cutright, Ph.D. EE (UVA)

Oct 5 – Introduction to Engineering, Problem Solving, Patrol Bridge Building Competition

Oct 12 – (UVA Observatory) Scout Presentations (Sami & G. Michael), Star Wars Force Awakens Project

Oct 19 – (UVA) Field Trip to UVA Engineering School
Visiting three engineering labs – Materials, Robotics, Radios

Oct 26 – (STAB) Apple Harvest Catapult Construction

Dec 7 – (STAB) Triumphs/Disasters in Engineering. Careers in Engineering, Interview an Engineer
The Plan for Today
Part Two – Engineers Rock!

- Princess Pony Diving Board Results from last week
- Scout Presentations (Requirement 6c)
- Engineering Approach to Problem Solving (Requirement 5)
- Star Wars The Force Awakens Engineering Project (Requirement 1)
Patrol “Bridge” Building Competition Results
Patrol Princess Pony Diving Board Building Competition

- Parts provided (think why I would give these)
  - Three 8 foot bridge sections plus 2 yardsticks
  - 2 small clamps, 2 large clamps, 20 feet blue tape
  - 200 feet of string plus various Legos, scissors, 1 Princess Pony

Score 1: Length

Score 2: Load bearing

Nothing can touch floor (unless..)

All parts of table OK
Princess Pony Diving Board
Competition Results – 2\textsuperscript{nd} (tie)

- Second place (tie) – Cobras
  - Length = 103” (3\textsuperscript{rd}), Load Bearing Deflection = 10” (2\textsuperscript{nd})
Princess Pony Diving Board Competition Results – 2nd (tie)

• Second place (tie) – Wolverines
  – Length = 152” (2nd), Load Bearing Deflection = 24” (3rd)
Princess Pony Diving Board
Competition Results – 1st

• First place – Mountaineers
  – Length = 203” (1st), Load Bearing Deflection = 4” (1st)
  – Won trivia question and key prize of 1 floor support brace
Scout Presentations (Requirement 6c)
Scout Presentations

• Sami S – Speaker Design

• G. Michael F – PC Design
Engineering Approach to Problem Solving
(Requirement 5)
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
Star Wars The Force Awakens Engineering Project (Req’t 1)
Star Wars The Force Awakens Engineering Project

• Star Wars The Force Awakens Trailer:  
  https://www.youtube.com/watch?v=erLk59H86ww&list=PL148kCvXk8pD4i6tww4roNV1R_oAceb-5&feature=player_embedded

• Our Engineering Project:  
  https://www.youtube.com/watch?v=-1Y2WfcCb4M&feature=player_embedded
Patrol Design Challenge: Engineering a BB-8 Droid
Patrol Design Challenge: Engineering 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?
  – How would you control his movement?
  – How does his head stay on top?
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<th>Design Requirement</th>
<th>Approach/Required Technology</th>
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Engineering a BB-8 Droid: “Real” BB-8 Design

- Head Control
- Spin Motor (rotate/turn)
- Segway-style Gyro Base
- Rotate Motor (move Forward/Reverse)
- Spin Motor (rotate/turn)
- Rotate Motor (move Forward/Reverse)
Engineering a BB-8 Droid: Key Components

• Gyroscope:
  – Measures orientation
  – Gimbals set the planar axes
  – Rotor spins on spin axis, unaffected by tilting/rotation (conservation of angular momentum)
  – Not affected by magnetic forces

• Common uses:
  – Internal navigation systems
  – Stability control (e.g. helicopters)
  – Direction tracking in mining
  – Replacement for magnetic compasses
Engineering a BB-8 Droid: Key Components

• **Accelerometer:**
  - Device measures acceleration
  - Allows sensing of orientation
  - Senses force direction and magnitude

• **Common uses**
  - Monitor vibration in rotating machinery
  - Internal navigation systems
  - Phones and cameras to always display screen upright
  - Trains to detect movement and safe stopping
Engineering a BB-8 Droid: Key Components

• Bluetooth Link:
  – Bluetooth is a wireless technology standard for exchanging data over short distances
  – Bluetooth operates at frequencies between 2400 and 2483.5 MHz (including guard bands 2 MHz wide at the bottom end and 3.5 MHz wide at the top)
  – Bluetooth uses a radio technology called frequency-hopping spread spectrum. Bluetooth divides transmitted data into packets, and transmits each packet on one of 79 designated Bluetooth channels. Each channel has a bandwidth of 1 MHz.
  – Bluetooth is a packet-based protocol with a master-slave structure. One master may communicate with up to seven and all devices share the master's clock. Data exchange is based on the basic clock, kept by the master, which ticks at 312.5 µs intervals.
Engineering a BB-8 Droid: Key Components

• Control Application (Android/Apple):
Engineering a BB-8 Droid: Taking Him Apart

Engineering a BB-8 Droid: Internal View (Sphero Model)
Engineering a BB-8 Droid: All The Parts!!
Patrol Design Challenge: Trivia Prize: Play with BB-8 !!
End of Part 2!!