Materials:

- 6 pulleys with hooks
- 1 long rope/cable
- 1 large mass (maybe 100 lbs, will be split 6 ways) and a way to grab onto it in 3 locations
- Large frame
- Wooden spools
- Thick straws
- Wooden dowels
- Rubber bands
- Washers
- Tape
- Paperclips
- Cylinder
- Thin tubing
- Handle
- Tub/Bowl of water

Activities

1. Create the pulley system as shown. The force necessary to lift a mass on the other end should be approximately 1/6 the amount of weight.

2. Create spool cars. This activity will demonstrate the transition of potential energy to kinetic energy.
   a. Take a spool and weave a rubber band of approximately the same length of the body of the spool through the hole. Place a paperclip underneath one loop of the rubber band and tape it.
   b. On the other end, place a straw through the rubber band. Spin the straw until it begins to rotate if released.
   c. Place on the floor and let go of the straw. The spool should move forward.
   d. Other variations of this may include a washer on the side of the spool with the straw. Experiment with different size rubber bands and washers to try to make your spool move the furthest!
3. Create an Archimedes’ screw.
   a. Taking the cylinder, wind the thin tubing in a spiral from the bottom to the top. Hot glue this tube to the cylinder.
   b. Attach a handle to the top of the cylinder.
   c. Fill a tub/bowl full of water. Place the screw in the water and rotate. The water should begin to climb through the tube and come out the top end of the screw.

Application to Engineering

1. Pulley systems help to redirect weight and to redirect forces. They are used within daily life. Elevators, window blinds, flag poles, and engines all use pulleys.
2. The spool cars help to show the concept of kinetic and potential energy. Before releasing the straw, energy is being stored within the rubber band, which is called potential energy. After releasing it, the energy changes to kinetic energy, which is when the rubber band begins to release and rotate the spool. One example of this is a roller coaster. Engineers take the energies into account when designing the roller coaster.
3. There are many different types of simple machines, including the Archimedes’ screw, lever, pulleys, and axle. Each is used in industry. The Archimedes’ screw is used within pumps, especially those for flood control, sewage, and drainage. These pumps allow for the movement and lifting of liquids via the rotation of the screw.

Sites to Visit:

http://easyscienceforkids.com/all-about-simple-machines/

The Challenge

- Build the tallest, freestanding tower that can hold a marshmallow using only the materials provided

- Materials:
  - 1 m Tape
  - 1 m String
  - 1 Marshmallow
  - 20 Pieces of Spaghetti
  - 1 Brown Bag

Time Limit: 15 Minutes

- Rules:
  - Participants may work in teams or individually
  - All provided materials can be used, including the bag. No extra materials can be incorporated
  - Marshmallow must be supported on the very top of the tower
  - Tower only need to support marshmallow until official measurement is taken
  - All work must stop after 15 minutes
  - Participants may work in teams or individually

Applications to Engineering

- Structural design and engineering
  - Very important part of engineering. It is part of the design process for every building we see.
  - Makes sure that buildings are strong enough to support what they need to.

Teamwork:

- A big part of engineering is teamwork! How did working in a team help you build your tower? If you worked individually what benefits would working in a team have provided?
  - Teamwork allows for the collaboration of different ideas and thinking styles which allow for the best designs!
How do I talk about Biomedical Engineering in the classroom?

1. **Ask “What if?” questions**
   - “What would happen if DNA was changed?” “What could that do to somebody?”
   - “If you could have one trait from another organism, what would it be?”
     - Inspire creativity
     - Ask why
     - Examples: echolocation like a dolphin, eyesight like a hawk, etc.

2. **Urge students to explore how certain aspects affect others**
   - Why don’t animal cells have cell walls?
   - How would life be different if we couldn’t use our thumbs/eyes/ears?

3. **Support the scientific process!**
   - Do experiments with students and allow them to make hypotheses.
   - After they have gathered data, discuss whether their hypothesis was too high or too low and why.

4. **Support creative solutions!**
   - Have students attempt a task, but alter their ability to do it (don’t use your thumbs, close your eyes, only use one leg). Once they experience the difficulty, have them brainstorm ways to make the task easier.

5. **Relate topics to current events and pop culture**
   - Search for specific topics in the upper, right-hand corner
   - [https://student.societyforscience.org/](https://student.societyforscience.org/)