Kids ‘R’ kids Mini Camp

Engineer Club

Thinking like an Engineer

Engineer Club - Rescue Maxey

"Oh, no! A neighborhood dog named Maxey has fallen into a well and needs to be rescued from the hole. We need engineers to help rescue the animal!"

**Teacher will facilitate the following with a small group of campers or individually. The written lesson plans refer to teams (as participants), but the project works just as well for individual campers.

Teachers

<u>How to start campers on "Rescue Maxey" project:</u>

1. Ask interested campers if they have ever seen a person or animal being rescued from a dangerous situation on the news or on TV.
2. Invite campers to share what types of situations prompted these rescues and what type of equipment was involved.
3. Discuss that engineers must design equipment to stand up to the various challenges involved in rescue operations.
4. Explain what engineering means and the types of engineers. Make a chart list of the various types of engineering fields and what they relate to in everyday life.

Engineering: The branch of science and technology concerned with the design, building, use of engines, machines, and structures. An engineer's job involves taking scientific understanding of the natural world and using it to invent, design, and build things to solve problems. This can include the development of roads, bridges, cars, planes, machines, tools, processes, and computers.
Explain how engineering is involved with science, technology, math, and art. Lead a discussion with participants relating engineering to each of these fields: science, math, technology, art.

5. Explain that each team must design a rescue device that can save a puppy (weighing approximately one pound) from a sewer from a height of three feet in under three minutes. Coins or metal washers can be used as the weight of the puppy. For older campers, the height and weight specifications can be increased (use a heavier puppy, two puppies etc.).
6. Campers meet and develop a plan for their rescue device. They agree on materials they will need and write or draw their plan. Next, the group execute their plans. They may need to rethink their plan, change materials, or trade with other teams. Teams then complete an evaluation/reflection worksheet and present their findings.

Project Overview for Engineers

The "Rescue Maxey" project explores how rescue devices are designed to aid rescue professionals during emergency situations. Campers can work in teams of "engineers" to design and build their own rescue device out of everyday items. They will test their rescue devices, evaluate the results, and present to the whole group. The group presentation will be presented with all the research, building, and testing steps taken by the team. Each team will be given worksheets to help with the design and execution process.

The beauty of this project is that several teams or individuals can work on "The Rescue of Maxey" at one time. It can be a competition exercise if desired.

Project Focus:

- Understanding equipment design for rescue operations
- Design a method of rescue from a well

Objectives for Engineers:

- Design and build a rescue device
- Test and refine design
- Communicate design process and results

Choose from Master Materials List:

- rope
- small stuffed animal
- pulleys
- scissors
- cardboard boxes
- buckets
- ice chest to represent well
- cardboard boxes buckets
- paper and pencils for designing the plan
- internet access
- rubber bands
- tape
- weights - coins
- paper plates, plastic spoons
- clothespins
- paperclips
- brass fasteners
- craft sticks
- paper cups

Directions and Project Materials for Engineers

1. Campers meet and develop a plan for their rescue device.
2. They agree on materials they will need, write or draw their plan.
3. Ask for materials needed
4. Team executes the plans. They may need to rethink their plan, request other materials, trade with other teams.
5. Team then completes a reflection log and presents their findings
   Campers may video their process for presentation.

Engineer Club – Cast Away

"My ship was destroyed in a terrible storm!" cried the captain. "My crew and I were washed ashore on a deserted island last night, and now, at daylight, we are trying to survey the island. We must build a shelter to keep us out of this terrific wind and the harsh sun. We need engineering skills to survive."

**Teacher will facilitate the following with a small group of campers or individually. The written lesson plans refer to teams (as participants), but the project works just as well for individual campers.

Teachers:

<u>How to start engineers on "Survival Project":</u>

1. Ask interested campers if they have ever heard stories about explorers looking for undiscovered places and found a deserted island.
2. Invite campers to share these stories and what life was like on places the explorers landed. Were the elements (wind, heat, land topography, food supply) a factor in survival? How did the explorers shelter themselves from the weather? What types of structures were they able to build using the land's resources?
3. Discuss that engineers might have to design equipment to stand up to the various challenges involved in sheltering against the weather.
4. Explain what engineering means and the types of engineers. Make a chart list of the various types of engineering fields and what they relate to in everyday life.

   Engineering: The branch of science and technology concerned with the design, building, use of engines, machines, and structures. An engineer's job involves taking scientific understanding of the natural world and using it to invent, design, and build things to solve problems. This can include the development of roads, bridges, cars, planes, machines, tools, processes, and computers.
   Explain how engineering is involved with science, technology, math, and art. Lead a discussion with participants relating engineering to each of these fields: science, math, technology, art

5. Explain that each team must design a shelter that is strong enough to withstand a strong wind.
6. Campers meet and develop a plan for their shelter structure. They agree on materials they will need and write or draw their plan. Next, the group executes their plans. They may need to rethink their plan, change materials, or trade with other teams. Teams then complete an evaluation/reflection worksheet and present their findings.

Project Overview for Engineers

A group of adventurous explorers had to beach their sailing ship on the shores of a deserted island during a terrible storm at sea. They survived the first night huddled together against the wind and rain. The next day, they knew they would not survive very long without shelter from the terrific winds that blew from the water surrounding them. Your help is needed to create a hut that can withstand these forceful winds.

The beauty of this project is that several teams or individuals can work on "Cast Away" at one time. It can be a competition exercise if desired.

<u>Project Focus</u>

- Understanding structure design for building
- Using tools and equipment design to construct a strong shelter

<u>Objectives for Engineers</u>

- Design and build a shelter to withstand wind
- Test and refine design
- Communicate design process and results

<u>Choose from Master Materials List</u>

- index cards
- craft sticks
- small tree branches
- construction paper
- pieces of cardboard
- masking tape
- string/rope
- straws
- small amount of glue
- hairdryer

Directions and Materials for Projects

1. Campers meet and develop a plan for their hut/shelter.
2. The challenge is to develop a hut from the materials available.
3. Campers agree on what materials are needed and write or draw their plan.
4. Campers will execute the plan. Teams may need to rethink their plan, request other materials, or trade materials among other teams.
5. Campers will test structure for wind results.
6. Teams may video their process and final product.

Restrictions for Projects

1. The structure may not be glued or taped to the workspace top or tabletop.
2. The structure may not bigger than 24" long, 24" wide, and 24" high.
3. The structure must withstand wind (hairdryer on highspeed) for at least 12 seconds.
4. Masking tape may be used ONCE and the one continuous piece must be no longer than 5".

Engineer Club – Me and My Shadow

"I want spring to please hurry," cried the tree squirrel. "I'm tired of being cooped up inside this knot hole in this tree. My food is gone, and I want to go outside. What can I do? I know, I'll make sure that old groundhog can't see his shadow. According to the superstition, if the groundhog can't see his shadow when he crawls out of his hole, spring will come early. I need to some engineers to help."

**Teacher will facilitate the following with a small group of campers or individually. The written lesson plans refer to teams (as participants), but the project works just as well for individual campers.

Teachers

<u>How to start engineers on "Me and My Shadow" project:</u>

1. Explore the effects of the location of the sun on shadow formation.
2. Where does the sun need to be in order to create your shadow?
3. Using chalk on the playground, encourage campers to create, trace, and label shadows. If the shadow traced is from a permanent object (basketball stand, trash barrel, bicycle), have campers go out a few hours later to see how the shadows have moved from the chalk lines created earlier.

Project Overview for Engineers:
In order to ensure the groundhog will not see its shadow, it will be necessary to build a structure that will block the sun from casting the groundhog's shadow on the ground.

<u>Project Focus</u>:

- Understanding and building a structure with a door
- Using tools and equipment for shelter from light (sun)

<u>Objective for the Engineers</u>:

- Build a structure prototype that will make it impossible for the groundhog to see its shadow.
- The den must be big enough to move around in without touching any side.
- It must have an opening with a flap that conceals the animal from view.

<u>Choose from Master Material List</u>

- Flashlight to represent the sun
- Stuffed animal/plastic toy to act as ground hog
- Craft sticks
- Cotton balls
- Ruler
- Plastic wrap
- Cardboard
- Tape
- Rubber bands
- Paper clips
- Pipe cleaners

Directions and Materials for Projects

1. Campers meet and develop a plan for their groundhog den.
2. The challenge is to develop a den from the materials available.
3. Campers agree on what materials are needed and write or draw their plan.
4. Campers will execute the plan. Teams may need to rethink their plan, request other materials, or trade materials among other teams.
5. Campers will test the structure for wind results.
6. Teams may video their process and final product.

Engineer Club – Drilling for Oil

Oil has been discovered in a field behind farmer Ollie's barn. It's been seeping out the ground for several days. Mr. Ollie wants to be able to pump the oil from the ground. He tries to dig a big hole, but the oil is still a slow trickle and he has no way to capture the black gooey stuff. Farmer Ollie needs the help of an engineer.

**Teacher will facilitate the following with a small group of campers or individually. The written lesson plans refer to teams (as participants), but the project works just as well for individual campers.

Teachers

<u>How to start engineers on "Drilling for Oil" project:</u>

1. Set up this activity inside and complete the activity outdoors in case of spillage.
2. When it's time to get the oil out of the drill, campers may need to stand on a stool or chair so the drill can work properly. Make sure someone serves as a spotter.
3. Standing on a stool or chair will enable the well casing to form a straight line from mouth to the cola.
4. Make sure the participants understand the project overview.

Project Overview for Engineers:

Petroleum or crude oil is found thousands of feet below the earth's surface. In order to bring up the oil to the surface, companies must drill down thousands of feet, creating a well. Many sections of pipes (called casing) are put in, giving the oil an easy pathway to the surface. Machines can create artificial pressure to suck the liquid to the surface.

Viscosity is the property of liquids. It describes how much the liquid resists flowing. High viscosity liquids are thick, sticky, and slow moving. Low viscosity liquids are the opposite, so they are thin and runny. Crude oil from the group comes in many viscosities and colors depending on the location and how it was formed beneath the earth's surface. Some crude oil is dark brown and viscous (thick) similar to molasses or chocolate syrup. Other crude oil is clear or a yellowish color with low viscosity.

<u>Project Focus</u>

- Understanding the mechanics of oil drilling
- Understanding and building a simple machine to simulate an oil drilling operation

<u>Objective for the Engineers</u>

- Construct a casing for the oil to travel to the surface.
- How much pressure needs to be applied in order for the oil to reach the surface?
- Understand and test the viscosity properties of liquids chosen for the project.

Choose from Master Material List

- scissors
- plastic drinking straws
- masking tape
- cola (any type)
- chocolate syrup
- ruler or tape measure
- plastic cup

Directions and Materials for Projects:

1. Choose materials - 6 to 8 straws will be needed as well as the other materials
2. Using the scissors, cut a 1/3" slit at the end of each straw.
3. Join the straws end-to-end forming one long tube by placing the slit end of one straw inside the next.
4. Pour some cola into a plastic cup. The cola represents the oil.
5. Place "oil well" on a hard surface outside.
6. Place one end of the straw tubing into the cola so that it sticks straight into the air. The straws represent the oil well casing.
7. If necessary, stand on a stool or chair so that the well casing forms a straight line from participant's mouth to the cup filled with cola.
8. Now suck on the end of the straw casing to try to bring the liquid (cola) to the top of the well casing.
9. If it's not working, air is probably getting through the seams of the straw - wrap masking tape around the seams of each straw.

Adaptions to the Design

1. Pour some chocolate syrup into another cup and repeat procedure.
2. Was it harder/easier to bring the chocolate syrup (oil) to the surface?
3. Was more sucking action required to bring the syrup through your casing?
4. Decrease the length of the casing by cutting off one straw.
5. Now try to bring the oil up the casing - harder or easier?
6. What conclusions can be drawn about farmer Ollie's oil out of the ground?
7. What would engineers need to know about the oil before drilling? (Depth of oil source, How much pressure would be needed?, Containers for oil once it reached the surface, The viscosity of the oil, Testing for purity, etc.)

Engineer Club – 3,2,1… It's a Lift Off

Astronauts are trying to get to the moon for exploration. To launch rockets, NASA uses a special launch pad which enables the capsule rocket to get off the ground. The rocket engines have fuel that burns at a very high temperature creating a gas that pushes the rocket off the launch pad. Scientists have a hard time finding the right amount of fuel to move the rocket. The heavier the rocket structure is, the more fuel is needed. An engineer works at NASA to help design a rocket that is long and thin so it can fly better and faster. Become an engineer and help get the astronauts into space!

**Teacher will facilitate the following with a small group of campers or individually. The written lesson plans refer to teams (as participants), but the project works just as well for individual campers.

Teachers

<u>How to start engineers on "Rocket" project:</u>

1. Set up this activity inside and complete the activity outdoors to see how wind may influence the rocket launch.
2. Ask campers if they have ever made the paper wrapper fly off a straw. Why did the wrapper fly off?
3. Using that scenario of the wrapper and straw as a starting point, campers will perform the following.
4. As an aerospace engineer, your project is to design a functioning rocket.
5. Using the principles of engineering, you will plan and design a structure, test the structure, and make changes in order to make the design work better under different conditions.

Project Overview for Engineers

Campers will need to understand the principals of thrust and force: **Thrust** - When **force** (some effort) is applied to move an object in a direction, this force is called **thrust**. **Force**: - A **force** is a push or pull upon an object resulting from its interaction with another object.
Rockets must have a lot of force to escape earth's gravity. **Gravity** is the air force that holds us to the surface of the earth and keeps our atmosphere wrapped around our planet. An object's weight is a measure of the gravitational force acting on it.

Ask campers: Would your weight be different on another planet?

Yes. If you visited another world, you would notice a change in your weight because the force of gravity acting on you there would be different from the force of gravity here on earth.

<u>Project Focus</u>

- Understanding and building a simple machine
- Using tools and equipment to simulate rocket travel

Objective for the Engineers

- Design and construct a launch pad (a tool to hold your rocket during liftoff).
- Plan, design, and launch a rocket into the air.
- Change your design so that the rocket can travel farther.
- Change the rocket so that it is easier to steer or aim.
- Measure the distances between launch and landing.
- Does the angle of the launch affect the distance the rocket travels?
- What weather factors influenced the launch, travel distance, and landing?
- Create a decorative model rocket and test the design.
- How did the new design influence the way it worked?
- Graph the distances of each trial launch.

Choose from Master Material List

- paper (different weights)
- plastic straws
- paper straws
- tape
- fan with different speeds
- markers
- scissors
- graph paper
- ruler

Directions and Project Materials for Engineers

1. Campers meet and develop a plan for their launch pad and rocket.
2. They agree on materials they will need and write or draw their plan.
3. Gather materials needed.
4. Team executes the plans. They may need to rethink their plan, request other materials, or trade with other teams.
5. Team then completes a reflection log and presents their findings.
6. Campers may video their process for presentation.

Engineer Club – Slowing It Down

Jerry is a professional truck driver carrying a load of lumber over a mountain pass in the winter. Things are going smoothly on the road so far but it's an uphill climb to get over the mountain. The road is wide, and the roadbed is smooth. Finally, he's made it to the peak and ready to take his load down the other side. Looking ahead he sees a long patch of ice on the road. Jerry knows this can be a dangerous situation because there will be no friction between his tires and the ice on the road. Slowing his truck down enough before he hits the ice will be impossible. Luckily, a road engineer has built a steep incline on the side of the highway. The sign reads "Runaway Truck Ramp." This incline hill is just what Jerry needs to slow his truck's speed and avoid the ice. He veers off the highway and up the ramp.

**Teacher will facilitate the following with a small group of campers or individually. The written lesson plans refer to teams (as participants), but the project works just as well for individual campers.

Teachers

<u>How to start engineers on "Slowing It Down" project:</u>

1. Ask interested campers if they have ever seen a sign like Jerry, the truck driver, saw while traveling over steep highway passes.
2. **Road engineers** are vital to highway construction, safety, and management.
3. **Road engineers** basically direct and manage the road construction, maintenance activities, and operations at the construction site. They test the soil for adequacy and strength at the proposed site of construction.
4. Explain what engineering means and the different types of engineers. Make a list of the various types of engineering fields and how they relate to everyday life.

Project Overview for Engineers:
Friction is the resistance an object has when it rubs against another object. Friction between the wheels of a truck and the roadway is created when Jerry's truck travels up the mountain road. When Jerry sees the ice, he knows there will be none or little friction created between his truck and the road so he is very grateful when he sees the sign along the highway which will give him a solution to his problem. He will take the incline side road to help slow his truck and help his wheels grab the surface and slow him down.

Your shoes and a carpet create a lot of friction together. That means your feet don't slide around and you can walk. But ice does not create much friction so your shoes and Jerry's wheels will slide around. If friction didn't exist, you couldn't run or walk.

Project Focus

- Design and build ramps that create different amounts of friction using speed bumps
- Design and build a wheelchair ramp that is easy to get up a ramp (incline) but helps people go down the ramp safely
- Create a traffic sign for each ramp, telling directions for its use

Master Materials List

- toy car or truck
- cardboard to make ramps
- sandpaper (several grades from fine to course)
- rubbery shelf liner
- play dough
- clear tape
- masking tape
- yarn
- fabric
- aluminum foil
- waxed paper
- paper, markers
- craft sticks

Directions and Project Materials for Campers

1. Campers meet and develop a plan for ramps and designs.
2. Draw plans for ramps and unique uses: for highways, for wheelchairs, for
3. skateboarders, for hauling equipment, etc.
4. Create traffic signs that will be used.
5. Campers will execute the plan. Teams may need to rethink their plan, request other materials, or trade materials among other teams.
6. Campers may video their process or finished products.