I AM A MECHANICAL ENGINEER

What is a scientist? What is an engineer? What is the difference?

A scientist studies how the natural world works. An engineer takes that information and uses it to solve a problem. Engineers design buildings, roads, spaceships, and more. Engineers and scientists have a lot in common, but there are some differences between the two.

Science isn't about developing new technology; it is about gaining new knowledge about why the universe works the way it does. An engineer can take this knowledge and use it to make something practical. The scientist can tell you why something happens, but the engineer can tell you what you can do with it.

There are many different kinds of engineers. The mechanical engineer deals with anything that is made to move and the power needed to make it happened. A mechanical engineer designs, makes, and maintains the tools and machines we depend on. All machines we use had to be thought of by someone. They had to be planned and designed and made to do what they were intended to do.

The chart below shows the five major projects included in this kit that explore how to build and test machines that move. Each project offers one or more activities that highlight science, language, and math literacy skills. Hands-on activities included in the kit also provide suggested vocabulary, fun facts, and further reading.

In addition, the activities in this kit offer opportunity to incorporate the following practices of singing, playing, talking, reading, and writing into the learning experience with your child. *Current early literacy research has shown that regularly sharing these five practices with young children can help them to become ready to read by the time they start school. **(from 'Every Child Ready to Read', 2011)*

Project #1	Project #2	Project #3	Project #4	Project #5
Following a Blueprint	What is Fastest?	More Experiments with Ramps	Going on a Wheel Hunt	Now You Be an Engineer

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#1: Following a Blueprint

SUMMARY: Before a machine or a tool can be built, a detailed plan is made on paper to serve as a guide for construction. An engineer takes that blueprint and determines whether the design and the materials selected can safely be used to build the intended object. The 'blueprints' included in this kit serve as an introduction to the idea of a visual plan showing which parts, how many, and what sizes are needed to build a model of the vehicle pictured in the top right-hand corner of the blueprint.

WORDS TO USE:

- Analyze – to examine something; to find out what it is or what makes it work
- Axle – a pin or shaft on which a wheel or pair of wheels turns
- Blueprint – a detailed technical drawing presented by an engineer that outlines their design of a machine or tool. It can be hand-drawn or drawn using a computer aided drawing program
- Component – a part needed to make a product
- Connector – a thing that links something together
- Engineer – a person who uses math and science to design and create things for the benefit of people and our world.
- Evaluate – to judge the value or condition of something
- Machine – a device with moving parts that does some desired work when it is provided with power, (human force, electrical, water, etc.)
- Model – a pattern or figure of something to be made
- Prototype – the first thing of its kind
- Rod – a straight slender stick or bar
- Wheel – a disk or circular frame that can turn (rotate) on a central point

MATERIALS NEEDED:

- Building set and 'blueprints' included in this kit
- Tape measure
- Paper
- Crayons or Markers

ACTIVITY:

- Show your child the visual designs (blueprints) included in the binder in this kit.
- Examine each blueprint and talk with your child about what each kind of vehicle is intended to do.
- Ask your child to choose one blueprint to use to build a model of the vehicle.
- Use the blueprint to select the components needed to construct the model of the vehicle.
- Follow the picture on the blueprint to build the model.
- Repeat these steps for the other blueprints in the kit, as desired.

OBSERVATIONS:

Notice how your child begins to construct the model. Discuss with your child any problems that occur during the building process. *Why do you think there is a problem? What could be done differently to fix the problem*? *Is there a better way to connect the parts together?*

DID YOU KNOW?

- Traditional blueprints have largely been replaced by more modern, less expensive printing methods and digital displays using computer software.
- As print and display technology have advanced, the traditional term 'blueprint' has continued to be used informally but practicing engineers, architects and drafters just call them 'drawings' or 'prints'. (http://en.wikipedia.org/wiki/Blueprint)

EXTRA ACTIVITIES:

- Write the word *component* on the top of a piece of paper. Say the word aloud and ask your child to repeat it. Explain to your child that a component is "a part needed to make a vehicle, machine or tool." A machine or vehicle is made up of many different kinds of components.
- Point out the different components included in the kit for building the models of the vehicles: wheels, rods, connectors, etc.
- Write down these words on the paper below the word *component.* Say aloud each word as you point to it and ask your child to repeat it after you.

- Ask your child to lay the appropriate *component* next to the word as you point to it on the paper.
- Discuss with your child the different properties of the components: some are long and straight, some are short and straight, some are round, etc.
- Examine the tape measure included in the kit with your child.
- Point out how it uses numbers to indicate how long, tall or wide something is. Practice using the tape measure to measure the length of one or more of the rods in the kit.

SUGGESTED READING:

E Burton	Mike Mulligan and His Steam Shovel
E Sobel	B is for Bulldozer
E Van Dusen	If I Built a Car
J 629.2232 Z	Pickup Trucks on the Move

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#2: What is Fastest?

SUMMARY: Who doesn't like to race? Build a few different models, set up a cardboard ramp, and see what happens.

WORDS TO USE:

- Compare – to examine for similarities or differences
- Decline - to bend or slope downward
- Incline - to bend or slope upward
- Fast – moving, operating, or acting quickly
- Ramp – a surface with one end higher than the other. Also called an incline plane
- Slow – moving, flowing, or going at less than the usual speed
- Test – to find out the nature, quality, or value of something
- Vehicle – something used to transport people, animals or things

MATERIALS NEEDED:

- Two vehicle models
- Large piece of cardboard
- A box or block
- Tape measure

ACTIVITY:

- Build two of the vehicle models.
- Talk about the models. *Which is your favorite? Why?*
- Ask your child to predict which will win a race. *Why?*
- Make a ramp using a piece of cardboard propped up at one end on a block or box.
- Place the two models at the top of the ramp and release them at the same time.
- *Which model is the fastest?*
- *Which model rolled farthest?* Measure it with the tape measure*. Did the fastest one roll the farthest?*

OBSERVATIONS:

- Don't be surprised if your child believes that one vehicle is better/faster than the other even after the race because of the color or another non-essential factor. Children of this age often have difficulty separating out what they believe from what they actually observe. This type of activity is worth repeating many times of the years. As your child's brain matures they will start seeing past their expectations to the reality.
- You may expect that the smaller "sportier" vehicles will win the race but you might find instead that it is the larger, heavier models that do best. There are so many factors that affect performance. Don't worry about coming up with the "right" answer—just have fun talking about the results. *Do heavier vehicles always win?* Try it and find out!

DID YOU KNOW?

- The word 'Engineer' comes from Latin meaning "cleverness". *(www.sciencekids.co.nz/sciencefacts/engineering.html)*
- Golf balls have dimples because they help reduce drag. This allows the ball to go farther than a smooth one. *(www.sciencekids.co.nz/sciencefacts/engineering.html)*

SUGGESTED READING:

E Barton	Machines at Work
E Hall	Ox-cart Man
E Long	The Runaway Shopping Cart
E Lord	Hot Rod Hamster
E Sis	Fire Truck

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#3 More Experiments with Ramps

SUMMARY: Playing with ramps and different objects introduces your child to the following simple principles of physical science and engineering:

- whether an object will roll, slide, or stay put
- how the shape of an object affects whether it will slide, roll, or stay put
- how objects that slide are more likely to move on steeper inclines
- how both rolling and sliding objects move faster down steeper inclines

WORDS TO USE:

- Bounce – to spring back or up after hitting a surface
- Categorize - to place into groups based a shared quality
- Compare – to examine for similarities or differences
- Decline - to bend or slope downward
- Incline – to bend or slope upward
- Measure – to find out the size, extent, or amount of
- Predict – to say or estimate that (a specified thing) will happen in the future or will be a consequence of something
- Ramp – a surface with one end higher than the other. Also called an incline plane
- Roll – to move or cause to move by turning over and over on a surface
- Slide – to move or cause to move smoothly over a surface
- Swerve – to turn aside suddenly from a straight line or course

MATERIALS NEEDED:

- Paper and pencil
- A ramp (try cardboard, a game board, or a picture book)
- Blocks or a box to prop up your ramp
- Objects that may or may not roll:
    - a ball
    - a book
    - a crayon
    - a paper towel roll
    - a spoon
    - a stuffed animal
    - a paper cup

ACTIVITY:

- Make a ramp by propping up one end of a game board, picture book, or piece of cardboard on a block or box.
- Gather an assortment of objects (see the list above).
- Ask your child to predict what might happen when you try to send one of these objects down the ramp. *Will it roll? Will it slide? Will it stay put? Why do you think so?*
- As you experiment, sort each object into a category: things that roll, things that slide, and things that stay put.

EXTRA ACTIVITIES:

- Repeat the above activity but now make the ramp steeper or less steep. What changes do you observe?
- Try using a piece of corrugated cardboard for a ramp. Does the change in the surface of the ramp make a difference in how the objects move down the ramp?
- Write down your child's observations on paper as you test different objects. Engineers keep written records of what they learn to help them during the research process. Information becomes more valuable when recorded and shared. Other people can share in the discovery and add their insights.
- Encourage your child to write, draw, or scribble their own thoughts on paper too!

OBSERVATION:

- As you experiment with different objects, introduce descriptive words when you and your child discuss your observations: steep, less steep, smooth, bumpy, round, flat, heavy, light, far, farther, hard, soft, more and fewer.

DID YOU KNOW?

- The motion and speed of a rolling or sliding object is affected by the texture of the object and the texture of the surface on which it is rolling or sliding.
- The steeper a ramp becomes, the more quickly and object will roll or slide down the incline, and the farther it will roll after leaving the incline.

SUGGESTED READING:

E Ashman	Samantha on a Roll
E Sis	Trucks Trucks Trucks
J 531.11 S	Motion: Push and Pull, Fast and Slow

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#4: Going on a Wheel Hunt

SUMMARY: Wheels are everywhere! Take a look around your house and your neighborhood and make a list of all the wheels you see.

WORDS TO USE:

- Machine -- a piece of equipment whose different pieces work together to do a job, often using electricity or an engine.
- Tool – an instrument used or worked by hand or machine to perform a task
- Wheel-- a disk or circular frame that can turn on a central point

MATERIALS NEEDED:

- Camera (optional)
- A wagon or a stroller
- Paper
- Crayons or a pencil

ACTIVITIES:

- Look for wheels in the house, neighborhood, and/or magazines. *Why do you think each object has wheels? What would it be like without wheels?*
- Go for a walk. Let your child push or pull a wagon or stroller uphill, downhill, and on a flat area. Talk about what it's like to push something up hill versus pulling it downhill.
- Have your child collect several toys with wheels. Line them up and sing a counting song to the tune of 'Ten Little Indians':

One little, two little, three little wheels,
four little, five little, six little wheels,
seven little, eight little, nine little wheels,
ten wheels on my toys (in my room/house)

.

- Make a list of all the objects with wheels you see around the house. Remember to point out the objects with wheels that are not necessarily vehicles.

OBSERVATIONS:

- Making lists is an important early math skill to develop since it teaches young children to organize things by shared attributes or qualities.
- Consider different ways of organizing the lists: machines with wheels that use electricity, machines with wheels in the kitchen, machines with wheels in the garage, etc. *Do some machines fit into more than one category?*

DID YOU KNOW?

- Wheels do not exist in nature, and no animals use them except people.
- Wheels help people to do something easy for a longer time, instead of doing something hard for a shorter time.

(http://scienceforkids.kidipede.com/physics/machines/wheel.htm)

EXTRA ACTIVITY:

- Some things have 1, 2, 3, 4 or more wheels. Make a chart and write the following five headings at the top: '1 Wheel', '2 Wheels', '3 Wheels', '4 Wheels', and 'More than 4 Wheels'.
- Have your child draw the appropriate number of circles under each heading to represent that category's number of wheels.
- Walk around your neighborhood and look for different objects/machines/vehicles with wheels. During the walk, place a tic mark under the appropriate category. *Which group had the most marks?*

SUGGESTED READING:

E Ashman	Samantha on a Roll
E Cobb	Wheels!
E Garcia	Tip Tip Dig Dig
E Lewis	My Truck is Stuck!
E Prince	What Do Wheels Do All Day?
E Rockwell	Big Wheels

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#5: Now You Be an Engineer

SUMMARY: Use the materials in the kit to design and build your own machine. Talk with your child about what the machine is intended to do. *How many of each colored rods will be used? How many connectors? How many wheels will you need, if any? Will it have eyes?* Draw a picture (blueprint).

WORDS TO USE:

- Brainstorming – a sudden inspiration of ideas
- Design – the art or process of planning and creating something
- Evaluate – to judge the value or condition of something
- Problem – something to be worked out or solved
- Test – a means of finding out if something works the way you expected it to

MATERIALS NEEDED:

- Assorted components from the building kit
- Paper, large
- Pencil
- Crayons

ACTIVITY:

- Discuss with your child what kind of vehicle or machine to build. *How will the machine or vehicle be used to help people?*
- Have your child build it using the materials in the kit.
- Ask your child to draw a simple picture (blueprint) of it on paper. *What is the name of the machine or vehicle?* This could be the name of a real object or it could be made-up by your child. Write this down on the blueprint.
- Together, count how many wheels, then rods, and then connectors were needed to build the model. Record this information on the blueprint.
- Test the model to see if it rolls, slides, or stays put. *Does it work the way you thought it would?* If not, talk about what parts to change.
- Try rebuilding it if necessary.

- Write down your child's thoughts and observations about building the vehicle, how it is to be used by people, where it would be used, etc.
- Take a photograph of the final project. Taking a picture and labeling the photo with the name of the object is another great way to record results.
- Be sure to have your child write his name on the work. (Scribbling is a pre-writing skill).
- Staple your child's blueprint, the written notes, and photograph(s) together into a research report and together talk about the completed project.
- Encourage your child to share the research report with others.

EXTRA ACTIVITY:

- Bring a photograph of your model to the library. Be sure to write down your child's name and the name of the model. We might share it on our website or Facebook!

OBSERVATIONS:

- Remember, all engineering projects begin with research and testing*. Did you think of ways to improve your design? Or was it perfect the first time?*

DID YOU KNOW?

- Did you know the Ferris Wheel is considered an engineering wonder? The Ferris Wheel was designed by George W. Ferris in 1893. It was designed to be the landmark of the World's Fair in Chicago that same year. The wheel is supported by two 140-foot steel towers. The towers are connected by a 45-foot axle, making the axle the largest single piece of forged steel made at that time. Be sure to point out a Ferris Wheel to your child the next time you attend a carnival or an amusement park.
- Some folks have more than one career. Hedy Lamarr was a famous movie actress of the 1930's. While starring in films on the big screen, Lamarr was also an engineer. She held a patent on technology which is the foundation for today's advanced wireless networks.

(http://www.engineergirl.org/what_engineers_do/FunFacts.aspx)

SUGGESTED READING:

E Bee	And the Cars Go…
E Dotlich	What Can a Crane Pick Up?
E Lee	Twenty Big Trucks in the Middle of the Street
E Taylor	Robot Rumpus!
E Vetter	Down by the Station
ICR J 629.224 B	DK Readers: Big Trucks
J 621.865 H	Earthmovers on the Go
J 796.7 N	Monster Trucks on the Move