



EARLY ENGINEERS Handbook

Office of Government and Community Outreach
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VCU College of Engineering

WELCOME TO THE EARLY ENGINEERS AT-HOME HANDBOOK

HOW TO USE THIS BOOK

The activities in this book are meant to let you grow your engineering skills with a focus on play and exploration. Most of the activities can be done with things already in your home! Get your family members and friends in on the action. Engineering is for everyone!

ACKNOWLEDGMENTS

Some of these activities were sourced online, and we have cited those sources. Other activities were created by our faculty, staff and students in the College of Engineering at VCU. We want to thank all of those contributors for enabling us to provide this free resource.

We want to hear from you! Feel free to email us about your experiences. Remember to have a parent email us if you are a kid!

HAVE FUN!

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BACKYARD CODING

SIMON SAYS WITH BASIC COMPUTER CODING LANGUAGE!

The Challenge

One person is the programmer and everyone else is a computer. The programmers give instructions that the computers try to follow!

Rounds

Round One:

If I Do This, Then You Do This

Example: If I turn in a circle, then you turn in a circle.

Round Two:

If I Do This, Then You Do That

Example: If I turn in a circle, then you jump up and down.

Round Three:

If I Do This, Then You Do That, Else You Do Something Else

Example: If I turn in a circle, then you jump up and down, else raise your right arm.

Next Step

Add in eliminations. As soon as a computer makes a mistake, then it breaks and is out for the round!

BRIDGE BUILDER

HOW MANY CARS CAN YOUR BRIDGE HOLD?

The Challenge

You need to build a bridge across a 1-foot gap that will hold the weight of at least 3 cars for 10 seconds.

Materials Are Limited!

You will only have 25 Popsicle sticks and 3 feet of tape to make your bridge.

Instructions

If your bridge holds 3 cars, see if it can hold more! Can it hold all 7?

FOIL BOATS

DON'T SINK THE BOAT!

The Challenge

Create a boat out of aluminum foil and try to get it to hold as much weight as possible without sinking.

Materials

- Aluminum foil
- Coins, toy cars, other small items to use as weights
- Container of water (bathtubs and sinks work!)

Next Steps

Create different boat designs and see which are the most seaworthy. If you use coins see if you can maximize the amount of money that the boats can hold (not the weight)!

LIGHT MAZE

USE REFLECTION TO BOUNCE A LIGHT FROM START TO FINISH!

The Challenge

Shine your light on the word “start” and put the light down so that it doesn’t move. Then use mirrors to reflect the light around to the other side of the paper and shine on the word “finish”. Can you make it so that no one is touching the mirrors? What can you build to hold the mirrors in place?

Materials

- Flashlight
- Small handheld mirrors or old CDs/DVDs (at least 3)
- Clothespins (or extra people to hold the mirrors in place!)
- A piece of paper folded into a tent with “start” written on one side of the tent and “finish” written on the other side of the tent

Next Steps

Can you use more mirrors or cover a larger distance? What if the “finish” is in another part of the room?

Our source for this wonderful activity is

https://youtu.be/4TK2VLj_61c

MARBLE RUN

The Challenge

Create a pathway on the wall for a marble or a rock. Use toilet paper and paper towel tubes, rolled up construction paper, or other recyclables to create a fun and exciting pathway for your marble, but don't forget to put a cup at the bottom to catch it!

Materials

- Toilet paper and paper towel tubes
- Construction paper
- Recyclables (get creative!)
- Painter's or easy release tape for putting things on the wall
- Instructions

Next Steps

Can you create a branching pathway that allows the marble to go in a different direction each time you drop it in? How many times can you make the marble switch directions?

Need Help Getting Started?

Put paper on the wall and draw out the pathway you want to build!

PYRAMID PROTOTYPE

HOW TO BUILD STRONG STRUCTURES!

The Challenge

Build a pyramid with a square base that has a side length of 2 toothpicks.

Materials Are Limited!

You must use exactly 36 toothpicks and 14 marshmallows.

Need Help Getting Started?

Start with a smaller pyramid where the square base has a side length of 1 toothpick. Can you put 5 of the little pyramids together to make 1 big one?

SURFACE TENSION

HOW CAN YOU MOVE A BOAT WITHOUT TOUCHING IT?

The Challenge

Place the paper boat in a container of water and let it float on the surface. Put a drop of soap in the cut out section of the boat. What happens? How many times does this work before it stops working?

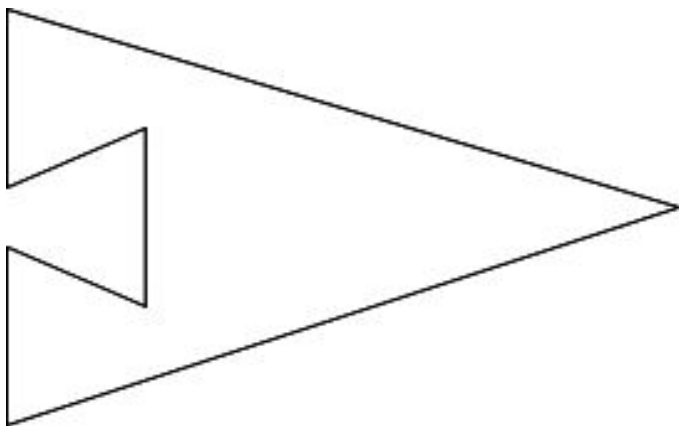
Materials

- One or more paper boats (see template below)
- Container of water (bathtubs and sinks work!)
- Dish soap

Next Steps

Try different sizes of boats. How many can you get to move at once? Look up surface tension and surfactants online to see if you can figure out why this works!

Paper Boat Template:



TOWER TOPPER

HOW HIGH CAN YOU BUILD YOUR TOWER?

The Challenge

Build the tallest tower possible that can stand unsupported for 10 seconds.

Materials Are limited!

You may only use 10 pieces of spaghetti and 10 marshmallows to build your tower.

Next Steps

If your tower stood for 10 seconds, see how long it can stand on its own!

WHITE CRAYON DECODE

CAN YOU DECODE THE SECRET MESSAGE?

The Challenge

Take turns creating and decoding secret messages. Use a white crayon to write a message or draw a picture onto white paper. Then have someone try to decode the message by painting over the paper with watercolors. Can they guess the message?

Materials

- White paper
- White crayon
- Watercolor paint
- Brush
- Cup of water

Next Steps

Can you use this process to create a scavenger hunt around the house where each secret message leads to another? What special prize could you put at the end for someone to find?

WRITE YOUR OWN ALGORITHM

CAN YOU THINK LIKE A COMPUTER PROGRAMMER?

The Challenge

Write instructions for how to stack 3 cups that a robot could follow. You have to be precise (that means using a lot of details and measurements!). Now give the instructions and the cups to a family member. Have that person pretend to be a robot and follow your instructions. Did it work?

Materials

- 3 cups (that's it)

Next Steps

What other things could you code your robot to do? How about instructions for getting dressed, riding a bike, or making a sandwich?



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