

SORTING SOLUTIONS


Grades
3–5, 6–8,
9–12


30–60
minutes

DESIGN CHALLENGE

Design a multitiered chute that can sort different sizes and shapes of pasta into separate containers.

MATERIALS

Supplies and Equipment (per team):

- ❑ 1 pair scissors
- ❑ 5 clear, same-sized containers and 1 lid (examples: quart-sized takeout containers or clear party cups)
- ❑ 5 rubber bands that are thick and strong for attaching mesh to cups

Consumables:

- ❑ Pasta of varying shapes and sizes
- ❑ Mesh materials of many varieties, cut into 20 cm squares. Some examples include:
 - 6 mm mesh rug underlay
 - 10 mm mesh hairnets
 - Loofah sheets
 - 25 mm toy hoop netting
 - Laundry bags
 - Fruit packaging

GETTING READY

For each team, prepare the following:

- 5 clear containers, 4 with the bottoms cut off and 1 lid to cover the top of 1 container
- An assortment of mesh materials cut into 20 cm squares
- Rubber bands
- Equal portions of 2 to 5 different pasta shapes; ¼ cup of each type will suffice
 - Beginner pasta shapes: jumbo shells, orzo
 - Intermediate pasta shapes: farfalle, small elbows, orzo
 - Difficult pasta shapes: jumbo shells, farfalle, rotini, small elbows, orzo

Consider dyeing or painting the pasta to make it more colorful.



INTRODUCTION

Ask questions to introduce the activity:

- Have you ever gotten a big bag of assorted candy before a movie? Did you wish you could quickly pick out the one kind that you hate, so that you can enjoy the rest of the flavors in peace?
- What about sorting marbles of different sizes because only one size fits the game you're playing? How about a jumbled drawer of hair clips, earrings, and other flotsam and jetsam—wouldn't it be nice if you could just toss them into a sorter and have them all organized?

Say: "Engineers design systems to sort all kinds of things. Sometimes the systems sort by shape, sometimes by weight, and sometimes by another characteristic altogether, such as the ability to float. Engineers frequently have to create ways to filter materials out of something else; filtering is a kind of sorting that separates solids from liquids. Today we have a sorting design challenge. Your team will devise a method of sorting different sizes and shapes of pasta so that they wind up separated into different containers."

INSTRUCTIONS

Introduce the design challenge. Participants will devise and test a pasta sorting system. Provide the following constraints:

- The system entails nesting same-sized cups into one another to form a vertical chute.
 - The goal is to sort the pasta into different containers.
1. Demonstrate the activity using one cup that has its bottom and the other with a mesh filter for a bottom. Nest the cup with the filter into the other cup. Sprinkle some pasta in, shake, and make sure participants see how some of the pasta falls into the bottom cup.
 2. Split participants into small teams and show them where the mesh and pasta are. Distribute the cups and one lid to each team.
 3. Instruct teams to assess the different pasta shapes and meshes before choosing which ones they want to try out.
 4. Each team attaches the mesh to the bottomless containers using rubber bands, after some experimentation to determine the most secure method. Teams place cups inside each other to assemble a vertical chute.



INSTRUCTIONS (CONTINUED)

5. Teams must consider the qualities of each mesh in order to choose the best order.
6. To test their apparatus, teams pour pasta into the top cup and attach the lid. Then they shake the whole chute. Tell participants to note how the pasta moves, or doesn't, through the chute.



7. After evaluating their results, teams can make changes to their designs in order to make them more effective.



ACTIVITY VARIATIONS

- Design a sorting system that separates all of the different types of pastas.
- Replace the pasta with different types of objects to sort.
- Create meshes by cutting fabric or paper.
- For younger participants, use fewer cups.

RELEVANT TERMINOLOGY

Chute: A channel or slide for moving things to a lower level.

Filter: To pass liquid, gas, light, or sound through something that removes unwanted material.

Mesh: Material made from interlaced strands that form a network.

Sort: To separate into groups according to particular characteristics.



GUIDANCE FOR YOUNGER CHILDREN

QUESTIONS TO ASK AFTER THE ACTIVITY

- Which kind of mesh let which kind of pasta pass through?
- How much shaking did you have to do to get the pasta to move through your design?
- What are your ideas for making a better pasta sorter?
- How is this activity similar to pouring pasta into a sieve to get it out of a pot of boiling water so that you can eat it for supper?

ENGINEERING CONNECTIONS

Engineers use the concept of sorting in many different ways. For example, they have designed different methods of sorting materials at recycling centers. Recycling centers use chutes to help sort the different materials, such as cardboard and plastic. These systems also shake materials through different layers in order to separate out things such as aluminum cans, while magnets are used to pull out anything with iron. Cans, newspaper, and plastic are all shipped to factories to be made into something new. Engineers are always at work to find better ways to recycle. The more we recycle, the less garbage and pollution we make.

Another example comes from geotechnical engineers. They sort the different components of soil in order to analyze them. They use mesh, in the form of sieves, to help them with this work. They separate larger from smaller soil particles by shaking the dirt through the sieves. Then they can figure out how good the soil is for uses such as farming, or mineral extraction, or holding the foundation of a building.

SCIENCE CONNECTIONS

Our bodies need to sort materials too. Our urinary system is an amazing sorter! It separates what the body wants to keep from what it wants to get rid of. Our kidneys do this work. Kidneys are full of tiny tubes called nephrons. They are like very narrow chutes. As blood passes through the nephrons, it gets filtered in different ways. The useful substances get returned to the bloodstream, and the rest gets turned into urine and leaves the body.



GUIDANCE FOR OLDER YOUTH AND ADULTS

QUESTIONS TO ASK AFTER THE ACTIVITY

- What role does movement play in a sorting system?
- How would adding layers or using fewer layers affect your design?
- What practical applications can you think of for this type of sorting mechanism?
- What factors affect the consistency or inconsistency of your test results?

ENGINEERING CONNECTIONS

Examples of how engineers use sorting as a solution include the systems they have designed for recycling centers. Recycling centers use chutes to sort the different materials. These systems also shake materials through different layers in order to separate out things like aluminum cans, while magnets are used to pull out anything with iron. Engineers at some recycling centers have even figured out how to sort the different kinds of gases that are produced as garbage decomposes. They separate CO₂ from methane, which is used as fuel. Engineers are always at work to find better ways to recycle. The more we recycle, the less garbage and pollution we make.

Geotechnical engineers sort the different components of soil in order to analyze them. They use mesh, in the form of sieves, to help them with this work. They separate larger from smaller soil particles by shaking the dirt through the sieves. Then they can figure out how good the soil is for uses such as farming, or mineral extraction, or holding the foundation of a building.

SCIENCE CONNECTIONS

In the human urinary system, the kidneys sort substances to keep or discard through a filtering process. The kidneys contain about 1 million tiny tubes called nephrons. Separating large particles from smaller ones occurs in a part of the nephron called the glomerulus. The glomerulus capillaries are similar to a fine mesh in that their pores are larger than regular capillaries. Some particles can be pushed through, whereas others are too large. The large particles are mostly blood cells and proteins that the body wants to keep. These become reabsorbed into the bloodstream. Other parts of the nephron filter the remaining substances until only what needs to be discarded as urine is left.

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