Western Engineering Outreach

Building a Ferris Wheel

Grades 6-8

Meet Today's ENG HERO!

Moncef Nehdi – Professor with Western Engineering

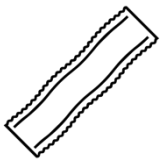
Dr. Nehdi completed his B.A.Sc. at Laval University, his M.A.Sc. at Sherbrooke University, and his Ph.D. at the University of British Columbia. Dr. Nehdi was the Technical Director at Imasco Minerals Inc. in British Columbia before he became a professor at Western University. His research and consulting areas of expertise are focussed on cement and concrete, including new technology, durability, and repair, structural behaviour of special concretes and recycling products from construction applications.
To learn more about Dr. Nehdi visit: https://www.eng.uwo.ca/civil/faculty/nehdi_m/index.html

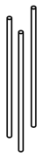
Learning Goal:

- Students will create a Ferris wheel using knowledge of engineering design and understandings of gravity, force, and structure.
- Curriculum Connections: Grade 7 - Form and Function

Materials Needed:

- Various shapes of dry pasta
- Paper
- Pencil
- Hot glue
- String
- Paper clips
- Cardboard
- Cardboard tube (i.e. paper towel or toilet paper tubes)
- 4-8 dry tea bags (optional, can use as the cars on the ride)
- Black construction paper





Engineering and Science Connections:

Ferris Wheels

Have you ever seen or been on a Ferris wheel? Ferris wheels have become very popular and are part of amusement parks or are tourist attractions in cities all over the world.

There are also some very famous Ferris wheels, like the Singapore Flyer or the High Roller. The Singapore Flyer is the second tallest Ferris wheel in the world and gives a fantastic view of Singapore and even a distant view of some Indonesian islands. The High Roller is located in Las Vegas and is the tallest Ferris wheel in the world. The High Roller stands at 167.6 m tall and has a ride that lasts 30 minutes.

How do Ferris wheels work?

Ferris wheels are large, non-building structures that have seats attached to an outer wheel that turns around a central axis.

A Ferris wheel is the same principle as a wheel rotating around an axis. Seats are attached to the outer wheel and can rotate freely so that they are always hanging down. Gears and motors are used to spin the Ferris wheel upwards and gravity helps pull the wheel back down, in a continuous cycle. Riders climb onto the ride at the bottom of the Ferris wheel, the wheel then moves upwards and the ride cycles around. In the activity today, the Ferris wheel you build won't have any motors, but you should be able to spin it around an axis using your hand.

A Ferris wheel rotates at a constant speed (except when passengers are boarding). The velocity of the Ferris wheel is always changing however, since the direction is always changing as the car moves in a circle around the wheel. For a Ferris wheel to operate safely, it needs to be designed so that the forces in all directions are fully supported when the wheel is moving.

Key Terms:

Gravity- pulling downwards toward the earth
Speed- how fast something is moving
Velocity- how fast something is moving in a specific direction (like speed but velocity will always have a direction associated with it)
Force- a push or pull of an object
Axle- a rod or spindle that passes through the center of a wheel(s)
Spokes- the bars or rods connected to the center of a wheel to its outer edge

The Engineering Design Process

The engineering design process is a set of steps that engineers use when they are designing, building, and testing their products. Following these steps helps engineers clearly understand the problem they are trying to solve.

BUILDING A FERRIS WHEEL

In the engineering design process, first, you must define the problem so you understand what the problem is that you are solving and what constraints will impact your solution. Then, you need to do your research to learn about what other products exist and how this problem has been solved before. Next, brainstorm and develop possible solutions to the problem. Pick one of your solutions, then make a plan and design your solution. Once you have a design, build your prototype of your solution. Once you've built your design, test it and then evaluate if there are any ways that you would improve your design.

Even if your original design didn't work exactly how you expected it to, that's okay! Engineers almost always make multiple adjustments to their designs to perfect their product. Every time a prototype doesn't work exactly how you expected it to, it creates an opportunity for learning and is all part of the process.

Today you will use the engineering design process to design and build a prototype of your Ferris wheel out of dried pasta.

Video Recommendation: Invention Of Ferris Wheel | The Dr. Binocs Show

https://www.youtube.com/watch?v=01f8PFAyl6c

Activity:

Define the problem

You are using the engineering design process to design and build a Ferris wheel out of dried pasta.

Note: the images included below are an example. You don't have to build your Ferris wheel that way. The photos can serve as an inspiration and clarify the design challenge.

Do your research:

1. Spend some time researching different Ferris wheels and what they look like. What components do all Ferris wheels have (e.g. base, towers, wheels, spokes on the wheel, axle running through the center, etc.)? You will use the knowledge from your research when brainstorming potential solutions.

Develop possible solutions:

2. Brainstorm different options for building your Ferris wheel. Consider the materials (and specifically the shapes of dried pasta) you have available, how large you want it to be, and what shapes you need to build it from.

Design your solution:

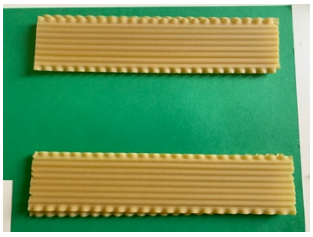
3. Using a pencil and paper, draw out what your Ferris wheel will look like. You will use this design as the blueprint for building.

Build your prototype:

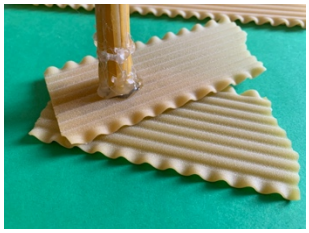
4. Begin constructing your Ferris wheel. This activity is a design challenge so there is no specific way to do it best. Use what you have learned from your research and brainstorming, as well as your design, to figure out the best way to build your Ferris wheel.
5. Optional: attach the tea bags to the outer wheel to represent the cars.

If you are stuck and need some guidance for building, consider the following aspects of the design and try breaking it down step-by-step:

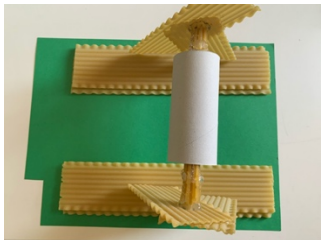
- Start with the base (how large does it need to be, what will you attach your towers to);



- Then build the towers (recommend two long pieces leaning together in an upside down V);

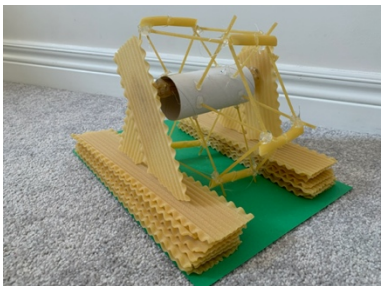


- Consider the axle you are using (i.e. toilet paper or paper towel roll), how wide it is, and how you will attach the dried pasta to it (towers and spokes of the wheel);



- Add the spokes outward from the axle;

- Other notes:
    - If your dried pasta is really thin, try attaching a bunch of pasta together to make it stronger.
    - Depending on the type of glue you are using, you may need to leave certain pieces to dry for a period of time so that they are strong and do not full apart when you put your Ferris wheel together.
    - If you are using hot glue, you may have to hold the pasta in the position you want until the hot glue dries.



Test it:

6. Test out your Ferris wheel once you have finished construction. You want your Ferris wheel to spin around the axle.

Evaluate:

7. Ask yourself, what would you change about your design? Did something work well or not work well? What improvements can be made?
8. Make those changes. The engineering design process is an iterative process, which means that you can return back to other steps and redo some things to make your product even better.

What Did You Learn?

- How do Ferris wheels work?
- What is the engineering design process?
- How does using the engineering design process make better products in the end?

Future Learning

- Try building prototypes of other structures like roller coasters or famous buildings and use the engineering design process.
- Investigate other places wheels are used in the world e.g. water wheels.

Share your creations!

We would love to see what you made. Email as at discover@uwo.ca or tag us on social media.

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Thanks for discovering with us!