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# ONTARIO SCIENCE CENTRE



**Exhibit Inquiry**

# Fun with Physics

**Grade 4-8**

An agency of the Government of Ontario



**ONTARIO  
SCIENCE  
CENTRE**

## Exhibit Inquiry

# Fun with Physics

Have students look for the following exhibits related to structures and mechanisms during their visit to the Ontario Science Centre:

## Pulleys and Mechanical Advantage

Where to go:

Science Arcade (Level 6)  
*Strength is Not Always the Answer*



What it's about:

Students explore the mechanical advantage given by different arrangements of pulleys.

What to say and do:

- Which pulley system do you think will make it easier to lift the weight? Test your prediction.
- Why do you think the system with the most pulleys is the easiest to lift? (*The more times the rope goes between the load and the attachment, the greater the mechanical advantage of the pulley system.*)
- Although the system with many pulleys makes it easier to lift the weight, can you think of some disadvantages to using a system like this? (*A lot of rope has to move a long distance. Friction between the ropes and pulleys can make the system inefficient.*)

## Exploring Levers

Where to go:

Science Arcade (Level 6)  
*Your Weight in the Law of Levers*



What it's about:

Exerting a small force on one end of a lever, can result in a much larger force, depending how far the forces are from the fulcrum (pivot point). Moving up and down on the lever lets students experience that principle. Using some math, students can even calculate their own weight.

What to say and do:

- Find the spot where you balance the weight.
- What happens if you move farther from the fulcrum? (*Your end of the lever goes down.*)
- What happens if you move closer to the fulcrum? (*You begin to balance.*)
- Can you calculate your weight?

### Where to go:

Science Arcade (Level 6)  
*How Friction Fades into Thin Air*



## Removing Friction

### What it's about

Galileo Galilei and Isaac Newton recognized that a moving object stays in motion unless a force acts to stop it. That force is often friction. Friction is so common that before Galileo and Newton, scientists believed that an object would naturally tend to stop. In this exhibit, students try to move a heavy puck across a smooth table with and without friction.

### What to say and do:

- What happens if you push the puck then stop the airflow? (*The puck slows and stops.*)
- What do you think is happening? (*When the air flows, friction between the table and the heavy puck is low and the puck keeps moving. When the air stops, friction stops the puck.*)

Do you think you could walk normally if you had jets of air coming out of the bottom of your shoes? (*e.g. It would be hard because friction keeps your feet from sliding on the ground. It might be a bit like ice-skating.*)

## Playing with Air Pressure

### What it's about:

Can you use a vacuum to blow up a balloon? Students change the air pressure inside a jar and observe how it affects a partially-inflated balloon.

### What to say and do:

- What happens when you blow up a balloon? (*By adding air, you increase the pressure inside the balloon. This new air pushes on the skin of the balloon which then expands.*)
- When you press the button, the air is removed from the jar. What do you think will happen to the balloon? Test your prediction. (*The balloon inflates.*)
- How do you think removing air from the jar makes the balloon inflate? (*The air inside has less to push against – and the balloon inflates. Another way to think of this is that the air inside pushes out to fill the space left by the air we removed from outside of the balloon.*)
- The vacuum pump in the exhibit shuts off automatically, letting air back into the jar and equalizing the air pressure. What do you think would happen to the balloon if the vacuum pump continued to remove air from the jar? (*The balloon would eventually burst as the air inside it continued to expand.*)
- Name a few examples of structures that use the same principle for their structural strength. (*e.g. the sail on a paraglider, air mattresses, yoga balls.*)

### Where to go:

Science Arcade (Level 6)  
*Blowing Up a Balloon from the Outside* (a part of the vacuum experiments)



## Exhibit Inquiry

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**Have students look for the following exhibits related to structures during their visit to the Ontario Science Centre:**

## Structures at the Ontario Science Centre

Where to go:

Front entrance (Level 2)



What it's about:

The Ontario Science Centre building shows many of the structural elements that students are learning about.

What to say and do:

- Take your students outside and look at the building.
- Try to identify as many different aspects of structures as possible. (e.g. *The dome of the Omnimax theatre, columns supporting the roof of the front entrance hall, struts and ties of the windows, cylindrical shape of many of the structural parts.*)
- What kind of loads does each structure have to support? (e.g. *The roof has to be able to support water and snow; the large areas of windows have to withstand high winds without breaking, while letting in as much light as possible.*)
- Get close to the windows underneath the large Ontario Science Centre sign. Does the structure that holds the window frames remind you of something. (*It resembles an archer's bow. The bent rods are similar to the bow and the thinner cables are similar to the bow string.*)
- Explain that separating the part that resists compression (the rods) from the part that resists tension (the cables) enables lightweight but extremely strong structures. Other examples of structures that use the same principle of separating tension and compression are suspension bridges, bicycle wheels, the rigging on sailboats, old TV antennas with rope support etc.

## Structures in Nature

Where to go:

Rainforest & The Living Earth (Level 6)



What it's about:

Most structures are not man-made – natural structures are everywhere. Explore these exhibition halls to discover natural structures in the environment and consider different functions they serve.

What to say and do:

- Find the skulls in *The Living Earth*. Are they solid, frame or shell structures? What are other examples of these structures and how do they fit their purpose?
- Look at the tree roots in the Rainforest. What structural role do the roots play? (*They anchor the tree into the soil making it stable. Some of the roots also form "buttresses", creating a triangular shape with the ground. This shape is extremely strong and prevents even giant trees from tipping over.*)
- Find as many structures as you can in these natural environments (they may be parts of the habitat or the creatures themselves). Can you identify their load? Are they experiencing tension or compression? Why is the structure a good one?

### Vocabulary

<b>Block and tackle</b>	A system of two or more pulleys with a rope or cable threaded between them, usually used to lift or pull heavy loads.
<b>Combined pulley system</b>	One or more pulleys joined to combine the mechanical advantage.
<b>Compression</b>	A force that acts to shorten the object it is acting on; to press together. A “push” force.
<b>Effort</b>	Force applied to a simple machine (e.g. lever, pulley, wheel, inclined plane) that produces an output force on the load.
<b>Force</b>	Push or a pull by one body on another that can change the speed or direction of a moving object.
<b>Load</b>	Something that is carried by a structure or mechanism.
<b>Mass</b>	The quantity of matter an object contains.
<b>Mechanical advantage</b>	The ratio of the force <i>produced by</i> a machine or system to the force <i>applied to</i> the machine or system.
<b>Pressure</b>	The force applied to a unit area of surface.
<b>Pulley</b>	A simple machine consisting of a wheel with a groove through which a rope can run.
<b>Stability</b>	The ability of an object (like a structure) to maintain its original position after disturbance by outside forces (wind, water, load).
<b>Strength</b>	The power to resist strain or stress; durability.
<b>Structure</b>	A supporting framework (a skeleton, a bridge or a building that sustains a load).
<b>Strut</b>	A bar or rod used to resist compression along its length.
<b>Support</b>	To bear the weight of or hold up (a load or mass).
<b>Suction</b>	A force produced by a difference in pressure.
<b>Tensegrity</b>	Describes a structure that retains its integrity under tension by balancing the counteracting forces of compression and tension.
<b>Tension</b>	A force that acts to expand or lengthen the object it is acting upon. A “pull” force.
<b>Tie</b>	A beam, rod or chain holding two parts together; it withstands tension forces.
<b>Weight</b>	The force experienced by an object as a result of the pull of gravity. Most commonly refers to the force of Earth’s gravity.
<b>Weight distribution</b>	The gravitational force acting on an object (weight) distributed over an area to lower the pressure. (e.g. bed of nails, snowshoes, skis)

### Internet Links

Building Big  
[www.pbs.org/wgbh/buildingbig/index.html](http://www.pbs.org/wgbh/buildingbig/index.html)

**PLEASE NOTE:** Programs and exhibits are subject to change without notice.