



Chair Lift Challenge

Provided by TryEngineering - www.tryengineering.org



Lesson Focus

Lesson focuses on unique challenges in transportation engineering, such as devising a method for skiers or hikers to get to the top of a mountain. Students work in teams to design a "chair lift" out of everyday items that can transport a ping pong ball in a chair of their own design from the bottom of a "valley" to the top of a "mountain" along a clothes line or wire without the ball falling out. Students design their chairlift and chair on paper, execute their design, test it, reflect on the challenge, and share their experiences with the class.

Lesson Synopsis

The "Chair Lift Challenge" explores how engineers develop transportation systems to operate in different and sometimes challenging environments. Students work in teams to design a chair lift made out of everyday materials that can carry a ping pong ball up a rope line and back down in a controlled manner so that the ball does not fall out of a chair the team has also designed. They sketch their plans, consider material selection, build their system, test it, reflect on the challenge, and present their experiences to their class.

Year Levels

Year 8 – Term 3.

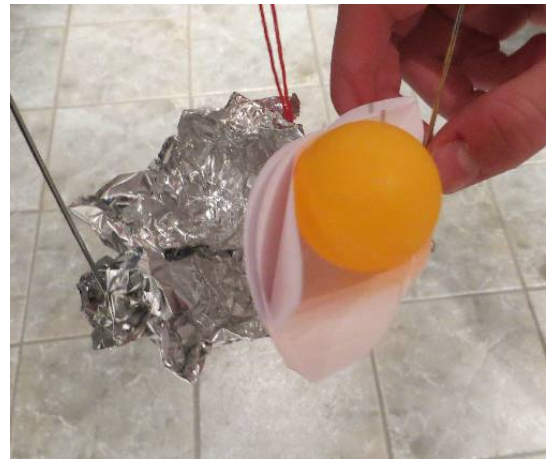
Objectives

- ✦ Learn about engineering design and redesign.
- ✦ Learn how engineering can help solve society's challenges.
- ✦ Learn about teamwork and problem solving.

Anticipated Learner Outcomes

As a result of this activity, students should develop an understanding of:

- ✦ civil engineering
- ✦ engineering design
- ✦ teamwork



Lesson Activities

Students explore how engineers work to provide safe transportation options in different environments and climates. Students work in teams to construct a chair lift or system to move a ping pong ball up a line from the valley of the floor to the mountain at the top of a chair. Teams build their system out of everyday materials, test their design, reflect on the experience, and share with the class.

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Modified and aligned to
Australian Curriculum by
Queensland Minerals and
Energy Academy

Resources/Materials

- ✦ Teacher Resource Documents (attached)
- ✦ Student Resource Sheet (attached)
- ✦ Student Worksheet (attached)

Alignment to Curriculum Frameworks

See curriculum alignment sheet at end of lesson.

Internet Connections

- ✦ TryEngineering (www.tryengineering.org)
- ✦ Aerial People Movers (<http://aerialpeoplemovers.com/>)
- ✦ Doppelmayr (<http://www.doppelmayr.com>)
- ✦ Curriculum links (www.acara.edu.au)

Optional Writing Activity

- ✦ Write an essay or a paragraph about an environment or location where you think an aerial lifts could help lessen ground traffic congestion.

Extension Ideas

- ✦ Have students transport a golf ball up and down the lift instead of a ping pong ball - or require the chair lift to have two seats (two ping pong balls or a ping pong and a golf ball) -- or have one basket going up while another is going down.

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For Teachers: Teacher Resources

◆ Lesson Goal

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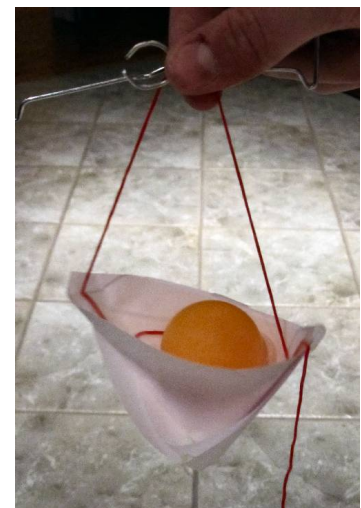
◆ Materials

- ✦ Student Resource Sheets
- ✦ Student Worksheets
- ✦ Student Team Materials: ping pong ball, string, floral wire, pipe cleaners, bendable aluminum wire, straws, paper towel tubes, paper clips, tape, balloons, glue, string, foil, plastic wrap, pulley, other items available in the classroom.



◆ Procedure

1. Show students the student reference sheets. These may be read in class or provided as reading material for the prior night's homework.
2. To introduce the lesson, consider asking the students if they have ever seen an aerial lift or ski lift. Have them consider the engineering challenges of building such a transportation system.
3. Teams of 3-4 students will consider their challenge, and consider how the available materials might be used to create a chair lift.
4. Teams will develop a detailed drawing showing their lift design including a list of materials they will need to build it and the chair the ping pong ball will ride in.
5. Students build their lift, and test it under teacher supervision. Each lift must be able to transport the tennis ball "up the mountain" and "down the mountain" without the ball dropping out of the chair they develop to hold the ping pong ball.
6. Students should observe the chair lifts that other teams create.
7. Teams reflect on the challenge, and present their experiences to the class.



◆ Time Needed

One to two 45 minute sessions.

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Student Resource: What is a Chair Lift?

An elevated passenger ropeway, or chairlift, is a type of aerial lift, which consists of a continuously circulating steel cable loop strung between two end terminals and usually over intermediate towers, carrying a series of chairs. They are used extensively at ski areas, but are also found at amusement parks as well. Depending on carrier size and loading efficiency, a passenger ropeway can move up 4000 people per hour, and the swiftest lifts achieve operating speeds of up to 12 m/s (26.8 mph; 43.2 km/h).



◆ Aerial Lifts

An aerial lift is an increasingly popular means of transportation in which cabins, cars, gondolas or open chairs are hauled above the ground by means of one or more cables. These are becoming popular in urban environments where ground space is at a premium. Over 600 years ago aerial systems were used in China to help move people and goods over streams. During the 1800's, the technology was improved by the by the mining industry to assist in the transport of minerals over difficult terrain. Aerial lifts are being installed in some cities to assist with urban transportation.

Safety is always a concern on chair lifts, which is why engineers have incorporated many safety features into them including lift bars (which provides the passenger with a horizontal bar to hold onto, and locking devices so the cable cannot move backwards.

The mechanism at the top of a chairlift allows for the steel rope to wind horizontally, returning empty chairs down a mountain. The image to the right is the ski lift mechanism in the resort of Tsakhkadzor, Armenia.



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Student Resource:
News Release:

◆ New Ropeway to be Built on Top of the Highest Mountain in Europe

In early 2011, Doppelmayr Italia GmbH was awarded the contract for the construction of the new ropeway on the Mont Blanc. The new installation will replace the old ropeway from the 1940s and 1950s. The installation is located on the Italian side at the foot of the Mont Blanc and connects the tourist resort Courmayeur with the Pointe Helbronner.



The future ropeway to the Mont Blanc scales the Pointe Helbronner at approximately 3,500 m above sea level in two new sections. The three line sections of the old installation will be demolished upon completion of the building works for the new ropeway. Glass and steel will set architectural highlights for the station buildings and the futuristic cabins. The stations are spacious and allows for views over the impressive mountain scenery by means of observation platforms.

The cabins have a round shape, are completely glazed and rotate about their centre axes. Doppelmayr has already implemented this advanced technology in other famous locations: for example in Cape Town, Palm Springs, at the mountain Titlis in Switzerland and at the Monte Baldo at the Lake Garda. But it is still a challenge for Doppelmayr: Never before has a rotating cabin been used in such height.

In each section a total of 4 carriers with a capacity of 80 passengers each is planned. The overall line length is 4.3 km and a difference in height of 2,140 m is overcome with an operating speed of 9 m/s (approx. 30 km/h). The track ropes are approximately 7 cm thick.

The drive consists of two electric motors with an output of 600 kW each. Per hour 800 and respectively 600 passengers (section 1 and section 2) can be transported.

The interior fittings of the cabins are of state-of-the-art design: heating elements integrated into the cabin floor and walls, sound system, and video screens. On these screens pictures made by the camera that is attached to the outside of the cabin floor are shown through a wireless connection. In addition, the screens show information such as weather data and event tips. Other features the high-tech cabin offers are air conditioning, adjustable LED lighting and intelligent sway dampers – to only name a few.

The construction period of the new ropeway on the Mont Blanc is four years, the start-up is scheduled to take place in 2014.

(Source: Doppelmayr Italia GmbH www.doppelmayr.com)

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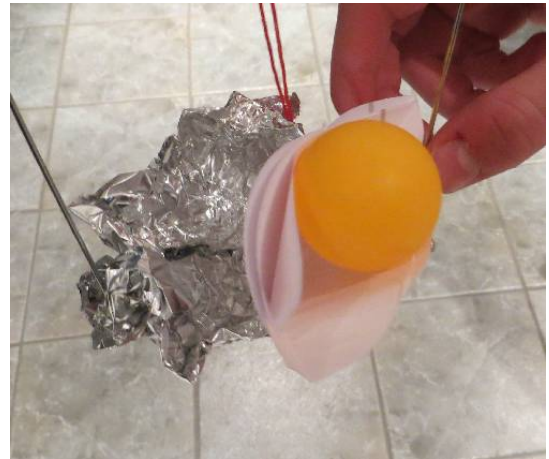
Student Worksheet: Build a Chair Lift

◆ Research and Planning

You are part of a team of engineers who have been given the challenge of building a chair lift to carry a ping pong ball up the mountain (from the floor of your classroom to the top of a desk or chair) using materials provided to you. Your lift must both carry the ball up the mountain and also back down without the ball dropping out. How you design your chairlift and the chair that will carry the ball, and what materials you use are up to you!

◆ Design Phase

You have been provided with many materials from which to design and build your own chairlift and chair. Consider which materials you would like to use, and list them in the box below. On a separate piece of paper, draw a diagram of the system you intend to build.



Parts Required:

◆ Build it! Test it!

Next build your chairlift and test it. You may share unused building materials with other teams -- and trade materials too. Be sure to watch what other teams are doing and consider the aspects of different designs that might be an improvement on your team's plan.

You may decide to completely change your design when in the manufacturing phase -- and you may ask for additional materials, or try different solutions as you build.

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Student Worksheet: Build a Racquet

◆ Reflection

Complete the reflection questions below:

1. How similar was your original design to the actual chair lift your team built?

2. If you found you needed to make changes during the construction phase, describe why your team decided to make revisions.

3. Was your chairlift able to carry the ping pong ball up and down the mountain without it falling out of the chair you designed?

4. Which chairlift system that another team developed was the most effective or interesting to you? Why?

5. Do you think that this activity was more rewarding to do as a team, or would you have preferred to work alone on it? Why?

6. If you could have used one additional material (tape, glue, wood sticks, foil -- as examples) which would you choose and why?

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For Teachers: Alignment to Curriculum Frameworks

Science Understandings

Year 8

Energy appears in different forms including movement (kinetic energy), heat and potential energy, and causes changes within systems **(ACSSU155)**

Science Inquiry Skills

Year 8

Collaboratively and individually plan and conduct a range of investigation types including fieldwork and experiments, ensuring safety and ethical guidelines are followed **(ACSI140)**

In fair tests, measure and control variables, and select equipment to collect data with accuracy appropriate to the task **(ACSI141)**

Reflect on the method used to investigate a question or solve a problem, including evaluating the quality of data collected, and identify improvements to the method **(ACSI146)**

Science as a Human Endeavour

Year 8

Science knowledge can develop through collaboration and connecting ideas across the disciplines of science **(ACSHE226)**

People use understanding and skills from across the disciplines of science in their occupations **(ACSHE227)**

Mathematics Links with Science Curriculum (Skills used in this activity)	General Capabilities	Cross-Curriculum Priorities
<ul style="list-style-type: none">• Process data using simple tables• Data analysis skills (graphs)• Analysis of patterns and trends• Use of metric units	<ul style="list-style-type: none">• Literacy• Numeracy• Critical and creative thinking• Personal and social capacity• ICT capability	<ul style="list-style-type: none">• Sustainability

Science Achievement Standards

Year 8

By the end of Year 8, students compare physical and chemical changes and use the particle model to explain and predict the properties and behaviours of substances. **They identify different forms of energy and describe how energy transfers and transformations cause change in simple systems.** They compare processes of rock formation, including the time scales involved. They analyse the relationship between structure and function at cell, organ and body system levels. Students examine the different science knowledge used in occupations. They explain how evidence has led to an improved understanding of a scientific idea and describe situations in which scientists collaborate to generate solutions to contemporary problems.

Students identify and construct questions and problems that they can investigate scientifically. **They consider safety and ethics when planning investigations, including designing field or experimental methods. They identify variables to be changed, measured and controlled.** Students construct representations of their data to reveal and analyse patterns and trends, and use these when justifying their conclusions. **They explain how modifications to methods could improve the quality of their data and apply their own scientific knowledge and investigation findings to evaluate claims made by others.** They use appropriate language and representations to communicate science ideas, methods and findings in a range of texts types.