

ENERGY machines



Energy Machines is one of a series of online resources developed by the Canadian Centre for Energy Information (Centre for Energy) to accompany its print learning resources and make them more accessible

to a variety of learning communities.

This resource, designed for grade four students studying simple machines, is an extension of the Centre for Energy learning resource: *Energy Machines*. The print resource offers two hands-on learning experiences that help students develop an understanding of two important energy machines – a pumpjack and a drill rig – and the moving parts and forces that make them work. **This is a summary activity. It is recommended that students try the pumpjack activity in the print resource before they try these online activities.**

This online resource uses graphics, sound, animation and real-world examples to help students apply their knowledge of machines to construct an animated model of a pumpjack. Further, students practice problem-solving skills and apply principles of basic physics to identify what is wrong with a completed pumpjack and figure out how they can fix it. Students can play alone or with a friend.



Canadian Centre for Energy Information

Your Resource Source

The Canadian Centre for Energy Information (Centre for Energy) is a non-profit organization created in 2002 to meet a growing demand for balanced, credible information about the Canadian energy sector. On January 1, 2003, the Petroleum Communication Foundation (PCF) became part of the Centre for Energy. Our educational materials will build on the excellent resources published by the PCF and, over time, cover all parts of the Canadian energy sector from oil, natural gas, coal, thermal and hydropower to nuclear, solar, wind, fuel cell and other alternative sources of energy.

The Centre for Energy does not take positions on issues. The Learning Resource Series was developed using a multi-stakeholder review process with the aim of creating fact-based, balanced documents. Educators helped ensure that the educational materials are interesting and applicable to students in schools across Canada.

Canadian Centre for Energy Information
Tel: 403-263-7722
Facsimile: 403-237-6286
E-mail: infoservices@centreforenergy.com

To order publications and educational materials, call toll free:
1-877-606-4636

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Curriculum Links and Learning Outcomes

The activities in Energy Machines are designed to fit within these Alberta curriculum and learning outcomes:

SCIENCE 4: WHEELS AND LEVERS

- Demonstrate a practical understanding of wheels, gears and levers by constructing devices in which energy is transferred to produce motion.
- Predict how changes in the size of a level or the position of the fulcrum will affect the forces and movements involved.

SCIENCE 4: BUILDING DEVICES THAT MOVE

- Explore and evaluate variations in the design of a mechanical device, demonstrating that control is an important element in the design and construction of that device.
- Identify steps to be used in constructing a device or vehicle, and work cooperatively with other students to construct the device or vehicle.

INFORMATION AND COMMUNICATION TECHNOLOGY 4 TO 6

- Understand the role of technology as it applies to self, work and society.
- Organize and manipulate data.
- Use technology to aid collaboration during inquiry.
- Use technology to investigate and/or solve problems.

Pan-Canadian Science Links

The activities in Energy Machines fit within the grade 4 to 6 general learning outcomes from the Pan-Canadian Common Framework for Science listed below.

- *#106:* Describe ways that science and technology work together in investigating questions and problems and in meeting specific needs.
- *#107:* Describe applications of science and technology that have developed in response to human and environmental needs.
- *#207:* Work collaboratively to carry out science-related activities and communicate ideas, procedures and results.
- *#303:* Describe forces, motion, and energy and relate them to phenomena in their observable environment.

Glossary Terms

Throughout the resource, a number of important, and perhaps unfamiliar, terms are highlighted in red. When a player rolls the mouse over one of these words or phrases, a definition for the term appears. In this resource, the terms listed are (in order of appearance):

- **Crude oil** is petroleum in its natural state. It is trapped in the spaces within sedimentary rocks like sandstone and limestone.
- **A lever** is a machine made of a bar or rod that moves up and down on a point.
- **A fulcrum** is the point on which a lever turns. In order for the lever to move up and down easily, it must be balanced on the fulcrum.
- **A counterweight** is a weight or force used on one end of a lever. This force moves the object that is attached to the lever's other end.

Activity Components

Energy Machines has two components:

- **Pump It Up Online:** review of levers and how they work, followed by an introduction to the workings of a pumpjack and an opportunity to build a simple pumpjack in a drag and drop activity
- **What's Wrong?:** application of knowledge of levers to discover why the recently constructed pumpjack doesn't work properly

NOTE

Definitions for the lever, fulcrum and counterweight have been adapted from those found in the grade four science text: *Silver Burdett & Ginn Science Canadian Edition*. Agincourt, Ontario: GLC Publishers Limited, 1989.

Pump It Up



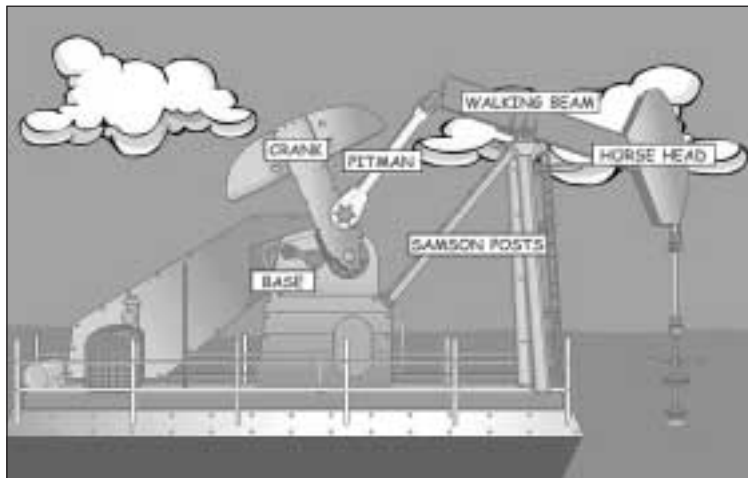
How To Play

The game is introduced by Jac, a new college graduate and oil field employee. Jac has studied a lot about pumpjacks but since it's only her first day on the job, she is a little nervous about building a pumpjack on her own. Jac begins by reviewing some basic lever concepts. Using a teeter-totter as an example, she reminds players that levers have to be balanced. With animations, Jac illustrates how a fulcrum has to be centred and how the weight and counterweight on opposite ends of lever must be equal. Jac then shows players how a lever works in a pumpjack. The first activity is a drag and drop. Players build a pumpjack by choosing each pumpjack part in the correct order and dropping it in the right place. Only correct answers remain in place. If a part is chosen in the wrong order, or is placed in the wrong location, it moves back to its original position at the bottom of the screen. Correct responses are reinforced with cheering. Incorrect responses are marked by a funny sound.

Answer Key

Order of placement of parts

1. Base
2. Samson posts
3. Walking beam
4. Horse head
5. Pitman
6. Crank



What's Wrong?

How To Play

Once the pumpjack is constructed, players are invited to test it to make sure it operates properly. They soon find two mistakes have been made during the construction phase. They must decide how to fix the pumpjack, choosing from the following options:

- Make the counterweight heavier and slide the fulcrum to the left.
- Make the counterweight heavier and slide the fulcrum to the right.
- Make the counterweight lighter and slide the fulcrum to the left.
- Make the counterweight lighter and slide the fulcrum to the right.

If players choose one of the wrong answers, an animation shows them why the solution they chose doesn't work. Players are then given the chance to go back and try again. When they find the correct answer, they are rewarded with cheering, and they get to see the animated pumpjack operating perfectly.

At the end of the activity, the resource offers players a link to the Centre for Energy careers web site, www.centreforenergy.com where they can explore a number of interesting oil and gas industry career opportunities.

Answer Key

In the pumpjack players built in the first activity, the counterweight is too small and light, and the fulcrum is too far to the left. To fix it, players must choose:

- Make the counterweight heavier and slide the fulcrum to the right.