History

Explore the discoverer's biography, including general facts about his life and anecdotes regarding how he made this particular discovery. Also see other significant scientific discoveries built largely on this concept and other real-world applications in history that may not still be relevant.

Discoverer/Developer

Boyle's Law from 1662. Robert Boyle (1627-1691) was an Irish-born gentleman philosopher who did research and investigation in physics, chemistry, alchemy, and theology. Boyle was one of the original Fellows of the Royal Society. His opus magnum is The Sceptical Chymist, 1661. Boyle concentrated intently on the quiet study of science, rather than the wealth or praise he could have attained from his studies. Boyle is known as the founder of modern chemistry because he believed in the intrinsic value of chemistry, developed the rigorous experimental scientific method, and defined the element. Boyle worked at Oxford University, along with Robert Hooke, who stated Hooke's Law, relating the force of elasticity. Boyle, in his study of gas, conceptualized the gas particle as a spring. He also expanded on the assumptions of René Descartes, who said pressure is due to the "restless agitation" of the air particles. Boyle proved his law for both great and small pressures, using the now-famous Mercury U-Tube experiment. (See videos below). Boyle's study of gases also helped lead to the development of atomic theory. He, along with others in his time, discussed the role of distinct "corpuscles" in the application of his Law. He published what is now known as Boyle's Law in 1662.

Use/Application through History

Boyle's Law can be explained with Daniel Bernoulli's law (1738) and Rudolf Clausius' kinetic-molecular theory (1857), which both say that gas particles are in constant never-ending motion with a lot of space in between. Pressure is all the gas molecules hitting the walls of the container, so if you shrink the container, the gas molecules will hit more, and the pressure will increase. Boyle's Law assisted in the discovery of atoms and molecules. Boyle's Law contributed to the development of the kinetic theory of matter. Boyle's Law can also be applied to osmosis, which, in turn, allows the determination of molecular weights by osmotic pressure.

Concept Definition

Study the primary definition of this concept, broken into general, basic, and advanced English definitions. Also see the mathematical definition and any requisite background information, such as conditions or previous definitions.

General Science

Pressure increases as volume decreases if temperature remains constant. Pressure decreases as volume increases if temperature remains constant.

Basic

Pressure and volume of a gas at constant temperature are inversely proportionate.

Advanced

The product of the pressure (P) and volume (V) for any gas is constant at a constant temperature. Pressure and volume are inversely proportionate for a constant temperature.

Mathematical Definition

Background Information

Ideal Gas

An "ideal gas" is a gas in which:

- All collisions are totally elastic (particles always bounce off each other)
- There are no intermolecular attractions (a particle can only change direction when it collides with another particle)
- The molecule is infinitely small (particles will come all the way together before they collide)

What does this mean? An ideal gas is a collection of super-small bouncy-balls that never stop bouncing.

Real World Application

Discover processes or disciplines in the natural or man-made worlds that employ the concept.

Syringes and turkey basters are operated by Boyle's Law: pulling back on the plunger increases the volume inside the syringe, which decreases the pressure, which then corrects when liquid is drawn into the syringe, thereby shrinking the volume again.

Spray cans, like spray paint and air freshener, are governed by Boyle's Law: intense pressure inside the can pushes outward on the liquid inside the can, trying to escape, and forces the liquid out when the cap makes an opening.

You breathe because of Boyle's Law.

Balloons work because of Boyle's Law.

A car (combustion) engine works when the sudden increase in pressure from the combustion of the fuel expands the cylinder and pushes on the piston, causing the crankshaft to turn.

Vocabulary

Learn important vocabulary for this concept, including words that might appear in assessments (tests, quizzes, homework, etc.) that indicate the use of this concept.

Important Vocabulary **Term** **Context**

Compress

- gas is compressed
- compress a gas

Constant Temperature

- expands/compresses at a constant temperature

Expand
- gas expands
- gas is expanded

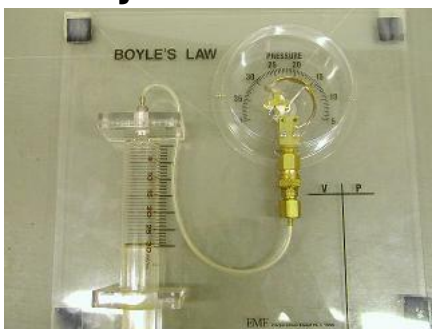
Isothermal
- gas in an isothermal process
- expands/compresses isothermally

Standard Temperature
- expands/compresses at standard temperature

Videos

Browse relevant videos from the Journal of Chemical Education's (JCE) Chemistry Comes Alive! library and other video sources.

Boyle's Law



Boyle's Law is shown with a syringe attached to a pressure gauge.

Duration: 18.4 s s; Size: 582 KB

Boyle's Law: J Tube

Computer Animations

Experience computer simulators or animations that illustrate the concept discussed here. Many simulators or animations come with

worksheets for use in class.

http://www.grc.nasa.gov/WWW/K-12/airplane/Animation/frglab2.html
http://www.walter-fendt.de/ph14e/gaslaw.htm
http://phet.colorado.edu/simulations/sims.php?sim=Gas_Properties
http://lectureonline.cl.msu.edu/~mmp/applist/f/f.htm
http://www.mhhe.com/physsci/chemistry/essentialchemistry/flash/gasesv6.swf
http://intro.chem.okstate.edu/1314F00/Laboratory/GLP.htm
http://preparatorychemistry.com/Bishop_animations.htm

Summary

Read a summary of the concept, indicating the enduring understanding students should retain after class.

Summary

If temperature does not change, increasing the volume of a container will decrease its pressure. Decreasing the volume of a container will increase its pressure.

Works Cited

Review the works cited to write the researched parts of this page, such as the discover's biographical information and other areas.

Works Cited

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Ihde, Aaron J. The Development of Modern Chemistry. New York: Harper & Row, 1964.

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Wistrom, Cheryl. "The Gas Laws." Chemistry: Concepts and Applications. Teacher's wraparound ed. New York: Glencoe/McGraw-Hill, 2000. 382-392.

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