List of Formulas

$a = (v_f - v_i)/(t_f - t_i)$
Acceleration is the rate of change of velocity.

displacement = $x_f - x_i$
Displacement is a change in position.

$F = ma$
Force is equal to the product of the object's mass times the acceleration.
(Newton's second law of motion)

$KE = 1/2\ mv^2$
Kinetic energy is equal to one-half the product of the mass times the velocity squared.

$PE = mgh$
Potential energy is equal to the product of the mass, the gravity, and the height.

Height of support structure = (eye level height)/(span fraction)

momentum = mv
Momentum is equal to the product of the mass and velocity.

$s = d/t$
Speed is equal to the change in distance divided by the change in time.

$t = 2\pi\sqrt{\frac{l}{g}}$
The time (period) for one vibration of a pendulum is equal to 2 π times the square root of the length divided by gravity.

$\text{velocity}_{ave} = (x_f - x_i)/(t_f - t_i)$
The average velocity is equal to the total displacement divided by the change in time.

Amusement Park Physics and Related Web Sites

Amusement Park Physics
http://curie.uncg.edu/~mturner/title.html
This site has several activities with questions that can be used while riding on several well-known amusement park rides. The answers are given as well.

Amusement Park Physics: What are the forces behind the fun?
http://www.learner.org/exhibits/parkphysics/
This excellent Web site has lesson plans, creative demonstrations, roller coaster FAQs, information on Newton's laws of motion, and concise explanations on aerodynamics.

Coaster Links: Build a Coaster
http://dsc.discovery.com/convergence/coasters/interactive/interactive.html
Design a roller coaster and find out how it rates on the "Fear-o-Meter."

Physics of Amusement Parks
http://library.thinkquest.org/2745/data/openpark.htm
Students learn about potential and kinetic energy, centripetal force, and free fall. This site offers information and statistics on major roller coasters. Directions are provided on how to build an accelerometer.

Roller Coaster Database
http://www.rcdb.com/
This site provides the most complete and accurate statistics on more than 475 roller coasters found throughout the world.

Amusement Park Physics Links
http://homepage.mac.com/cbakken/pga/links.html
This site has links to other interesting sites, including one that simulates the forces in a Clothoid loop.

Avian Development Facility
http://spaceresearch.nasa.gov/research_projects/ros/adfop.html
This site describes flight hardware that studies the development of bird embryos in low gravity.

Drop Towers
http://microgravity.grc.nasa.gov/drop2/
http://microgravity.grc.nasa.gov/FACILITY/ZERO.HTM
These Web sites describe two facilities and the scientific research done at NASA Glenn Research Center where weightlessness is created using free fall.

Research Aircraft (KC–135)
http://jsc-aircraft-ops.jsc.nasa.gov/kc135/index.html
Find out about how NASA research aircraft create weightless conditions.

Sounding Rockets
http://www.wff.nasa.gov/pages/soundingrockets.html
Discover information about research rockets used to create weightless conditions.

NASA Resources for Educators

Central Operation of Resources for Educators (CORE) was established for the national and international distribution of NASA-produced educational materials in multimedia format. Educators can obtain a catalogue and an order form by one of the following methods:

NASA CORE
Lorain County Joint Vocational School
15181 Route 58 South
Oberlin, OH 44074–9799
Phone: 440–775–1400
Fax: 440–775–1460
E-mail: *nasaco@leeca.org*
Home page: http://core.nasa.gov

Educator Resource Center Network (ERCN)

To make additional information available to the education community, NASA has created the NASA ERCN. Educators may preview, copy, or receive NASA materials at these sites. Phone calls are welcome if you are unable to visit the ERC (Educator Resource Center) that serves your geographic area. A list of the centers and the regions they serve includes

AK, Northern CA, HI, ID, MT, NV, OR, UT, WA, WY
NASA Educator Resource Center
NASA Ames Research Center
Mail Stop 253–2
Moffett Field, CA 94035–1000
Phone: 650–604–3574
http://amesnews.arc.nasa.gov/erc/erchome.html

IL, IN, MI, MN, OH, WI
NASA Educator Resource Center
NASA Glenn Research Center
Mail Stop 8–1
21000 Brookpark Road
Cleveland, OH 44135
Phone: 216–433–2017
http://www.grc.nasa.gov/WWW/PAO/html/edteachr.htm

CT, DE, DC, ME, MD, MA, NH, NJ, NY, PA, RI, VT
NASA Educator Resource Laboratory
NASA Goddard Space Flight Center
Mail Code 130.3
Greenbelt, MD 20771–0001
Phone: 301–286–8570
http://www.gsfc.nasa.gov/vc/erc.html

CO, KS, NE, NM, ND, OK, SD, TX
Space Center Houston
NASA Educator Resource Center
NASA Johnson Space Center
1601 NASA Road One
Houston, TX 77058
Phone: 281–244–2129
http://www.spacecenter.org/educator_resource.html

FL, GA, PR, VI
NASA Educator Resource Center
NASA Kennedy Space Center
Mail Code ERC
Kennedy Space Center, FL 32899
Phone: 321–867–4090
http://education.ksc.nasa.gov

KY, NC, SC, VA, WV
Virginia Air & Space Center
NASA Educator Resource Center
NASA Langley Research Center
600 Settlers Landing Road
Hampton, VA 23669–4033
Phone: 757–727–0900 x757
http://www.vasc.org/erc/

AL, AR, IA, LA, MO, TN
U.S. Space and Rocket Center
NASA Educator Resource Center
NASA Marshall Space Flight Center
One Tranquility Base
Huntsville, AL 35807
Phone: 256–544–5812
http://erc.msfc.nasa.gov

MS
NASA Educator Resource Center
NASA Stennis Space Center
Mail Stop 1200
Stennis Space Center, MS 39529–6000
Phone: 228–688–3338
http://education.ssc.nasa.gov/erc/erc.htm

CA
NASA Educator Resource Center
NASA Jet Propulsion Laboratory
Village at Indian Hill
1460 East Holt Avenue, Suite 20
Pomona, CA 91767
Phone: 909–397–4420
http://learn.jpl.nasa.gov/resources/resources_index.html

AZ and Southern CA
NASA Educator Resource Center
NASA Dryden Flight Research Center
PO Box 273 M/S 4839
Edwards, CA 93523–0273
Phone: 661–276–5009
http://www.dfrc.nasa.gov/Education/ERC/index.html

VA and MD's Eastern Shores
NASA Educator Resource Center
GSFC/Wallops Flight Facility
Visitor Center Building J–17
Wallops Island, VA 23337
Phone: 757–824–2298
http://www.wff.nasa.gov/~WVC/ERC.htm

Regional Educator Resource Centers offer more educators access to NASA educational materials. NASA has formed partnerships with universities, museums, and other educational institutions to serve as regional ERCs in many states. A complete list of regional ERCs is available through CORE, or electronically via NASA Spacelink at http://spacelink.nasa.gov/ercn.

NASA's Education Home Page serves as the education portal for information regarding educational programs and services offered by NASA for the American education community. This high-level directory of information provides specific details and points of contact for all of NASA's educational efforts, field center offices, and points of presence within each state. Visit this resource at the following address: http://education.nasa.gov.

NASA Spacelink is one of NASA's electronic resources specifically developed for the educational community. Spacelink serves as an electronic library to NASA's educational and scientific resources, with hundreds of subject areas arranged in a manner familiar to educators. Using Spacelink Search, educators and students can easily find information among NASA's thousands of Internet resources. Special events, missions, and intriguing NASA Web sites are featured in Spacelink's "Hot Topics" and "Cool Picks" areas. Spacelink may be accessed at: http://spacelink.nasa.gov.

NASA Spacelink is the official home to electronic versions of NASA's Educational Products. A complete listing of NASA Educational Products can be found at the following address: http://spacelink.nasa.gov/products.

NASA Television (NTV) features Space Station and shuttle mission coverage, live special events, interactive educational live shows, electronic field trips, aviation and space news, and historical NASA footage. Programming has a 3-hour block—Video (News) File, NASA Gallery, and Education File—beginning at noon Eastern and repeated four more times throughout the day. Live feeds preempt regularly scheduled programming.

Check the Internet for program listings at http://www.nasa.gov/multimedia/nasatv/index.html
For more information on NTV, contact
NASA TV
NASA Headquarters—Code P–2
Washington, DC 20546–0001
Phone: 202–358–3572

NTV Weekday Programming Schedules (Eastern Time) (subject to change)

Video File	*NASA Gallery*	*Education File*
12–1 p.m.	1–2 p.m.	2–3 p.m.
3–4 p.m.	4–5 p.m.	5–6 p.m.
6–7 p.m.	7–8 p.m.	8–9 p.m.
9–10 p.m.	10–11 p.m.	11–12 p.m.
12–1 a.m.	1–2 a.m.	2–3 a.m.

How to Access Information on NASA's Education Program, Materials, and Services (EP–2002–07–345–HQ) This brochure serves as a guide to accessing a variety of NASA materials and services for educators. Copies are available through the ERC network, or electronically via NASA Spacelink.

Amusement Park Physics With a NASA Twist

A Middle School Guide for Amusement Park Physics Day

EDUCATOR REPLY CARD

To achieve America's goals in Educational Excellence, it is NASA's mission to develop supplementary instructional materials and curricula in science, mathematics, geography, and technology. NASA seeks to involve the educational community in the development and improvement of these materials. Your evaluation and suggestions are vital to continually improving NASA educational materials.

Please take a moment to respond to the statements and questions below. You can submit your response through the Internet or by mail. Send your reply to the following Internet address:

http://ehb2.gsfc.nasa.gov/edcats/educator_guide

You will then be asked to select the appropriate educator guide and enter your data at the appropriate prompt.

Otherwise, please return the reply card by mail.

1. With what grades did you use the guide?

Number of teachers/faculty:

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_____ College/University _____ Undergraduate _____ Graduate

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_____ College/University _____ Undergraduate _____ Graduate

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_____ Administrators/Staff _____ Parents _____ Professional Groups

_____ General Public _____ Civic Groups _____ Other

2. a. What is your home 5- or 9-digit zip code? __ __ __ __ __ — __ __ __ __

b. What is your school's 5- or 9-digit zip code? __ __ __ __ __ — __ __ __ __

3. This is a valuable guide.

❏ Strongly Agree ❏ Agree ❏ Neutral ❏ Disagree ❏ Strongly Disagree

4. I expect to apply what I learned from this guide.

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Fold along line and tape closed.

5. What kind of recommendation would you make to someone who asks about this guide?

❏ Excellent ❏ Good ❏ Average ❏ Poor ❏ Very Poor

6. How did you use this guide?

❏ Background Information ❏ Critical Thinking Tasks ❏ Demonstrate NASA Materials

❏ Demonstration ❏ Group Discussions ❏ Hands-On Activities

❏ Integration Into Existing Curricula ❏ Interdisciplinary Activity ❏ Lecture

❏ Science and Mathematics ❏ Team Activities ❏ Standards Integration

❏ Other: Please specify: _____

_____

7. Where did you learn about this guide?

❏ NASA Educator Resource Center (ERC)

❏ NASA Central Operation of Resources for Educators (CORE)

❏ Institution/School System

❏ Fellow Educator

❏ Workshop/Conference

❏ Other: Please specify: _____

_____

8. What features of this guide did you find particularly helpful?

_____

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9. How can we make this guide more effective for you?

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10. Additional comments:

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