Chapter 2

Racing on the ceiling, swimming through syrup
(fluids)

Here are the references and web links for the stories in the book. Recently added references are highlighted. For updates to those stories and for all the new stories, go to

Chap 2 archives part A (1-40)
Chap 2 archives part B (41-76)
Chap 2 archives part C (77-154)
Chap 2 archives part D (155-end)

Jan 2015

2.1 Race cars on the ceiling


The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

Videos
http://www.youtube.com/watch?v=T1VQLSgok78  Discovery Channel piece about the McLaren F1
http://www.youtube.com/watch?v=Pq4tuT_l36g   Testing aerodynamics of the F1

Photos and discussion
http://www.chaparralcars.com/2e.php   Official chaparral website
http://www.jimhayes.com/Archives/hall1.jpg  Photo
http://www.popsci.com/popsci/futurecar/06f099a138b84010vgnvcm1000004eebcddcrd/3.html   Mentions upside down car and shows the Chaparral 2E
http://people.bath.ac.uk/pb235/aero/history.htm  Shows Jim Hall’s “sucker car” and a car with an adjustable wing
http://ffden-2.phys.uaf.edu/211.web.stuff/Langman/phys211-ec.htm   Shows Hall’s chaparral that could hug the turns.
www.f1journal.com/f1_teknik/tek_acv_030501a.html

References

- Dots ● through ●●● indicate level of difficulty
- Journal reference style: author, journal, volume, pages (date)
- Book reference style: author, title, publisher, date, pages

2.2 Drafting


The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

References

Dots ● through ●●● indicate level of difficulty

Journal reference style: author, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages


2.3 Aerodynamics of passing trains

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://www.youtube.com/watch?v=Z5stmjA74-s&feature=related  Fast train almost runs down two people. Watch the airflow as the train passes them. 
http://www.youtube.com/watch?v=EqJAM8A8H-o Video of two fast trains passing each other in opposite directions. Note the uncontrollable motion of the camera. 
Videos of Snow plowing by train 
http://www.youtube.com/watch?v=QenN5DVuL7w  Snow plowing by train
http://www.youtube.com/watch?v=Ww-7X-LNMdU

References

Dots ● through ●●● indicate level of difficulty

Journal reference style: author, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages

•● Cameronlingo, C., and A. Varlamov, “An incident on the train,” Quantum, ??, 42-44 (November-December 1990)
• Fuji, K., and T. Ogawa, “Aerodynamics of high speed trains passing by each other,” Computers & Fluids, 24, No. 8, 897-908 (1995)

2.4 Collapse of the old Tacoma Narrows Bridge


The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

Movies and newsreels
http://www.youtube.com/watch?v=j-zcJXSxnr  Newsreel with narration and music
http://video.google.com/videoplay?docid=-8848571026603178234&q=tacoma+narrows+bridge+collapse
Another newsreel and more bridge-breaking music
http://www.youtube.com/watch?v=P0Fi1VcbpAI
http://www.youtube.com/watch?v=i_MQ61vyqSM Vortex shedding by a cylinder
http://www.youtube.com/watch?v=CB2aWiesq0g Same here
http://www.youtube.com/watch?v=SuZri0q9MAg another one

Still photos
http://www.ketchum.org/bridgecollapse.html

References

Dots ● through ●●● indicate level of difficulty

Journal reference style: author, journal, volume, pages (date)
Finch, J. K., “Wind failures of suspension bridges or Evolution and decay of the stiffening truss,” Engineering News Record, 402, 74-79 (13 March 1941)


Goller, R. R., “The legacy of ‘galloping gertie’ 25 years after,” Civil Engineering, 35, 50-53 (October 1965)


McKenna, P. J., N. Gilbert, and H. Petroski (letters) “Let’s twist again,” American Scientist, 80, 3-4 (1992)


Feldman, B. J., “What to say about the Tacoma Narrows Bridge to your introductory physics class,” Physics Teacher, 41, 92-96 (February 2003)


2.5 Aerodynamics of buildings


The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

References

Dots • through ■■■ indicate level of difficulty
Journal reference style: author, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages
• Thomann, H., “Wind effects on buildings and structures,” American Scientist, 63, 278-287 (May-June 1975)
• Holford, Lord, “Problems for the architect and town planner caused by air in motion,” Philosophical Transactions of the Royal Society of London A, 269, 335-341 (1971)
■■ Owen, P. R., “Buildings in the wind,” Quarterly Journal of the Royal Meteorological Society, 97, 396-413 (1971)

Related reference

2.6 Kites

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://www.youtube.com/watch?v=6QYaJo5Uzuo  Video, five kites in a “dance”
http://www.youtube.com/watch?v=2BzGeKmgKU&mode=related&search= Video, more. I love this stuff.
http://www.youtube.com/watch?v=mttPruk7gQA&mode=related&search= Even more video
http://www.youtube.com/watch?v=M-9SfuK7s4&mode=related&search= Indoor kite
http://www.youtube.com/watch?v=1SW_l5gLRwo&mode=related&search= Kite dancing

References

- Walker, J., "Introducing the Musha, the double lozenge and a number of other kites to build and fly," in “The Amateur Scientist,” Scientific American, 238, No. 2, 156-161 (February 1978)
- Alexander, K., and J. Stevenson, “Kite equilibrium and bridle length,” Aeronautical Journal, 105, No. 1051, 535-541 (September 2001)

2.7 Ski jumping


The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://www.youtube.com/watch?v=W-amNJqWpEo  Video, watch his left leg and ski
http://www.youtube.com/watch?v=qkpo-zSOMDQ&mode=related&search= Video
http://www.youtube.com/watch?v=PNh5GAWrY8&mode=related&search= Video

References


Related references


2.8 Speed of a downhill skier


The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

References

Dots • through ��� indicate level of difficulty

Journal reference style: author, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages

Allen, J., (letter) “Friction on the ski slopes,” Physics World, ??, 17 (March 1977)  ??check this citation


Perlman, E., “The ballistics of speed skiing,” Science 80, 1, 74-75 (January/February 1980)

2.9 Boomerangs


The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

http://www.youtube.com/watch?v=YOnBy9rU43M&NR=1   Video, throwing a boomerang
http://www.youtube.com/watch?v=a5EggR_4piE  Video, world’s smallest boomerang
http://www.youtube.com/watch?v=VAp1rr6Lgrg Video

References

- Dots • through ••• indicate level of difficulty
- Journal reference style: author, title, journal, volume, pages (date)
- Book reference style: author, title, publisher, date, pages

Fluids

- Ruhe, B., and E. Darnell, Boomerang: How to Throw, Catch and Make It, Workman Publ., 1985
- Hanson, M., "The flight of the boomerang," Physics Teacher, 28, No. 3, 142-147 (March 1990)

Related reference

2.10 Throwing cards

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://www.youtube.com/watch?v=o16DeNuXHcs  Video, how to attack various pieces of fruit with a card

References
- Dots • through *** indicate level of difficulty
- Journal reference style: author, title, journal, volume, pages (date)
- Book reference style: author, title, publisher, date, pages
2.11 Seeds that spin


The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

http://www.istockphoto.com/imageindex/574/8/574889/Helicopter_Seed_Pod.html Photo
http://waynesword.palomar.edu/plfeb99.htm Wayne’s Word: An on-line textbook of natural history, which has many fine pages to explore. This page is about the different ways seeds and fruits can be dispersed by wind. Use the menu at the bottom to find various individual pages, such as the one about the ones that rotate like helicopters:
http://waynesword.palomar.edu/plfeb99.htm#helicopters

References

Dots • through *** indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages

2.12 Flying snakes

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://homepage.mac.com/j.socha/aerial_images/paradisi/paradisi_air_gallery_1.html Photos and discussion

References

Dots • through ⭐⭐⭐ indicate level of difficulty

Journal reference style: author, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages


Related references


2.13 Air drag on tennis balls


The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

References

Dots • through ••• indicate level of difficulty

Journal reference style: author, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages


Related reference


2.14 Veering a football around a defensive wall


The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

[http://www.youtube.com/watch?v=iEjzHLINaig](http://www.youtube.com/watch?v=iEjzHLINaig) Video: excellent curved path

[http://www.youtube.com/watch?v=RRqS-dKXHEM](http://www.youtube.com/watch?v=RRqS-dKXHEM) Lots of goals, some with remarkable curved paths

[http://www.youtube.com/watch?v=jjyr1zXViuk](http://www.youtube.com/watch?v=jjyr1zXViuk) Same here
References

Dots • through ●●● indicate level of difficulty

Journal reference style: author, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages

• Briggs, L. J., “Effect of spin and speed on the lateral deflection (curve) of a baseball; and the Magnus effect for smooth spheres,” American Journal of Physics, 27, 589-596 (1959)


• Glenn, G., personal communication about beach-ball deflection, 1989


2.15 Golf-ball aerodynamics


The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://archives.cbc.ca/IDC-1-41-1723-11853/sports/golfing/clip3  Jan Ingram and me, in an audio clip from the CBC show Quirks and Quarks.
http://www.cookeassociates.com/seesite/BALLS/balls_students_background.htm  golf ball (go down to the photos showing smoke tracers moving past a tennis ball)
http://www.youtube.com/watch?v=XYU6jWmp7k0  Instruction video on how to hit the ball to launch it into a high flight

References

2.16 Baseball aerodynamics


The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

Videos

http://www.youtube.com/watch?v=V26Fbsrpcus  How to throw a curveball
http://www.youtube.com/watch?v=X3tWTKL6xNM  How to throw a knuckleball
http://www.youtube.com/watch?v=8hBv5CEYbqE  How to throw a splitfinger fastball
http://www.youtube.com/watch?v=kkn0TMdLg0M  How to throw a two-seam fastball
http://www.youtube.com/watch?v=WDMwTJUAgvQ  How to throw a four-seam fastball
http://www.youtube.com/watch?v=BrQ6cB0GEq4  How to throw a changup
http://www.youtube.com/watch?v=06AVCBkW_Y  Another video on how to throw a split finger fastball

References

Dots • through ● indicate level of difficulty

Journal reference style: author, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages

• Weaver, R., “Comment on ‘Aerodynamics of a knuckleball’,” American Journal of Physics, 44, No. 12, 1215 (December 1976)
• Edge, R. D., “The spin on baseballs or golf balls,” Physics Teacher, 18, 308-309 (April 1980)
• Frohlich, C., “Aerodynamic drag crisis and its possible effect on the flight of baseballs,” American Journal of Physics, 52, No. 4, 325-334 (April 1984)
• Erlichson, H., “Is a baseball a sand-roughened sphere?” American Journal of Physics, 53, No. 6, 582-583 (June 1985); Frohlich, C., “Comments on ‘Is a baseball a sand-roughened sphere?’” page 583


Carter, R., “Knowing when to let go,” New Scientist, 150, 17 (6 April 1996)


Alaways, L. W., S. P. Mish, and M. Hubbard, “Identification of release conditions and aerodynamic forces in pitched-baseball trajectories,” Journal of Applied Biomechanics, 17, No. 1, 63-76 (February 2001)


Related reference

Bahill, A. T., and T. LaRitz, “Why can't batters keep their eyes on the ball?” American Scientist, 72, 249-253 (May-June 1984); see also letters on page 433


2.17 Cricket aerodynamics
2.18 Birds flying in V formation

The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

http://www.aerodyn.org/Annexes/Birds/birds.html Photo plus discussion

http://www.fotosearch.com/FSP188/086002/ Photo

**References**

Dots • through  indicates level of difficulty

Journal reference style: author, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages

• Shaw, E., “Schooling fishes,” American Scientist, 66, 166-175 (March-April 1978)
• Hayakawa, Y., “Spatiotemporal dynamics of skeins of wild geese,” Europhysics Letters, 89, article # 48004 (6 pages) (February 2010)

Related references


2.19 Speed swimming in syrup

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

References

Dots • through ⚫ indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages


2.20 Contrails

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

Videos

http://www.youtube.com/watch?v=6jCS8jPVU-o&feature=related You can the distance between the wings and the contrails

http://www.youtube.com/watch?v=ZRxN6vU5juE&feature=related Here the distance is not as much

http://www.youtube.com/watch?v=IUC1Z_vXkPw

http://www.youtube.com/watch?v=jC6iojI4UEi&feature=related

http://www.youtube.com/watch?v=ormqIgbxgsI

http://www.youtube.com/watch?v=AWwpYgBqmCo

http://www.youtube.com/watch?v=mPPQDfOQLhc

Photos

http://www.es.lancs.ac.uk/hazelrigg/amy/Home.htm National Contrail Network home page


http://www.victoriaweather.ca/clouds.php?image=contrail Photo, contrail and its shadow on clouds

http://www.atoptics.co.uk/ Many photos and explanations of atmospheric optics

http://www.lounge.org/elvis/contrail_and_shadow_41000.jpeg Photo, contrail and its shadow

References

Dots • through ⚫ indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages
• Subrahmanyam, V. P., and G. Nicholson, “Contrail shadows,” Weather, 22, 244 (1967)
• Scorer, R. S., Clouds of the World, Stackpole Books, 1972, pages 120-129
• Crane, H. R., “Negative contrails,” Physics Teacher, 19, 409 (September 1981)
• Staley, D. O., (letter) “Contrail shadows,” Weatherwise, 36, No. 1, 44 (February 1983)
• Lewellen, D. C., and W. S. Lewellen, “The effects of aircraft wake dynamics on contrail development,” Journal of the Atmospheric Sciences, 58, 390-406 (15 February 2001)
• Marquart, S., M. Ponater, F. Mager, and R. Sausen, “Future development of contrail cover, optical depth, and radiative forcing: impacts of increasing air traffic and climate change,” Journal of Climate, 16, 2890-2904 (1 September 2003)


Related reference


2.21 Inward flutter of a shower curtain


The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://www.youtube.com/watch?v=AvLwqRCbGKY Coanda effect on a spoon near flowing water
http://www.youtube.com/watch?v=o -Eph9w6_A Coanda effect with a spoon in a stream of water
http://www.straightdope.com/classics/a2_104.html and
http://www.straightdope.com/columns/010810.html Cecil Adams, in his “Straight Dope” columns, discusses the shower curtain effect, with a different conclusion from me.

References

Dots • through ☆ indicate level of difficulty
Journal reference style: author, title, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages


Walker, J., "Does convection or the Bernoulli principle make the shower curtain flutter inward?" in "The Amateur Scientist," Scientific American, 258, No. 6, 116-119 (June 1988)

2.22 Prairie dog and giant ant nests

http://www.youtube.com/watch?v=zJNSfp3o-uA  Kids video about prairie dog’s sounds but it also shows the burrows.
http://www.youtube.com/watch?v=JLQ70JJpa0M  Video about vacuuming up the prairie dogs from the homes (they are not hurt).
http://www.proseandphotos.com/AZ-35-18-b_small.jpg  Photo of prairie dog sitting on the mound entrance to its home
http://www.adventure-tours-australia.com/australian-outback-photos/ant-hill.html  Photo magnetic ant hill in Australia

References


Related reference


### 2.23 Bathtub vortex


To see me demonstrate the bathtub vortex on television, go to http://www.gumfrog.com/dailyplanet and use Username: previewguest Password: dIse0very  (note the two numbers)
I suggest that you click the box that allows the computer to remember this information (or you may have to enter it several times)
Choose Jan 2008. Scroll down to Jan 22 / 08. Click on "Fact of the Matter"

http://www.youtube.com/watch?v=VsrCODFd2V0  Video: bathtub vortex is not controlled by the Coriolis effect
http://www.youtube.com/watch?v=gccduFJSisI  This is the stuff shown to tourists. Can you spot how he makes the water drain the way he wants it to?
Same stuff. He makes a living showing the Coriolis effect at a location where the effect is actually zero.

Another person making a living showing an effect that does not exist.

Ink tracer vortex in a water container, with the camera rotated by 90 degrees (bottom is to the right)

Ink tracer in vortex

Photos and description

Photo plus description

References

Dots • through ⋆⋆⋆ indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages


• Whiten, A. J., “Concerning plug-holes,” Weather, 18, 73-76 (1963)


• Linn, A., “Oh, what a spin we’re in, thanks to the Coriolis effect,” Smithsonian, 13, No. 11, 66-73 (1983)


Miloh, T., and P. A. Tyvand, “Nonlinear transient free-surface flow and dip formation due to a point sink,” Physics of Fluids, 5, No. 6, 1368-1375 (June 1993)
Salzsieder, J. C., “Exposing the bathtub Coriolis myth,” Physics Teacher, 32, 107 (February 1994)
Klimenko, A. Y., “Moderately strong vorticity in a bathtub-type flow,” Theoretical and Computational Fluid Dynamics, 14, 243-257 (2001)
Klimenko, A. Y., “A small disturbance in the strong vortex flow,” Physics of Fluids, 13, No. 6, 1815-1818 (June 2001)

Related references

2.24 Vortex in a cup of coffee

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

References
• Walker, J., "Wonders of physics that can be found in a cup of coffee or tea," in "The Amateur Scientist," Scientific American, 237, 246-257 (September 1977)
• Maxworthy, T., “A vorticity source for large-scale dust devils and other comments on naturally occurring columnar vortices,” Journal of Atmospheric Sciences, 30, No. 8, 1717-1722 (November 1973), see footnote 5 on page 1722

2.25 Gathering of tea leaves, spinning of olives

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

References
• Einstein, A., “The cause of the formation of meanders in the courses of rivers and of the so-called Beer’s law,” Essays in Science, Philosophical Library, 1955, pages 85-91
• Satterly, J., “Rotating liquid motions,” American Journal of Physics, 27, 526 (1959)
• Walker, J., “Wonders of physics that can be found in a cup of coffee or tea,” in "The Amateur Scientist," Scientific American, 237, No. 5, 152-160 (November 1977)
• Snyder, M., personal letter about olives spinning in swirling martinis, 1978
• Aslamazov, L., “Meandering down to the sea,” Quantum, 2, No. 6, 34-37 + 61 (July/August 1992)
2.26 Meandering rivers

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://www.stacey.peak-media.co.uk/Year7/7-7Rivers/7-7Meanders/7-7Meanders.htm

River meander images

References

Dots ● through ●● indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages


● Leopold, L. B., and W. B. Langbein, “River meanders,” *Scientific American*, 214, No. 6, 60-70 + 144 (June 1966)


● Tinkler, K. J., “Geological Society of America Bulletin, 81, 547-552 (February 1970)


● Tinkler, K. J., “Active valley meanders in south-central Texas and their wider implications,” Geological Society of America, 82, 1783-1800 (July 1971)


• Ferguson, R. I., “Regular meander path models,” Water Resources Research, 9, No. 4, 1079-1086 (August 1973)
• Walker, J., “Wonders of physics that can be found in a cup of coffee or tea,” in "The Amateur Scientist," Scientific American, 237, No. 5, 152-160 (November 1977)
• Aslamazov, L., “Meandering down to the sea,” Quantum, 2, No. 6, 34-37 + 61 (July/August 1992)
• Hudson, P. F., and R. H. Kesel, “Channel migration and meander-bend curvature in the lower Mississippi River prior to major human modification,” Geology, 28, No. 6, 531-534 (June 2000)
• Hayes, B., “Up a lazy river,” American Scientist, 94, No. 6, 490-494 (November-December 2006)

Related references

2.27 Bird spinning in water

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

References

Dots ● through ●●● indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages

2.28 Water climbing a spinning egg

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

References

Dots • through ⬤ indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages


2.29 Circular water-flow pattern in a sink

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

References

Dots • through ⬤ indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages


Related references


Hildebrand, P. H., “Hydraulic jump in thunderstorm outflow,” Bulletin of the American Meteorological Society, 58, No. 6, 504 + front cover (June 1977)
Fluids 32


2.30 Water level in canals

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

References

Dots • through ⬤ indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages


Stockstill, R. L., and R. C. Berger, “Simulating barge drawdown and currents in channel and backwater areas,” Journal of Waterway, Port, Coastal, and Ocean Engineering, 127, No. 5, 290-298 (September/October 2001)


Related references

Maynord, S. T., “Power versus speed for shallow draft navigation,” Journal of Waterway, Port, Coastal, and Ocean Engineering, 126, No. 2, 103-106 (March/April 2000)

Husig, A., T. Linke, and C. Zimmermann, “Effects from supercritical ship operation on inland canals,” Journal of Waterway, Port, Coastal, and Ocean Engineering, 126, No. 3, 130-135 (May/June 2000)
2.31 Solitary waves
The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

References
Dots • through ⃝ indicate level of difficulty
Journal reference style: author, title, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages
�� Taylor, B. A. P., “What is a solitary wave?” American Journal of Physics, 47, No. 10, 847-850 (October 1979)
�� Olsen, M., H. Smith, and A. C. Scott, “Solitons in a wave tank,” American Journal of Physics, 52, No. 9, 826-830 (September 1984)
�� Herman, R., “Solitary waves,” American Scientist, 80, 350-361 (July-August 1992)

Related references
2.32 Tidal bores

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://www.youtube.com/watch?v=PtUmLLlm7S0  Video of surfers riding the bore on the Severn River
http://www.youtube.com/watch?v=dX05gCni9Wg&mode=related&search= Another surf video
http://www.youtube.com/watch?v=3tYAZf2OMsk&mode=related&search= Video of Severn bore
http://www.youtube.com/watch?v=LQNxj99rNw&feature=related  Another Severn surfing video
http://www.youtube.com/watch?v=Qc96txWJAOc&feature=related  Another one, distant shot
http://www.youtube.com/watch?v=3tYAZf2OMsk&feature=related Series of photos and then video

Audio, photos, discussion
http://www.bbc.co.uk/wales/surfing/sites/features/pages/severn_bore06.shtml
http://www.bbc.co.uk/gloucestershire/interactive/interactive_map/gloucester/severn_bore.shtml
http://www.bbc.co.uk/gloucestershire/content/articles/2007/04/09/severn_bore_feature.shtml news item and nice photo
http://www.bbc.co.uk/radio4/science/extremebritain.shtml  BBC Radio. If this site is still active, scroll down to the program “The Biggest Tide,” which is about the bore on the Severn River, including some discussion of the surfing. The show is part of the series called “Extreme Britain,” hosted by Mike Dilger.

References

Dots through ★★★ indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages


Related references

2.33 Tides

References

Dots ● through ▼▼▼ indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages

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Levine, J., “The earth tides,” Physics Teacher, 58, 585 (December 1982)
Jelley, J. V., “The tides, their origins and behaviour,” Endeavour, 10, No. 4, 184-190 (1986)
• Good, R. H., “Tides and densities,” American Journal of Physics, 68, No. 4, 387 (April 2000)

2.34 Tides in the Bay of Fundy

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://content.answers.com/main/content/wp/en/7/76/Bay_of_Fundy_High_Tide.jpg High tide at a point
http://content.answers.com/main/content/wp/en/c/cf/Bay_of_Fundy_Low_Tide.jpg Low tide at that same point

References
Dots • through ⋆⋆⋆ indicate level of difficulty
Journal reference style: author, title, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages
• Brooks, D. A., “Tides and tidal power in Passamaquoddy Bay: a numerical simulation,” Continental Shelf Research, 12, Nos. 5-6, 675-716 (1992)
• Desplanque, C., and D. J. Mossman, “Bay of Fundy tides,” Geoscience Canada, 28, No. 1, 1-11 (March 2001)

Related reference
2.35 Dead water


The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

References

- Bascom, W., *Waves and Beaches*, Anchor Books, 1980, pages 139-140

2.36 Tornadoes


The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

Videos (warning, some mild cursing)

- Manitoba tornado
- Scary stuff
- Many tornado videos compiled, including a shot of a house being pulled apart. (The parking lot vortex is a dust devil, not a tornado, or the pickup truck that drives through it would have destroyed. So is the playground vortex.)
- Winds at 318 miles per hour!
- Cameras inside a tornado
- Texas tornadoes
- Witcha Falls, Texas
- Tornado rips through trees
- F4 in Manitoba
- Jarrell, Texas, 1997
- Tornadoes and the damage, including the damage path through a Wal-Mart. (The kids are playing in a dust devil, not a tornado)

http://www.youtube.com/watch?v=xCI1u05KD_s
http://www.youtube.com/watch?v=DNL7ASv4k4
http://www.youtube.com/watch?v=2iA18W2X6zM
http://www.youtube.com/watch?v=cJH4rylVATU
http://www.youtube.com/watch?v=EqajULQwi90
http://www.youtube.com/watch?v=UVppfnXtPZ4
http://www.youtube.com/watch?v=4pbqGsS5iB4
http://www.youtube.com/watch?v=nKGOjiNh
http://www.youtube.com/watch?v=WlfVwljstRo
http://www.youtube.com/watch?v=5vEBiTTkpYU
http://www.youtube.com/watch?v=rFeufWFPVm4
http://www.youtube.com/watch?v=zy8H-RTVGew
http://www.youtube.com/watch?v=GrCLJuMerco
http://www.youtube.com/watch?v=mUbR6Ty7TO4
http://www.youtube.com/watch?v=vo5Q48nV8SI
Two tornadoes
Big, violent Manitoba tornado
Slide show, with van Halen music.

Kansas tornado, with what looks like video from a flying car.

Video

Description of the tornado

photos and descriptions:

Reference

Journal reference style: author, title, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages

Vonnegut, B., and C. B. Moore, “Giant electrical storms” in Recent Advances in Atmospheric Electricity, Pergamon Press, 1959, pages 399-411
Turner, J. S., “Carbonated-water vortex,” Oceanus, 10, 14-17 (1963)
Turner, J. S., and D. K. Lilly, “The carbonated-water tornado vortex,” Journal of the Atmospheric Sciences, 20, 468-471 (September 1963)
Bathurst, G. B., “The earliest recorded tornado?” Weather, 19, 202-204 (1964)
Turner, J. S., “Laboratory models of evaporation and condensation,” Weather, 20, 124-128 (1965)
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• Hsu, C. T., and B. Fattahi, “Mechanism of tornado funnel formation,” Physics of Fluids, 19, No. 12, 1853 (December 1976)
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• Olson, S., “Year of the tornado,” Science 84, 5, 174-183 (November 1984)
• Hall, R. S., “Inside a Texas tornado,” Weatherwise, 40, 72-75 (April 1987); reprinted in January/February 1998
• Herzer, J., “Monster on the prairie,” Weatherwise, 44, 23-25 + 28 (February 1991)
• Hurley, M. K., (photo), Weatherwise, 44, 31 + front cover (August/September 1991)
• Snyder, C. H., “That’s the way the building crumbles,” Weatherwise, 44, 28-32 (June 1991)
• Moore, G., “Trapped in the great Tupelo tornado,” Weatherwise, 45, No. 5, 16-18 (October/November 1992)
• Silver, D., editor, “The fury of Kansas weather,” Weatherwise, 45, No. 1, 28-29 (February/March 1992)
• Crowther, H. G., “Tornadoes strike,” Weatherwise, 47, 28-35 (February/March 1994)
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• Rosenfeld, J., “Mr. Tornado: the life and career of Ted Fujita,” Weatherwise, 52, 18-25 (May/June 1999)
• Bluestein, H., Tornado Alley, Oxford University Press, 1999
• Yih, C-S., “Tornado-like flows,” Physics of Fluids, 19, article # 076601 (6 pages) (2007)

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• Turner, J. S., and D. K. Lilly, “The carbonated-water tornado vortex,” Journal of the Atmospheric Sciences, 20, 468-471 (September 1963)
• Turner, J. S., “Carbonated-water vortex,” Oceanus, 10, 15 (1963)

2.37 Short story: Looking up into a tornado

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://www.youtube.com/watch?v=668begWTof0 Driving into a weak tornado
http://www.youtube.com/watch?v=yTaWGF51Lrg Below a funnel

References
Dots • through $$$ indicate level of difficulty
Journal reference style: author, title, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages
• Hall, R. S., “Inside a Texas tornado,” Weatherwise, 4, 72-75 (April 1987)
• Keller, B., “Looking a tornado in the eye,” Weatherwise, 44, 30 (June 1991)
• Cosgrove, D., (letter) “Inside an F0 tornado,” Weatherwise, 45, No. 3, 6 + 50 (June/July 1992)
• Hall, R. S., “Inside a Texas tornado,” Weatherwise, 51, 16-20 (January/February 1998); also see the excerpt by Snyder, C. H., “Looking at tornado in the eye” on page 19
• Bluestein, H., Tornado Alley, Oxford University Press, 1999, pages 3-4

Related reference
• McCown, D., “Close encounter with a Rocky Mountain whirlwind,” Weatherwise, 50, 29-30 (June/July 1997)

2.38 Waterspouts and funnel clouds

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

Videos:
http://www.youtube.com/watch?v=QfhBKljhizk Multiple waterspouts
http://www.youtube.com/watch?v=IHGq23Zfu5Q&mode=related&search= (Correct the audio: these are waterspouts, not tornados)
http://www.youtube.com/watch?v=WpeGHPk9hgo&mode=related&search=
http://www.youtube.com/watch?v=5lyxg9OrE5I

Photos and discussions:
http://apod.nasa.gov/apod/ap050120.html
http://www.ghettodriveby.com/waterspout/
http://www.vantagepointguides.com/how_to/images/waterspout_weather.jpg

References
Dots • through ●●● indicate level of difficulty
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• Rossmann, F. O., “Some further remarks on waterspouts,” Weather, 14, 104-106 (1959)
• (photos) Weather, 21, 360-362 (1966)
2.39 Dust devils, fog devils, and steam devils

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

Photos
http://www.nasa.gov/vision/universe/solarsystem/2005_dust_devil_prt.htm
http://media.graytvinc.com/images/dust+devil.jpg
http://www.gc.maricopa.edu/earthsci/imagearchive/dust_devils.htm

Video
http://www.youtube.com/watch?v=CQLCJFbABgg&feature=related Huge dust devil, with people on bikes riding through it and the camera operator walking through it
http://www.youtube.com/watch?v=u2gT9GRirN8&NR=1 Wal-Mart dust devil
http://www.youtube.com/watch?v=2rK-ctpFBz8&NR=1 Big dust devil develops at a baseball game
http://video.google.com/videoplay?docid=899964669942411501&q=dust+devils&hl=en
http://www.youtube.com/watch?v=MYwzNNeuOSY&mode=related&search= Dust devil (vortex) produced by a fire
http://www.youtube.com/watch?v=2SWTzZXc0sg Driving through a dust devil
http://www.youtube.com/watch?v=Kwa0ivfrcvE Whirlwind coming off a bonfire
http://www.youtube.com/watch?v=GiDTT8JQsY More bonfire vortices, really good
http://www.youtube.com/watch?v=H37oeNVJUDM More of the bonfire vortices
http://www.youtube.com/watch?v=VDeRe1_bHjY Big dust devil at camping ground
http://www.youtube.com/watch?v=2iBjqFJsraM Paragliders picked up a whirlwind
http://www.youtube.com/watch?v=5Fw1qiAld2U&NR=1 Whirlwinds from a brush fire

Movies and other images of martian dust devils
http://science.nasa.gov/headlines/y2005/14jul_dustdevils.htm
http://www.msss.com/mars_images/moc/7_1_99_devils/
http://www.msss.com/mars_images/moc/lpsc2000/3_00_dustdevil/
http://www.lpl.arizona.edu/~lemmon/mer_dd.html

References

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Book reference style: author, title, publisher, date, pages

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• Hallett, J., and T. Hoffer, “Dust devil systems,” Weather, 26, No. 6, 247-250 (June 1971)
• Barcilon, A. I., and P. G. Drazin, “Dust devil formation,” Geophysical Fluid Dynamics, 4, 147-158 (1972)
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Fluids 44

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- Ringrose, T. J., “Inside dust devils,” A&G, 46, 5.16-5.19 (October 2005)
2.40 Ring vortexes


The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

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Lim, T. T., “A note on the leapfrogging between two coaxial vortex rings a low Reynolds numbers,” Physics of Fluids, 9, No. 1, 239-241 (January 1997)


2.41 Siphons and toilets


The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://www.toiletology.com/crapper.shtml Site about Thomas Crapper
http://www.toiletology.com/history-02.shtml

References

Journal reference style: author, title, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages


Related references

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Scholander, P. F., “Tensile water,” American Scientist, 60, 584-890 (September-October 1972)
• Apfel, R. E., “The tensile strength of liquids,” Scientific American, 227, No. 6, 58-71 (December 1972)
• Gianino, C., “A strange fountain,” Physics Education 42, No. 5, 488-491 (September 2007)
• Hughes, S. W., “A practical example of a siphon at work,” Physics Education, 45, No. 2, 162-166 (March 2010)
• Planinsic, G., and J. Slisko, “The pulley analogy does not work for every siphon,” Physics Education, 45, No. 4, 356-361 (July 2010)

2.42 Lizards walking on water

The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

Photos:
[http://www.ri.net/schools/West_Warwick/manateeproject/Rainforest2/images/walk%20on%20water.jpg](http://www.ri.net/schools/West_Warwick/manateeproject/Rainforest2/images/walk%20on%20water.jpg)
[http://news.bbc.co.uk/2/low/science/nature/4033725.stm](http://news.bbc.co.uk/2/low/science/nature/4033725.stm)  BBC item with photos

Video:
[http://www.youtube.com/watch?v=Qhsxo7vY8ac](http://www.youtube.com/watch?v=Qhsxo7vY8ac)
[http://www.youtube.com/watch?v=sVVwWafi-MU](http://www.youtube.com/watch?v=sVVwWafi-MU)
[http://www.youtube.com/watch?v=1wWh4LzWUPY](http://www.youtube.com/watch?v=1wWh4LzWUPY)
[http://www.youtube.com/watch?v=vCGAkMzoKb8](http://www.youtube.com/watch?v=vCGAkMzoKb8)
[http://www.youtube.com/watch?v=mBEansolk1A](http://www.youtube.com/watch?v=mBEansolk1A)

References

Dots • through ••• indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages


2.43  Lead bar floating in a boat

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

References

   Journal reference style: author, title, journal, volume, pages (date)
   Book reference style: author, title, publisher, date, pages


2.44  Floating bars and open containers

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

References

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• Delbourgo, R., “The floating plank,” American Journal of Physics, 55, No. 9, 799-802 (September 1987)
2.45 Hole in a dam, ship in dry dock
The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

References


Related references

2.46 g-LOC in pilots
The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

References

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Related reference

2.47  Blood circulation in snakes, giraffe, and tall dinosaurs

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://www.youtube.com/watch?v=QUJpvUygLRs&mode=related&search= Video of giraffe drinking from a pond.

References
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• Young, B. A., R. J. Wassersug, and A. Pinder, “Gravitational gradients and blood flow patterns in specialized arboreal (Ahetulla nasuta) and terrestrial (Crotalus adamanteus) snakes,” Journal of Comparative Physiology B, 167, 481-493 (1997)
• Choy, D. S. J., and R. Ellis, (letter) “Multiple hearts in animals other than Barosaurus,” Lancet, 352, 744 (29 August 1998)
Related references

2.48 Did the sauropods swim?

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

References

Journal reference style: author, title, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages


2.49 Gastroliths in dinosaurs and crocodiles

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.


References

Journal reference style: author, title, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages


2.50 Coanda effect

The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

http://www.youtube.com/watch?v=S-SAQtODAQw  Video, watch the flap be pulled upward by the Coanda effect (note, the Bernoulli principle is not involved).
http://www.youtube.com/watch?v=AvLwqRChGKY  Coanda effect with a spoon in a stream of water
http://www.youtube.com/watch?v=o -Eph9w6_A  Coanda effect with a spoon in a stream of water
http://www.smartsecondskin.com/img/African_bombardier_beetle.jpg  Photo of the bombardier beetle spraying
http://www.failedsuccess.com/images/beetle2.jpg  Photo of the bombardier beetle
http://www.youtube.com/watch?v=tpJ3asv3XMY  Video of the bombardier beetle, part 1
http://www.youtube.com/watch?v=nFUIEuNeWw4  Video of the bombardier beetle, part 2
http://jnaudin.free.fr/html/repcotst.htm  Coanda saucer, photos and plans for making
http://www.youtube.com/watch?v=aER2ExobzDU  Video of a Coanda saucer
http://www.youtube.com/watch?v=ggUIJDgkSSs  Video of a large Coanda saucer
http://www.youtube.com/watch?v=sdGV17kJId0  Another video

References

Dots • through ***** indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages

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• Turpin, J. L., “Use of streaming potential measurements for an investigation of the Coanda effect,” Physics of Fluids, 15, No. 6, 968-971 (June 1972)
• Walker, J., "The troublesome teapot effect, or why a poured liquid clings to the container," in “The Amateur Scientist,” Scientific American, 251, No. 4, 144-152 (October 1984)

Related references

2.51 Teapot effect

The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

References

Dots • through ⬁ indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)

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Reba, I., “Applications of the Coanda effect,” Scientific American, 214, 84-92 (June 1966)

Walker, J., ”The troublesome teapot effect, or why a poured liquid clings to the container,” in “The Amateur Scientist,” Scientific American, 251, No. 4, 144-152 (October 1984)


Related reference

2.52  Ascents after deep diving

The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

References

Dots • through ••• indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages

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• Elliott, D. H., “Man underwater 3: His return to the surface,” Underwater Science and Technology Journal, 2, 4-10 (March 1970)
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• Vann, R. D., P. Denoble, M. N. Emmerman, and K. S. Corson, “Flying after diving and decompression sickness,” Aviation, Space, and Environmental Medicine, 64, No. 9, 801-807 (September 1993)

Related references

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• Lam, T. H., and K. P. Yau, “Manifestations and treatment of 793 cases of decompression sickness in a compressed air tunneling project in Hong Kong,” Undersea Biomedical Research, 15, No. 5, 377-388 (September 1988)
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• Andersen, H. L., “Decompression sickness during construction of the Great Belt Tunnel, Denmark,” Undersea and Hyperbaric Medicine, 29, No. 3, 172-188 (fall 2002)

2.53  Snorkeling by people and elephants

The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

http://www.youtube.com/watch?v=ywXYfLFapLY Video of swimming elephants, shot from underwater

http://www.youtube.com/watch?v=9M1CVLK8150 Snorkling elephants

http://www.elephantnaturepark.org/news/0509b.htm

http://img2.travelblog.org/Photos/10149/53705/f/302193-Swimming-Elephant-0.jpg

References

Dots ● through ●●● indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages

● Mackay, R. S., “To determine the greatest depth in water at which one can breathe through a tube,” American Journal of Physics, 16, 186-187 (1948)


● West, J. B., “Why doesn’t the elephant have a pleural space?” News in Physiological Sciences, 17, 47-50 (2002)

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2.54 Deep diving, submarine escape


The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

http://www.youtube.com/watch?v=9m5jMXOg4MY Video of the Submarine Escape Training Tank.

References

Dots ● through ●●● indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages


2.55 Lake Nyos disaster

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://www.waterencyclopedia.com/images/wsci_02_img0296.jpg Photos of the lake and scores of dead animals
http://globalchange.umich.edu/globalchange1/current/lectures/kling/killer_lakes/nyos.jpg Photo of the lake

References
Dots through ●●● indicate level of difficulty
Journal reference style: author, title, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages


- Freeth, S. J., “Incident at Lake Nyos. Tracking the source of deadly cloud of gas,” The Sciences, 32, No. 3, 30-36 (May/June 1992)
2.56 Short Story: House-hopping, and riding the skies in a lawn chair


The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://www.youtube.com/watch?v=bVq0u1BTGgE Car floated with helium balloons, breaks free and floats away. Is this real?
http://www.youtube.com/watch?v=PeJibXrE9g4&NR=1 No, of course it is not real.
http://www.youtube.com/watch?v=JQ1GlwPrrBi&NR=1 Again, it is not real
http://www.news.com.au/dailytelegraph/story/0,22049,22055031-5012895,00.html Note that there are multiple images available.
http://www.youtube.com/watch?v=XDoix7MjLgs floating across the English Channel, television item
References
Dots • through ●●● indicate level of difficulty
Journal reference style: author, title, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages
• Faber, J., Great News Photos and the Stories behind Them, second revised edition, Dover, 1978, pages 76-77
• Patiky, M., "Balloon man vs. the Feds: Larry Walters fulfilled his impossible dream and found the FAA at his doorstep," Air Progress, 45, 25 + 57-63 (May 1983)

Related:

2.57 Flow of medieval cathedral window glass
The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

Comments

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Book reference style: author, title, publisher, date, pages
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2.58 Strange viscous fluids
The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

Barcelona video on YouTube
http://www.youtube.com/watch?v=f2XQ97XHjVw
http://www.mie.utoronto.ca/labs/rheology/objectives.html Photo plus discussion
Video of waves on a oscillating corn-starch slurry; holes pushed into the slurry remain and fingers can rise out of the slurry.

Video: Fingers grow out of an oscillating corn-starch slurry

Video: swelling of liquid upon emergence, the rod-climbing effect, and the leaping effect

Swelling of liquid upon emergence

Tubeless siphon

References

Dots through ●●● indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages


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  • Bachofer, S. J., “Viscoelastic surfactant solutions: a demo to catch the student’s attention,” Journal of Chemical Education, 67, No. 9, 790-791 (September 1990)
  • Garlaschelli, L., F. Ramaccini, and S. D. Sala, “A ‘miracle’ diagnosis. Several times each year, a large crowd of people gathers in the cathedral in Naples to witness the miraculous liquefaction of the ‘blood’ of St. Januarius. A team of Italian researchers has now arrived at a more scientific explanation for this phenomenon,” Chemistry in Britain, 30, No. 2, 123-125 (February 1994)
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  • Bermudez, V. de Z., P. P. de Almeida, and J. F. Seita, “How to learn and have fun with poly(vinyl alcohol) and white glue,” Journal of Chemical Education, 75, No. 11, 1410-1418 (November 1998)
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Related reference
• Epstein, M. S., “Using bad science to teach good chemistry,” Journal of Chemical Education, 75, No. 11, 1399-1404 (November 1998)
2.59 Soup reversal

The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

References

- Dots ● through +++ indicate level of difficulty
- Journal reference style: author, title, journal, volume, pages (date)
- Book reference style: author, title, publisher, date, pages


2.60 Bouncing liquid stream

The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

Videos

- [http://www.youtube.com/watch?v=IrVlq2AgwvA](http://www.youtube.com/watch?v=IrVlq2AgwvA) Kaye effect and rope coiling, excellent video
- [http://www.youtube.com/watch?v=nX6GxoicneY](http://www.youtube.com/watch?v=nX6GxoicneY) Video: swelling of liquid upon emergence, the rod-climbing effect, and the leaping effect
- [http://www.youtube.com/watch?v=wmUx-1o3Lzs](http://www.youtube.com/watch?v=wmUx-1o3Lzs) Kaye effect

Photo

- [http://chaos.ph.utexas.edu/~thrasher/research/genfluid.html](http://chaos.ph.utexas.edu/~thrasher/research/genfluid.html) Click on the photo.

References

- ● through +++ indicate level of difficulty
- Journal reference style: author, title, journal, volume, pages (date)
- Book reference style: author, title, publisher, date, pages


2.61 Rod-climbing fluids


The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://www.youtube.com/watch?v=npZzlgKjs0I  Video of the rod-climbing effect, really good
http://www.youtube.com/watch?v=nX6GxoiCneY Video: swelling of liquid upon emergence, the rod-climbing effect, and the leaping effect
http://web.mit.edu/nnf/research/phenomena/rodclimbing.html    Discussion plus videos. Click on the video options
http://www.mie.utoronto.ca/labs/rheology/objectives.html  Photo plus discussion

References

Dots • through ⋆⋆⋆ indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages


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2.62 Liquid rope coils


The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

http://www.youtube.com/watch?v=rEkuhC9eJlM Excellent video
http://www.youtube.com/watch?v=IrVlq2AgwyA Kaye effect and rope coiling, excellent video

References

2.63 Water waves

References
Dots • through ⚫⚫⚫ indicate level of difficulty
Journal reference style: author, title, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages

2.64 Extreme and rogue waves

Photos:
http://www.math.uio.no/~karstent/waves/index_en.html The photos embedded in the article may be slow to load, so be patient.
http://www.ifremer.fr/metocean/conferences/rogue_wave.htm Click on the photo to get an enlarged version
http://www.opc.ncep.noaa.gov/perfectstorm/rogue_wave2.jpg
http://www.msnbc.msn.com/id/5491071/ Photo plus description

References
Dots • through ⚫⚫⚫ indicate level of difficulty
Journal reference style: author, title, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages
- Bascom, W., “Ocean waves,” Scientific American, 201, No. 2, 75-84 (August 1959)
- Bascom, W., Waves and Beaches, Anchor Books, 1980, pages 58-65


Rozhkov, S. S., “Giant freak waves: Expect the unexpected,” EPL (Europhysics Letters), 85, article # 24001 (6 pages) (2009)


Related references


2.65 Waves turning to approach a beach


The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

References

Dots • through ••• indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages


### 2.66 Waves passes through a narrow opening


The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

http://video.google.com/videoplay?docid=6794478653908381414&q=DIFFRACTION&hl=en Video of water waves diffracting through a narrow opening

http://www.math.uio.no/~karstent/waves/index_en.html Aerial shot of ocean waves diffracting through an opening. The photos embedded in the article may be slow to load, so be patient.

#### References

- Journal reference style: author, title, journal, volume, pages (date)
- Book reference style: author, title, publisher, date, pages

### 2.67 Seiches and sloshes


The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

http://www.ireport.com/docs/DOC-21467

http://henrykisor.com/blog/2006/12/15/todays-mystery-writing-term-seiche/ Photos, before and during a seiche

#### References

- Journal reference style: author, title, journal, volume, pages (date)
- Book reference style: author, title, publisher, date, pages
Wright, B. L., “Exciting pools,” Physics Teacher, 13, 275-278 (May 1975)
Bascom, W., Waves and Beaches, Anchor Books, 1980, pages 104-111

Related reference

2.68 Wakes of ducks and aircraft carriers
The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://www.eng.vt.edu/fluids/msc/gallery/gall.htm  Photo of wake of aircraft carrier. Click on the various buttons to get other photos, including one from the Virginia Tech duck pond.
http://www.ifm.uni-hamburg.de/ers-sar/Sdata/oceanic/shipwakes/intro/index.html
http://www.ifm.uni-hamburg.de/ers-sar/Sdata/oceanic/shipwakes/intro/index.html  Photo plus description
http://www.docksidereports.com/dangerous_ship_wakes.htm  The danger of a smaller boat in the wake of a large ship

References

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●●● Chung, Y. K., “Bow wave patterns,” AIAA Journal, 21, No. 6, 909-911 (June 1983)


●●● Crawford, F. S., “Elementary derivation of the wake pattern of a boat,” American Journal of Physics, 52, No. 9, 782-785 (September 1984)


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Related references

2.69 Surfing

http://www.youtube.com/watch?v=hDW_fe0WTH8&feature=related  Huge wave
http://www.youtube.com/watch?v=WcEgnX-w3gg&mode=related&search=  Surfing and Jimi Hendrix, can life get any better?
http://www.youtube.com/watch?v=pFkSzJ0khgk  Way cool video
http://www.youtube.com/watch?v=s0Pw7vKtgpo  Laird Hamilton surfing
http://www.youtube.com/watch?v=V4Rowo06XeI  Video

References

Dots ⋆ through ⋆⋆⋆ indicate level of difficulty
Journal reference style: author, title, journal, volume, pages (date)
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- Krakauer, J., “Gidget has grown up, but surfing is still a ‘totally happening’ sport,” Smithsonian, 20, 106-119 (June 1989)

2.70 Porpoise and dolphin motion

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

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Book reference style: author, title, publisher, date, pages

• Hayes, W. D. (letter), and (reply) P. F. Scholander, “Wave-riding dolphins,” Science, 130, 1657-1658 (11 December 1959)
• Pennisi, E., “Drafting dolphins ride the wakes with ease,” Science News, 143, 149 (7 March 1992)

Related reference

2.71 Edge waves

The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

**References**

Dots • through ⬤ indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages


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⬤ Apfel, R. E., “‘Whispering’ waves in a wineglass,” American Journal of Physics, 53, No. 11, 1070-1073 (November 1985)


2.72 Beach cusps

The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

http://aslo.org/photopost/data/506/7Reflective_beach.jpg Photo
http://www.soton.ac.uk/~imw/jpg-Worbarrow/3WB-south-cusp.jpg Photo
http://www.geog.sussex.ac.uk/BAR/images/Kent/sandwich_bay/04140014.jpg Photo: Can you see the cusps left in the debris?

References


Related references


2.73 Oil and waves


The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://www.youtube.com/watch?v=00PPPt7EJjo Watch the waves disappear after the sunflower oil is put onto the water.

References

Dots • through ⬤ indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)

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Rayleigh, Lord, “Measurements of the amount of oil necessary in order to check the motions of camphor upon water,” Proceedings of the Royal Society, 47, 364-367 (March 1890)


Franklin, Benjamin, The Papers of Benjamin Franklin, Vol. 20, Yale University Press, 1976 reprint of papers, pages 463-474


Clark, R. W., Benjamin Franklin: a Biography, Random House, 1983, pages 136-137


Related references


2.74 Floating drops


The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

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Book reference style: author, title, publisher, date, pages


Walker, J., “Drops of liquid can be made to float on the liquid. What enables them to do so?” in “The Amateur Scientist,” *Scientific American*, 238, No. 6, 151-158 (June 1978)


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2.75 Splashing drops
The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://www.makezine.com/04/strobe/index.csp?page=last&x-order=date Splash photo
http://www.stanford.edu/~jrdx/fluids.html Scroll down to the two splashing-drop photos

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Dots • through ●●● indicate level of difficulty
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• Bussmann, M., S. Chandra, and J. Mostaghimi, “Modeling the splash of a droplet impacting a solid surface,” Physics of Fluids, 12, No. 12, 3121-3132 (December 2000)
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Related references
• Thoroddsen, S., and A.Q. Shen, “Granular jets,” Physics of Fluids, 13, No. 1, 4-6 (January 2001)

2.76 Bubbles in soda, beer, and champagne

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

Here is a link on the book’s discussion of the fact that bubbles in a freshly poured glass of Guinness stout move down the side of the glass.
http://www.youtube.com/watch?v=CZqR8PKhunY  Bubbles move downward in a glass of espresso
http://www.youtube.com/watch?v=-X30NAc8khc  Video of Guinness bubbles
http://www.straightdope.com/classics/a4_198.html  Cecil Adam’s “Straight Dope” column, about whether tapping the side of a shaken can of beer does any good.

http://www.youtube.com/watch?v=n_H5ZIoZSBo&mode=related&search= Video showing how mechanical disturbance to a supercooled beer causes rapid freezing. Way cool!
http://www.youtube.com/watch?v=4xTHSf112BY&NR=1  Similar
http://www.youtube.com/watch?v=KqQu7wIOYWU&mode=related&search=  Rapid freezing of beer

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• Cordry, S. M., “Finicky clay divers,” Physics Teacher, 36, 82-83 (February 1998)


Zhang, Y., and Z. Xu, “‘Fizzics’ of bubble growth in beer and champagne,” Elements, 4, 47-49 (February 2008)


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Crawford, F. S., “Hot water, fresh beer, and salt,” American Journal of Physics, 58, No. 11, 1033-1036 (November 1990)

2.77 Soap bubbles and beer foams

The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

http://www.youtube.com/watch?v=PLtrByKcClw&mode=related&search= pouring a Guinness to decrease the bubbles

References

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Journal reference style: author, title, journal, volume, pages (date)
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• Stong, C. L. “How to blow soap bubbles that survive for years,” in “The Amateur Scientist,” Scientific American, 229, No. 1, 110-115 + 122 (July 1973)
• Astarita, G., “I get no thick from champagne,” Physics Today, 45, No. 7, 91 (July 1992)
• Lubetkin, S. D., “The fundamentals of bubble evolution,” Chemical Society Reviews, 24, No. 4, 243-250 (August 1995)
• Vandewalle, N., and J. F. Lentz, “Cascades of popping bubbles along air/foam interfaces,” Physical Review E, 64, article # 021507 (4 pages) (July 2001)


Related references


Ross, S., “Cohesion of bubbles in foam,” American Journal of Physics, 46, No. 5, 513-516 (May 1978)


2.78 Bursting bubbles

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://www.youtube.com/watch?v=Cq6gv3woh58 Slow motion video of a water balloon burst at knife point. Watch the way the balloon pulls away from the initial rip.

http://www.youtube.com/watch?v=n3g5MKeqBwI&mode=related&search Slow motion video of water balloon burst by a fist strike

http://www.pulsephotonics.com/gallery.htm Photos of bursting balloon

http://www.makezine.com/04/strobe/index.csp?page=last&x-order=date Popping a balloon

References

Dots ★ through ★★★ indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages


★★ Debregeas, G., P. Martin, and F. Brochard-Wyart, “Viscous bursting of suspended films,” Physical Review Letters, 75, No. 21, 3886-3889 + Fig. 1 and Fig. 2 (20 November 1995)


2.79 Whales and bubble nets


The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

[http://video.google.com/videoplay?docid=7420209913897323484&q=bubble+nets&hl=en](http://video.google.com/videoplay?docid=7420209913897323484&q=bubble+nets&hl=en) Video of whales make a bubble net and then feeding on the fish trapped in the net.

[http://www.isvr.soton.ac.uk/fdag/UAUA/RESEARCH/Whales/front%20page%20to%20whales_3.htm](http://www.isvr.soton.ac.uk/fdag/UAUA/RESEARCH/Whales/front%20page%20to%20whales_3.htm) Discussion. Note the aerial photo where we can see a bubble net set up by whales to trap prey.

[http://www.isvr.soton.ac.uk/FDAG/UAUA/RESEARCH/echolocation%20and%20bubbles/echolocation%20and%20bubbles%201.htm](http://www.isvr.soton.ac.uk/FDAG/UAUA/RESEARCH/echolocation%20and%20bubbles/echolocation%20and%20bubbles%201.htm) Discussion and many photos, showing dolphins using bubble nets to herd fish.

References


Related reference


**Videos**

Go to [http://www.gumfrog.com/dailyplanet](http://www.gumfrog.com/dailyplanet) and use
Username: previewguest
**Password:** d1sc0very
I suggest that you click the box that allows the computer to remember this information (or you may have to enter it several times)
Go to March 17, 2008 and choose “Waterbots” (water striding robots)

- [http://www-math.mit.edu/~dhu/Press/Press03/MIT%20leaps%20to%20solution%20of%20walking-on-water%20mystery.htm](http://www-math.mit.edu/~dhu/Press/Press03/MIT%20leaps%20to%20solution%20of%20walking-on-water%20mystery.htm) Description and videos of a water strider and the robostrider (mechanical water strider) that is described in *The Flying Circus*
- [http://www.youtube.com/watch?v=0jMpuZVyKCI&mode=related&search=](http://www.youtube.com/watch?v=0jMpuZVyKCI&mode=related&search=) Video of striders
- [http://www.youtube.com/watch?v=mAahPBwV8wo&NR=1](http://www.youtube.com/watch?v=mAahPBwV8wo&NR=1) Note how the water bug responds to the waves
- [http://www.youtube.com/watch?v=KrUAzh0k3m0](http://www.youtube.com/watch?v=KrUAzh0k3m0) Paper clip floating on water
- [http://www.youtube.com/watch?v=47UVFtT12Ws](http://www.youtube.com/watch?v=47UVFtT12Ws) Objects floating via surface tension
- [http://www.youtube.com/watch?v=0jMpuZVyKCI](http://www.youtube.com/watch?v=0jMpuZVyKCI) Water strider
- [http://www.youtube.com/watch?v=756Tk9y0aN6](http://www.youtube.com/watch?v=756Tk9y0aN6) Water strider robot
- [http://www.youtube.com/watch?v=k310d_egebFk](http://www.youtube.com/watch?v=k310d_egebFk) Water striders jumping from water

**Photos**

- [www.aip.org/png/2005/236.htm](http://www.aip.org/png/2005/236.htm) A demonstration of floating via surface tension
  coin floating on water
- [http://www.fishpondinfo.com/insect3.htm](http://www.fishpondinfo.com/insect3.htm) Scroll down to the water strider photo

**References**

Dots • through ••• indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages


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• Wilcox, R. S., “Sex discrimination in *Gerris remigis*: role of a surface wave signal,” Science, 206, 1325-1327 (14 December 1979)
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Related reference


2.81 Beading on rods and saliva threads


The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

References

Dots • through ⋆stellar indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)

Book reference style: author, title, publisher, date, pages

2.82 Rain harvesting by desert lizards


The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

http://www.physorg.com/news69602541.html  Photo plus news story

References


2.83 Prey harvesting by shorebirds


The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

Comments
References

Dots ● through ★★★ indicate level of difficulty
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Book reference style: author, title, publisher, date, pages

● Rubega, M. A., “Surface tension prey transport in shorebirds: how widespread is it?” Ibis, 139, No. 3, 488-493 (July 1997)

2.84 Drops and liquid films on solid surfaces


The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

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Thompson, P., and M. Robbins, “To slip or not to slip? Computer simulations of the dynamics of fluid molecules have circumvented the inability of hydrodynamics to explain how fluids spread,” Physics World, 3, No. 11, 35-38 (November 1990)
Related references

- “Chemical tug can make water flow uphill,” Science News, ??, 391 (13 June 1992)

2.85 Breakfast cereal pulling together


The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

To see me on television, go to [http://www.gumfrog.com/dailyplanet](http://www.gumfrog.com/dailyplanet) and use Username: previewguest

Password: d1sc0very (note the two numbers)

I suggest that you click the box that allows the computer to remember this information (or you may have to enter it several times)

Choose Jan 2008. Scroll down to Jan 30 / 08. Click on "Fact of the Matter - Cereal"

[http://www-math.mit.edu/~dhu/Press/Press03/MIT%20leaps%20to%20solution%20of%20walking-on-water%20mystery.htm](http://www-math.mit.edu/~dhu/Press/Press03/MIT%20leaps%20to%20solution%20of%20walking-on-water%20mystery.htm)     Description and videos of a water strider and the robostrider (mechanical water strider) that is described in *The Flying Circus*
http://capillaryteam.pbwiki.com/General+Information  Self-assembly of floating objects using the Cheerios effect  
www.aip.org/png/2005/236.htm  A demonstration of floating via surface tension

References

Dots • through ●●● indicate level of difficulty
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Book reference style: author, title, publisher, date, pages

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●●● Vella, D., and L. Mahadevan, “The ‘Cheerios effect,” American Journal of Physics, 73, No. 9, 817-825 (September 2005) Go to http://www.damtp.cam.ac.uk/user/dv211/cheerios.html and then click on the button that offers a PDF file.
● Froehle, P., (letter) “Quick way to float a paper clip on water,” Physics Teacher, 46, No. 2, 70 (February 2008)

2.86 Sandcastles
The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

http://www.execkeys.com/images/Port%20Aransas%20Sandcastle.jpg  Photo

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● Smith, A. W. S., and A. C. Trembanis, “Beach harness variation --- new moisture related phenomenon and a case study from Byron Bay, Australia,” Journal of Coastal Research, 17, No. 4, 869-876 (fall 2001)

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• Vitz, E., “Magic Sand: modelling the hydrophobic effect and reversed-phase liquid chromatography,” Journal of Chemical Education, 67, No. 6, 512-515 (June 1990)


2.87 Appearance of bad coffee

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2.88 Tears of wine and other liquid surface play

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

Photos
http://www-math.mit.edu/~bush/tears.html
http://books.google.com/books?id=Sv8tAAAAIAAJ&pg=PA266&lpg=PA266&dq=tears+of+strong+wine&source=web&ots=WWonJ0MeA&sig=q6ByADdGiJwPCvQxZncgBRMv4Kw&hl=en&sa=X&oi=book_result&resnum=9&ct=result Encyclopaedia Britannica

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• Boys, C. V., Soap Bubbles, Doubleday Anchor Books, 1959, pages 39-44


Silverstein, T. P., “Polarity, miscibility, and surface tension of liquids,” Journal of Chemical Education, 70, No. 3, 253 (March 1993)


Related references


“Chemical tug can make water flow uphill,” Science News, ??, 391 (13 June 1992)


2.89 Tia Maria worm-like patterns


The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

[www.youtube.com/watch?v=b29nX-TRWzA](http://www.youtube.com/watch?v=b29nX-TRWzA) good video from New Scientist magazine where you can see the dynamic worm-like patterns

References


Related reference


2.90 Patterns in hot coffee and other fluids


The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

[http://jfi.uchicago.edu/~tten/Coffee.drops/](http://jfi.uchicago.edu/~tten/Coffee.drops/) Photo plus discussion (click on the button)

References

- Block, M. J., “Surface tension as the cause of Benard cells and surface deformation in a liquid film,” Nature, 178, No. 4534, 650-651 (22 September 1956)


Walker, J., "Wonders of physics that can be found in a cup of coffee or tea," in “The Amateur Scientist,” Scientific American, 237, No. 5, 152-160 (November 1977)


Related reference


2.91 Patterns in coffee stains


The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://jfi.uchicago.edu/~tten/Coffee.drops/ Photo plus discussion (click on the buttons)

References

Dots ● through ●●● indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)

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Iveson, S. M., and K. M. Awati, “On the formation of salt rings,” unpublished (Department of Chemical Engineering, University of Queensland, St. Lucia, Queensland 4072, Australia), 1996


Lin, Z., and S. Granick, “Patterns formed by droplet evaporation from a restricted geometry,” Journal of the American Chemical Society, 127, 9, 2816-2817 (9 March 2005)


Related references


2.92 Breath figures


The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

References

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Baker, T. J., “Breath figures,” Philosophical Magazine, 44, 752-765 (1952)


Fritter, D., C. M. Knobler, and D. A. Beysens, “Experiments and simulation of the growth of droplets on a surface (breath figures),” Physical Review A, 43, No. 6, 2858-2869 + Fig. 1 (15 March 1991)


Related reference

2.93 The lotus effect

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http://nanoarchitecture.net/images/211.jpg  Water drops beaded up on a lotus leaf

References

• Courbin, L., and H. A. Stone, “Your wetting day,” Physics Today, 60, No. 2, 84-85 (February 2007)
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• Mahadevan, L., and Y. Pomeau, “Rolling droplets,” Physics of Fluids, 11, No. 9, 2449-2453 (September 1999)

2.94 Aphids and liquid marbles
The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

References
Related references

- Mahadevan, L., and Y. Pomeau, “Rolling droplets,” Physics of Fluids, 11, No. 9, 2449-2453 (September 1999)

2.95 Paint brushes, wet hair, and dunking cookies


The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://www.sxc.hu/pic/m/m/ma/marinela/519356_wet_hair_2.jpg Photo

References

Dots • through ⭐⭐⭐ indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages

⭐ Chiodi, F., B. Roman, and J. Bico, “Piercing an interface with a brush: Collaborative stiffening,” Europhysics Letters, 90, article #44006 (6 pages) (2010)

2.96 Deep-fat frying of potatoes


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References

Dots • through ⭐⭐⭐ indicate level of difficulty

Journal reference style: author, title, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages
2.97 Ducks stay dry

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://images.worldofstock.com/slides/NBI2614.jpg  Photo

References


2.98 Cut potatoes, bird droppings, and a car

References

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**●** Berry, M. V., “The molecular mechanism of surface tension,” Physics Education, 6, 79-83 (1971)


2.99 Catapulting mushroom spores

http://www.herbarium.usu.edu/fungi/FunFacts/Dispersal.htm Scroll down to the last item

References

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- Vogel, S., “Living in a physical world III. Getting up to speed,” Journal of Biosciences, 30, No. 3, 303-312 (June 2005)

Related reference

2.100 Waves on a falling stream

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References
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- Book reference style: author, title, publisher, date, pages
2.101 Water bells, sheets, and chains


The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://www.huntington.org/Information/ChildrensGarden.htm Scroll down to the children
http://www.uh.edu/engines/waterbell.jpg Photo
http://www.uh.edu/engines/epi1598.htm John Lienhard essay
http://timgodsgraphics.homestead.com/Water_Bell_Published.jpg Photo water bell
http://www.fountainkinetics.com/examples/examples.html Photos plus discussion

References

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- Book reference style: author, title, publisher, date, pages

Fluids 115

• Shakerin, S., “Water fountains with special effects,” American Scientist, 93, No. 5, 444-451 (September-October 2005)

Related references

2.102 Stepping on a wet beach and into quicksand

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://www.youtube.com/watch?v=s0OXGxop3DI quicksand at a beach
http://www.youtube.com/watch?v=B_qRh5Y-hO8 Video of stepping onto wet sand and squeezing a plastic bottle of wet sand
http://www.inspirationline.com/Brainteaser/quicksand.htm Photo plus description
References

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Book reference style: author, title, publisher, date, pages

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• Kruszelnicki, K., “…The Earth did swallow them up!” New Scientist, ??, 27-29 (21/28 December 1996)

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2.103 Collapse of buildings and a freeway


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• Hough, S. E., “Constraining sediment thickness in the San Francisco Bay area using observed resonances and P-and-S conversions,” Geophysical Research Letters, 17, No. 9, 1469-1472 (August 1990)
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Ortega, R., R. B. Herrmann, and L. Quintanar, “Earthquake ground-motion scaling in central Mexico between 0.7 and 7 Hz,” Bulletin of the Seismological Society of America, 93, No. 1, 397-413 (February 2003)


Related references


2.104 Short story: Quicksand effect with grain


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http://www.youtube.com/watch?v=J_fOmbvnR8k  Video dry quicksand (sand liquefaction)

References

Dots ● through ●●● indicate level of difficulty
Journal reference style: author, title, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages


2.105 Pedestrian flow and escape panic


The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

References

Dots ● through ●●● indicate level of difficulty
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Book reference style: author, title, publisher, date, pages


Related reference

Chowdhury, D., K. Nishinari, and A. Schadschneider, “Self-organized patterns and traffic flow in colonies or organisms: from bacteria and social insects to vertebrates,” Phase Transitions, 77, Nos. 5-7, 601-624 (July 2004)
2.106 Sandpiles and self-organizing flow

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References

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- Kakalios, J., “Resource letter GP-1: Granular physics or nonlinear dynamics in a sandbox,” American Journal of Physics, 73, No. 1, 8-22 (January 2005)

Related references

2.107 Flows in hourglasses and silos

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://iusti.polytech.univ-mrs.fr/~gep/instability.html Video: watch the waves in the granular material flowing down the slanted plane

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Dots • through ⚫ indicate level of difficulty

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Book reference style: author, title, publisher, date, pages


Ristow, G. H., Pattern Formation in Granular Materials, Springer, 2000, page 71


Kakalios, J., “Resource letter GP-1: Granular physics or nonlinear dynamics in a sandbox,” American Journal of Physics, 73, No. 1, 8-22 (January 2005)


Related references

2.108 Brazil-nut effect and oscillating powders


Videos

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http://www.youtube.com/watch?v=2JqYyvR55_E&feature=related simulation, rough bodies

http://www.youtube.com/watch?v=sY6z2hLgYuY Oscillating power part 1

http://www.youtube.com/watch?v=kWadDf1FPN4&mode=related&search= Oscillating power part 2

http://www.youtube.com/watch?v=3csi-2Hrzhg&mode=related&search= Oscillating power part 3

http://www.youtube.com/watch?v=bAmjRK9wBA&NR=1 Oscillating power part 4

School activity

http://www.raft.net/ideas/Brazil%20Nut%20Effect.pdf

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References

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Book reference style: author, title, publisher, date, pages

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2.109 Avalanche balloon


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http://www.alpintravel.ch/d_reisen/bild.cfm?BilderID=811&ID=118&History=kurzbeschrieb.cfm&Search=berg  Photo
http://www.slf.ch/lmstein/lmstein-projects-en.html  Photo and discussion; scroll to the bottom
http://www.ur.co.nz/avalanche/equipment.htm  Sketch plus discussion

References

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• Radwin, M. I., C. K. Grissom, “Technological advances in avalanche survival,” Wilderness and Environmental Medicine, 13, No. 2, 143-152 (summer 2002)

Related references

2.110 Sand ripples and movement

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http://www.youtube.com/watch?v=N9hyL79pSPI    Underwater sand ripples
http://www.youtube.com/watch?v=yP9I1JY4PNA     Sand ripples
http://www.marsartgallery.com/s_sandsofmars.html  Sand ripples on Mars

References

Dots ● through ●●● indicate level of difficulty
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Book reference style: author, title, publisher, date, pages
●●● Nishimori, H., and N. Ouchi, “Formation of ripple patterns and dunes by wind-blown sand,” Physical Review Letters, 71, No. 1, 197-200 (5 July 1993); correction: Figure 1(b) on page 199 should be rotated by 180°
2.111 Sand dunes


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[http://www.nature.com/nature/journal/v437/n7059/fig_tab/nature04058_F1.html](http://www.nature.com/nature/journal/v437/n7059/fig_tab/nature04058_F1.html)  Sketches and discussion, from article in Nature

References

- Belser, B., “Bagnold of the dunes,” Science 82, 3, 30-35 + 103 (March 1982)
• Tsoar, H., “Linear dunes—forms and formation,” Progress in Physical Geography, 13, No. 4, 507-528 (December 1989)
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Related reference

2.112 Yardangs and other sand cuttings

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2.113 Snow fences and wind deposits

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http://instaar.colorado.edu/tundracam/img_gallery3/snow_fence_in_action.jpg Photo
http://instaar.colorado.edu/tundracam/img_gallery3/snow_fence_in_action.jpg Photo of buried sand fence
http://people.ucsc.edu/~mloik/scapphotos.htm Photos
http://www.unl.edu/nac/aug94/snowfences/snowfence.html Discussion

References

Dots • through ⋅⋅⋅ indicate level of difficulty
Journal reference style: author, title, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages


Related references

2.114 Snow avalanches

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://www.youtube.com/watch?v=6qVwluznFW0 Video of skier who causes an avalanche, which then sweeps down the cameraman
http://www.youtube.com/watch?v=Z2L_3QIEgiI&mode=related&search= Video: snowboarder triggers an avalanche
http://www.youtube.com/watch?v=BORWLxOFGLY&mode=related&search= Video of avalanches
http://www.youtube.com/watch?v=JhUhhbiNHis&mode=related&search= Video of snowboarder; very, very dangerous: racing with an avalanche. Music by Wolfmother (one of my favorite groups)

References
Dots ● through ●●● indicate level of difficulty
Journal reference style: author, title, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages

2.115 Long-runout landslides


http://www.youtube.com/watch?v=f19Onak6KC0  Japan landslide shot from just to the side of the slide. Scarry stuff.
http://www.ireap.umd.edu/granular/avalanche/welcome.html  Photos and discussion
http://www.eos.ubc.ca/research/landslides/landslides_files/image003.gif  Photo

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Melosh, H. J., “The physics of very large landslides,” Acta mechanica, 64, Nos. 1-2, 89-99 (December 1986)
• Abele, G., “Large rockslides: their causes and movement on internal sliding planes,” Mountain Research and Development, 14, No. 4, 315-320 (1994)
• Chiou, M.-C., Y. Wang, and K. Hutter, “Influence of obstacles on rapid granular flows,” Acta Mechanica, 175, 105-122 (2005)

Related references

2.116 Rockfalls

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http://www.physicalgeography.net/fundamentals/10x.html Discussion plus photos
http://virtual.yosemite.cc.ca.us/ghayes/happy.htm Happy Isles rockfall site
http://seismo.berkeley.edu/events_of_interest/yosemite/eoi_yos.html Rockfall site

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Dots • through ●●● indicate level of difficulty
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Book reference style: author, title, publisher, date, pages
• Day, R. W., “Case studies of a rockfall in soft versus hard rock,” Environmental & Engineering Geoscience, 3, No. 1, 133-140 (spring 1997)
Fluids 138


Related references

2.117 Fluttering flags and ribbons

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://www.youtube.com/watch?v=GqvfgQo_Gs0 Flapping toilet paper as rolls are thrown through the air (well, actually many rows)

References
  Dots • through ●●● indicate level of difficulty
  Journal reference style: author, journal, volume, pages (date)
  Book reference style: author, title, publisher, date, pages
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2.118  Fluttering fountains and pounding waterfalls


The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

References

Dots • through ⬤ indicate level of difficulty
2.119 Pulsating fountains

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

References
Dots • through ⋄ indicate level of difficulty
Journal reference style: author, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages


2.120 Pouring: inverted glass, yard-of-ale

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.


References
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Journal reference style: author, title, journal, volume, pages (date)
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ﭙ Soltzberg, L. J., “Far from equilibrium---the continuous-flow bottle,” Journal of Chemical Education, 64, No. 2, 147-152 (February 1987)
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Fluids 141


Solbrig, C. W., and J. B. Sherman, “Slugging flow of water draining from the bottom of a nonvented container,” Industrial Engineering Chemical Research, ??

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• Field, R. J., “Chemical organization in time and space,” American Scientist, 73, 142-150 (March-April 1985)

2.121 Dripping

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://commons.wikimedia.org/wiki/Image:Dripping_faucet_1.jpg Photo

References
Dots • through ••• indicate level of difficulty
Journal reference style: author, title, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages
Fluids 142


2.122 Soap bubble shapes

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://homepage.mac.com/keithmjohnson/BubbleArtist.com/  Homepage for Keith Johnson
http://www.youtube.com/watch?v=I0oVdXWjnsc  Video
http://www.youtube.com/watch?v=0g5w05UwmQI&mode=related&search=  Video
http://www.youtube.com/watch?v=xxzKH0N3QlM&mode=related&search=  Video

References

2.123 Bubble paths


The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

References

- dots • through ●●● indicate level of difficulty
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- Book reference style: author, title, publisher, date, pages

- ●●● Vermillion, R. E., “A look at some rising bubbles,” American Journal of Physics, 43, No. 2, 177-179 (February 1975)
• Wu, M., and M. Gharib, “Experimental studies on the shape and path of small air bubbles rising in clean water,” Physics of Fluids, 14, No. 7, L49-L52 (July 2002)

2.124 Antibubbles

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://www.youtube.com/watch?v=6r_8Pp9WkF0 Video
http://www.uvm.edu/~dahammon/whatsnew/whatsnew01.html Photos plus links to videos
http://www.irishscientist.ie/2005/contents.asp?contentxml=05p114b.xml&contentxsl=is05pages.xsl Photo plus discussion

References
Dots • through ••• indicate level of difficulty
Journal reference style: author, title, journal, volume, pages (date)
Book reference style: author, title, publisher, date, pages
• Skogen, N., “Inverted soap bubbles—a surface phenomenon,” American Journal of Physics, 24, 239-241 (1956)

Related reference

### 2.125 Lifting rice with a rod


The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

**References**


Related reference

### 2.126 Throwing a discus


The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

http://www.youtube.com/watch?v=BQ0eFINbsgM  Video

**References**

2.127 Javelin throw

The material here is located at www.flyingcircusofphysics.com and will be updated periodically.

http://www.youtube.com/watch?v=qjf-S1cZ4q8 Video

References

Dots • through ●●● indicate level of difficulty

Journal reference style: author, journal, volume, pages (date)

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Sing, R. F., *The Dynamics of the Javelin Throw*, Reynolds Publisher, 1984


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2.128 Two boats drawn together

The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

http://www.youtube.com/watch?v=1lxrLu_qio  Showing the same physics but with an air stream directed through the gap between two empty pop cans

References

2.129 Aerodynamics of cables and lines

The material here is located at [www.flyingcircusofphysics.com](http://www.flyingcircusofphysics.com) and will be updated periodically.

http://www.youtube.com/watch?v=i_MQ61vyaSM  Vortex shedding by a cylinder
http://www.youtube.com/watch?v=CB2aWiesq0g  Same here
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Related references


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2.132 Wave reflection by sand bars


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### 2.134 A salt oscillator


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2.135 Salt fingers and a salt fountain


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2.140 A pile of apples


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http://www.youtube.com/watch?v=bAmjK9wBA&NR=1 Chladni patterns part 4
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http://www.youtube.com/watch?v=teJ732tjFab8 Migrating powder
http://www.youtube.com/watch?v=G3s3wmr5EB4 Vibrating cinnamon powder
http://www.youtube.com/watch?v=qvNVd04znWc Large oscillations of powder
http://www.youtube.com/watch?v=WmxAQJ1VPA More migration of vibrated powder
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http://www.youtube.com/watch?v=rOfxTgapvjl  Pop bottle floating
http://www.youtube.com/watch?v=Vg-_nnYm7mw  Balloon
http://www.youtube.com/watch?v=vMA-wgdW3R0  Ball held in a water stream
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2.151 Oil stains on a road


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2.152 Patterns of water drops falling onto glycerin

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