

On the Cutting Edge: Professional Development for Geoscience Faculty Teaching Sedimentary Geology in the 21st Century

From Baseball, Beer, & Airplanes to Sedimentology: Teaching Students About Fluid Properties & Particle Transport

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Abstract

Fundamental principles of fluid properties and particle transport can be made more accessible for students by relating concepts and processes to common everyday events. For example, fluid viscosity can be related to the motion of bubbles in beer, fluid turbulence can be connected to baseball (specifically curve balls), and the entrainment of particles can be related to how planes take off. This poster includes a series of cartoons and short articles that can be used in any sedimentology classroom to teach these and other sediment transport concepts.

Laminar and Turbulent Flow

Source: "Hurling Toward Chaos", Elizabeth Svoboda, The Physics of WaterSlides, Discover, v.26, no.7, July 2005. Available online at: www.discover.com/issues/jul-05/departments/physics-of-waterslides/

The article from the in-flight magazine describes six different types of turbulence and includes diagrams showing wind currents. The Volkswagen Beetle in a wind tunnel illustrates how Cd (drag coefficient) is calculated and clearly shows streamlines converging over the 'beetle'. Both are used to help students learn about laminar and turbulent flow, the convergence of streamlines over an object resting on a bed, and the forces necessary to lift particles from the bed.



Why the Bumps?

The different types of turbulence

Soubresauts
Les différents types de turbulence

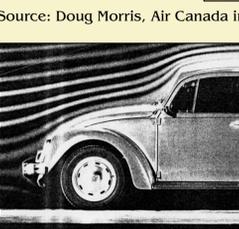
Three bumps sometimes experienced when flying are not caused by air pressure, as is commonly believed, actually air pockets do not exist. Sudden movements are caused by the turbulent conditions of the atmosphere that are irregular and chaotic. There are three different types of turbulence: clear air, clear air, and clear air. Each type of turbulence has its own characteristics and can be dangerous if not recognized and avoided in time.

Mechanical turbulence occurs when an aircraft encounters strong winds or rough terrain. It is caused by the friction of the air against the surface of the ground or the surface of the water. This type of turbulence is most common in the vicinity of mountains, hills, and other terrain features. It is characterized by sudden, irregular movements of the aircraft.

Wake turbulence is caused by the wingtip vortices of a large aircraft. These vortices are created by the pressure differential between the upper and lower surfaces of the wing. They can be dangerous to smaller aircraft flying in the same area.

Clear air turbulence is the most dangerous type of turbulence because it is invisible to the eye. It is caused by the interaction of air masses with different characteristics. It is characterized by sudden, irregular movements of the aircraft.

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Airplane

Source: Doug Morris, Air Canada in-flight magazine "Focus", May 1998, p.91-93.

Source: Volkswagen.

Terminal Velocity

Newspapers have recently reported that people have been killed by bullets fired up in the air that fall back to earth. Is this possible?

Jim Spencer, Lexington, Ky.

POINTING AND shooting a gun skyward endangers anyone in the area. Having gone up, a bullet must come down. How fast the projectile descends depends on its caliber, whether it tumbles or not, and if it falls nose- or blunt-ended first.

Forward at a typical muzzle velocity of about 2,700 feet per second, a bullet can climb two miles and remain in flight for more than a minute. As it falls, the bullet accelerates to a terminal velocity of 300 to 700 feet per second, at which point its aerodynamic drag equals the force of gravity and it can travel no faster.

Bullet velocity of 200 feet per second is sufficient to penetrate the human skull. Most of the random victims of shots aimed at the head, shoulders, or upper back.

Doctors at King/Trev Medical Center in Los Angeles have reported treating 118 people for falling bullet injuries from 1985 through 1992, 18 of whom died. Holiday weekend rescuers fired the shots.

Source: FYI column, Popular Science, Jan 1996, p. 76.

This short column reinforces the concept of terminal velocity when $F_d = F_g$, the conditions for applying Stokes Law of Particle Settling. While there are limitations in the application of Stokes Law, it is the equation commonly used to determine the settling rate for particles smaller than medium sand (~2 phi) and low Reynolds numbers.

Shape & Sorting of Sand



here's the dirt

Boutique composts and beautiful rocks make American Soil Products the talk of the town

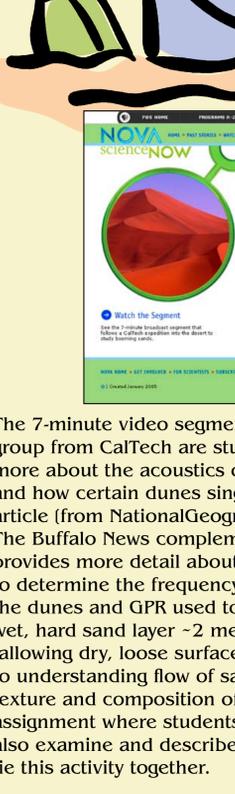
HERE IS DIRT, and there's nothing more to it than that. But for Allison Cook, it's a lot more than just dirt. She's a soil scientist at American Soil Products, a boutique compost and soil amendment company in Berkeley, California. She's also a soil scientist at the University of California, Berkeley, where she's studying the effects of soil on plant growth.

Cook and her colleagues at American Soil Products are working on developing a new type of soil amendment called "Bio-Soil". This soil is made from a combination of compost and biochar, which is a form of carbon that has been heated to high temperatures. Bio-Soil is designed to improve soil structure, increase water retention, and provide a source of nutrients for plants.

Cook says that Bio-Soil is a game-changer for farmers and gardeners. It's easy to use, and it's made from natural materials. She says that Bio-Soil is the future of soil amendment.

Source: "Here's the Dirt", Allison Cook, dig it column, House & Garden, Oct 1999, p. 105; ScienceNOW, NOVA, www.pbs.org/wgbh/nova/sciencenow/3204/04.html; "The Mystery of the Singing Sand", The Science Page, The Buffalo News, Nov 7, 2004.

Terminal Velocity



The mystery of the singing sand

Dunes give up their noisy secrets to science

BY STEVEN LUGGERS

IT SOUNDS LIKE A low-frequency power plant or a noisy engine deep beneath the surface of a desert. The booming sound made by some desert dunes has been a mystery for centuries. The rattle of the Sahara in Africa and the booming of the dunes in the California Coast Range have long fascinated scientists and engineers alike.

The sound is produced when sand on the surface of a dune is vibrated by the wind. The vibration causes the sand grains to move and rub against each other, creating a sound that is similar to the sound of a power plant or a noisy engine.

Scientists have long been interested in the phenomenon of singing sand. In the 1950s, a group of engineers from the California Institute of Technology (Caltech) began studying the phenomenon. They discovered that the sound is produced when sand grains are vibrated by the wind. The vibration causes the sand grains to move and rub against each other, creating a sound that is similar to the sound of a power plant or a noisy engine.

Source: "The Mystery of the Singing Sand", The Science Page, The Buffalo News, Nov 7, 2004.

Viscosity of Fluids



Mystery of Guinness bubbles is solved

But, can the rings in the glass tell your nationality?

BY CAROLINE EYVINE

DUBLIN, Ireland — As the first of 10 million frothy pints of Guinness are raised today in St. Patrick's Day, one of the most intriguing scientific debates will be available for all to see: Why do the bubbles in a glass of Guinness that descend instead of up?

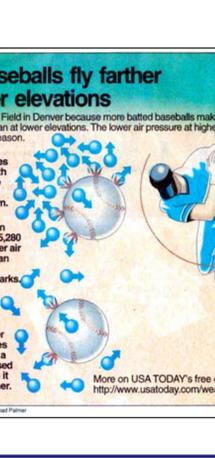
Anyone who has dived a bit of the thick dark stout—looked at it "downside the channel"—has no doubt noticed that Guinness bubbles lag the side of the glass and then slowly descend, appearing to defy the laws of nature.

It took a professor of computational engineering at the University of New South Wales in Sydney, Australia, to work out the mystery. Clive Fletcher decided to take a closer look at the bubbles in a glass of Guinness.

Fletcher used a computer to simulate the behavior of bubbles in a glass of Guinness. He found that the bubbles in Guinness are affected by the surface tension of the liquid and the viscosity of the liquid. This causes the bubbles to lag the side of the glass and then slowly descend.

Source: "Mystery of Guinness bubbles is solved", Carolyn Byrne, AP carried in, The Buffalo News, March 17, 2000.

Why baseballs fly farther at higher elevations



Why baseballs fly farther at higher elevations

Batters love Coors Field in Denver because more batted baseballs make it over the fence than at lower elevations. The lower air pressure at higher elevations is the reason.

- Air molecules colliding with a ball create drag, which slows it down.
- Denver, at an elevation of 5,280 feet has lower air pressure than other major league ballparks.
- Lower air pressure means fewer air molecules collide with a ball; decreased drag means it travels farther.

More on USA TODAY's free on-line service: <http://www.usatoday.com/weather/wbaseball.htm>

Source: "Why baseballs fly farther at high elevations", USA Today, Feb 20, 1997, available online at: www.usatoday.com/weather/tg/wbaseball/wbaseball.htm.



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