From Urination to...

The 25th First Annual Ig®Nobel Prize Ceremony

Thursday, September 17, 2015  6:00 PM
Sanders Theater, Harvard University

Tickets: $75 / $65 / $55 / $35  Student tickets: $70 / $60 / $50 / $30
IgGlorious (tickets with premium benefits): $150

Join us for the awarding of 10 new Ig Nobel Prizes

Also featuring...
World premiere mini-opera: The Best Life
Win-a-Date-with-a-Nobel-Laureate Contest
The 24/7 Lectures
…and other wondrous things

Live webcast

Inflicted on you by the science humor magazine Annals of Improbable Research (AIR)
And co-sponsored by
The Harvard-Radcliffe Society of Physics Students
The Harvard-Radcliffe Science Fiction Association
…and the book This Is Improbable Too

And then the winners explain all...
Ig Informal Lectures
Saturday, September 19, 1:00 pm
MIT, Cambridge
Co-sponsored by MIT Press Bookstore
Free admission (but limited seating)

www.improbable.com
CHAPTER 17

(a) Longitudinal (sagital) section of a human **penis**, showing the antterminal enlargement called the "navicular fossa." (b) Water coming out of two glass tubes, one with and one without an antterminal enlargement.

**Figure 17.9.**

character of the broken jet. A low value of this so-called Ohnesorge number indicates that breakup will be varicose (McCarthy and Molloy 1974). When a circular liquid jet breaks up, it often forms droplets of two widely
My first scientific paper, back in 2003
Freshman Admitted by Mistake, MIT Says

By Bob Woodward and Carl Bernstein

According to Interim Director of Admissions Marilee Jones, David Hu ’01 was admitted by mistake to the Class of 2001. “I really don’t know how it happened,” Jones said in an interview earlier today. “We checked our list twenty bazillion times, but somehow, that name slipped through.”

Apparently, the freshman’s application was inadvertently switched with that of Tim E. Beaver, who was denied admission and is attending the Cambridge Community College instead. The mistake freshman’s application listed “skateboarding” and “listening to loud music” as extracurricular activities; Jones said that the Admissions Office had somehow missed that, as well as an SAT math score of 800, not 800 as they first thought.

“I suppose I’ll have to change my Freshman Convocation speech from now on,” said President Charles M. Vest, referring to his statement that MIT doesn’t admit freshmen by mistake. “That could be difficult, because I’ve used the same speech for so long. I don’t even remember how to think originally,” Vest said.

Reached for comment, the freshman said, “Gee, I figured something was up. I got here and they all started using numbers for everything. I can’t even count higher than 10.”

Asked if any other students may have been mistakenly admitted, Jones said she didn’t think so, but the Admissions Office was investigating several possible fraudulent applications, including those of two students from the Maui School of Surfing who thought bodysurfing counted as an advanced placement class.
Start your own field
Doing science is a pretty good job

Demand for STEM occupations has grown three times faster than non-STEM careers over the last decade.

One million additional STEM graduates will be needed over the next 10 to 15 years to fill economic demands.

The average annual wage for all STEM occupations was $77,880 in May 2009, significantly above the U.S. average of $43,460 for non-STEM occupations.

In efforts to meet the national demand of skilled workers in the STEM fields, the federal government has allocated billions of dollars in national programs and initiatives to increase students' interests in the STEM fields.

<table>
<thead>
<tr>
<th>List of careers listed in order of happiness</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Floristry/gardeners</td>
<td>87%</td>
</tr>
<tr>
<td>Hairdresser/beauty</td>
<td>79%</td>
</tr>
<tr>
<td>Plumbing</td>
<td>76%</td>
</tr>
<tr>
<td>Marketing/PR</td>
<td>75%</td>
</tr>
<tr>
<td>Scientific/research/lab</td>
<td>69%</td>
</tr>
<tr>
<td>Leisure and tourism</td>
<td>67%</td>
</tr>
<tr>
<td>Construction</td>
<td>66%</td>
</tr>
<tr>
<td>Medical/dentistry</td>
<td>65%</td>
</tr>
<tr>
<td>Law/legal</td>
<td>64%</td>
</tr>
<tr>
<td>Nursing</td>
<td>62%</td>
</tr>
<tr>
<td>Architecture</td>
<td>62%</td>
</tr>
<tr>
<td>Childcare/youth</td>
<td>60%</td>
</tr>
<tr>
<td>Teaching</td>
<td>59%</td>
</tr>
<tr>
<td>Finance/accountancy</td>
<td>58%</td>
</tr>
<tr>
<td>Automotive</td>
<td>57%</td>
</tr>
</tbody>
</table>
But America is flunking science

Internationally, U.S. Stands in Middle of Pack on Science, Math Scores

Average scores of 15-year-olds taking the 2012 Program for International Student Assessment

<table>
<thead>
<tr>
<th>MATHEMATICS</th>
<th>SCIENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Score is significantly higher than U.S.</strong></td>
<td><strong>Score is not significantly different from U.S.</strong></td>
</tr>
<tr>
<td>Singapore 573</td>
<td>Russian Fed. 492</td>
</tr>
<tr>
<td>Hong Kong 561</td>
<td>Slovakia 487</td>
</tr>
<tr>
<td>Taiwan 550</td>
<td>Lithuania 479</td>
</tr>
<tr>
<td>South Korea 554</td>
<td>Sweden 478</td>
</tr>
<tr>
<td>Macao 538</td>
<td>Hungary 477</td>
</tr>
<tr>
<td>Japan 536</td>
<td>Croatia 471</td>
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<tr>
<td>Liechtenstein 535</td>
<td>Israel 468</td>
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<tr>
<td>Switzerland 531</td>
<td>Greece 453</td>
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<tr>
<td>Netherlands 523</td>
<td>Serbia 449</td>
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<tr>
<td>Estonia 521</td>
<td>Turkey 448</td>
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<tr>
<td>Finland 519</td>
<td>Romania 445</td>
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<tr>
<td>Poland 518</td>
<td>Cyprus 440</td>
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<tr>
<td>Canada 518</td>
<td>Bulgaria 439</td>
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<tr>
<td>Belgium 515</td>
<td>U.A.E. 434</td>
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<tr>
<td>Germany 514</td>
<td>Kazakhstan 432</td>
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<tr>
<td>Vietnam 511</td>
<td>Thailand 427</td>
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<tr>
<td>Austria 508</td>
<td>Chile 423</td>
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<tr>
<td>Australia 504</td>
<td>Malaysia 421</td>
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<tr>
<td>Ireland 501</td>
<td>Mexico 413</td>
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<td>Slovenia 501</td>
<td>Montenegro 410</td>
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<tr>
<td>New Zealand 500</td>
<td>Uruguay 409</td>
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<tr>
<td>Denmark 500</td>
<td>Costa Rica 407</td>
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<tr>
<td>Czech Republic 499</td>
<td>Albania 399</td>
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<tr>
<td>France 495</td>
<td>Brazil 391</td>
</tr>
<tr>
<td>United Kingdom 494</td>
<td>Argentina 388</td>
</tr>
<tr>
<td>Iceland 493</td>
<td>Tunisia 398</td>
</tr>
</tbody>
</table>

Our superiority was once the envy of the world. But we are sliding off past other countries are getting stronger. What’s the formula for a comeback?

BY MICHAEL B. LERNER
Scientists think that many Americans are wrong about almost all major issues.
How can we improve American science education? And for low cost?

- Textbook prices have risen over three times the rate of inflation from January 1977 to June 2015, a 1,041 percent increase.
- "They've been able to keep raising prices because students are 'captive consumers.' They have to buy whatever books they're assigned,"

In 18 years, the average sticker price for a private university could be as much as $130,428 a year.
How can we improve American science education?

I don’t have a clue.

But I know one thing that couldn’t hurt.
Celebrate Science Humor.
Leaning to the Left Makes the Eiffel Tower Seem Smaller

PSYCHOLOGY PRIZE: Anita Eerland and Rolf Zwaan [THE NETHERLANDS] and Tulio Guadalupe [PERU, RUSSIA, and THE NETHERLANDS] for their study "Leaning to the Left Makes the Eiffel Tower Seem Smaller"

Trying to understand what happens in the brains of people who see the face of Jesus in a piece of toast.

NEUROSCIENCE PRIZE [CHINA, CANADA]: Jiangang Liu, Jun Li, Lu Feng, Ling Li, Jie Tian, and Kang Lee, for trying to understand what happens in the brains of people who see the face of Jesus in a piece of toast.
Using magnets to levitate a frog

PHYSICS: Andre Geim of the University of Nijmegen (the Netherlands) and Sir Michael Berry of Bristol University (UK), for using magnets to levitate a frog. [REFERENCE: "Of Flying Frogs and Levitrons" by M.V. Berry and A.K. Geim, European Journal of Physics, v. 18, 1997, p. 307-13.]

NOTE: Ten years later, in 2010, Andre Geim won a Nobel Prize in physics (for research on another subject).
What is Science Humor?

**Science**
- the intellectual and practical activity encompassing the systematic study of the structure and behavior of the physical and natural world through observation and experiment.

**Humor**
- the quality of being amusing or comic, especially as expressed in literature or speech.

**Science humor**
- An activity that anyone can participate in that makes learning science more fun.

**The Ig Nobel Prize**
- The only award for science humor, for making people laugh and then think.
Six Nobel Laureates agree.

- The winners will physically receive their prizes, and a handshake, from genuine, genuinely bemused Nobel laureates:
  - Dudley Herschbach (chemistry, 1986)
  - Carol Greider (physiology or medicine, 2009)
  - Jack Szostak (physiology or medicine, 2009)
  - Frank Wilczek (physics, 2004)
  - Eric Maskin (economics, 2007)
  - Jerome Friedman (physics, 1990)
Nobel-prize-winning janitors

Nobel Prize laureate Roy Glauber carries a broom to sweep stray paper airplanes
Two case studies in science humor from 2015
YOUR EYELASHES ARE PERFECT
- SCIENCE
Guillermo Amador

-From Caracas, Venezuela

-Second place in Red Bull Flugtag Competition

-Currently at the Max Planck Institute, Germany

Red Bull Flugtag (German: flight day, airshow) is an event organized by Red Bull in which competitors attempt to fly home-made, size- and weight-limited, human-powered flying machines (max 10m/30 ft, 150 kg/330 lbs).

A team of University of Miami students won second place in the Red Bull Flugtag competition at Bayfront Park July 10. The annual event focuses on attempts at human flight in which teams pilot their machines off a 30-foot deck into Biscayne Bay. Engineers Guillermo Amador, Derek Schesser, Dustin Griner, William T. Hagen and Randall Schwartz modeled their aircraft after Sebastian the Ibis, outfitting it with the mascot’s familiar corncob pipe and intimidating snarl.
Length of Lashes Keeps Eyes From Drying, Study Finds

By JAMES GORMAN
FEB. 24, 2015

The new york times

SCIENCE

The origin of eyelashes

Mote prevention

The Economist

The hairs that fringe eyelids create aerodynamic armour for the eye

Feb 28th 2015 | From the print edition

Extra-Long Eyelashes Have a Dangerous Side Effect

Should you put down the mascara?

By Elizabeth Norton
216 Shares

COSMOPOLITAN

Jessica Alba

His #1 Sex Fantasy

No Woman Has Had the Nerve to Try This on Him...and He'll Go Totally Nuts When You Do

6 Instant Confidence Boosters

Hel-jo, Gorgeous!

Fall Clothes...hair, Makeup

COSMO NEWS

A New Kind of Date Rape You Would Know About

“My Boyfriend Didn’t Change His Boxers for 3 Months”

Historical and Cultural Context
Mammalian eyelash length is one-third eye width

\[ L = 0.34W \]
Wind tunnel tests reveal that eyelashes reduce evaporation by 2 X. And particle deposition too!
How do eyelashes protect the eye?
Fluid mechanics!

"The whole idea is to see things that are invisible, things
that happen in the air that we look right through." Gary
Settles
Fluid boundary layer around objects

In physics and fluid mechanics, a **boundary layer** is the layer of fluid in the immediate vicinity of a bounding surface where the effects of viscosity are significant.

*Figure 1: Schlieren photograph of the human thermal layer of a teenage girl.*
Calculations rationalize the optimal eyelash length

No lashes

Short lashes resist flow and generate a zone of stagnant flow above the eye surface

Long lashes channel flow towards the eye
Dissemination to the public
The future: solar panels with eyelashes

NASA/JPL-Caltech/Cornell
What you’ve all been waiting for
Patricia Yang (楊佩良)

• From Taichung, Taiwan

• 1st place in Head-Pomelo Competition

• Thesis
  “Urination, Defecation and Digestion – Internal Flows in Animal’s Body”

“Who would have expected urination time to be so nearly constant?...I wrote a whole book on biological fluid mechanics, even giving some space to one aspect of urination, and I never imagined.”

–Steven Vogel, biology professor at Duke
<table>
<thead>
<tr>
<th></th>
<th>Animal 1</th>
<th>Animal 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass</td>
<td>5 kg</td>
<td>5,000 kg</td>
</tr>
<tr>
<td>Bladder Volume</td>
<td>0.2 L</td>
<td>18 L</td>
</tr>
<tr>
<td>Duration</td>
<td>24 s</td>
<td>22 s</td>
</tr>
</tbody>
</table>
Methods

• geometry of urethra and bladder obtained from ultrasound, x-ray, and dissection studies
• N = 18 animals are filmed and flow rate measured manually, including 1 elephant, 2 goats, 3 dogs, 2 cows, 5 rats, and 5 mice
• Duration additionally measured from 30 videos from YouTube

Bladder volume $V$

- Rat: high speed video
- Dog: house-training pads, analytical balance
- Cow: bucket, vulva-massaging
- Elephant: trash can, stepstool

- $0.1$ mL
- $0.1$-$0.3$ L
- $2$ L
- $18$ L
Question: Why is duration nearly constant at $20 \pm 10$ seconds?

Expt: \[ T \sim M^{0.13} \]
The urinary system has constant proportions

- Aspect ratio is constant: $L = 18 \, D$
Torricelli’s Law

Evangelista Torricelli (1608–1647)

Torricelli's law relates the speed of fluid flowing out of an opening to the height of fluid above the opening $U \sim H^{0.5}$
Question: Why is duration nearly constant at 20 ± 10 seconds?
Answer: Two reasons: cross-sectional area and faster flow speed

$T = aM^{\frac{1}{3}} \left( b + M^{\frac{1}{3}} \right)^{-\frac{1}{2}}$

$T \sim M^{1/6}$ for large animals
Human trials on Discovery Channel 2014
Fahad (signed in using Hotmail)

I am sorry to say that this came to me as a shock since my average urination time is 60 seconds, and my longest time ever was 150 seconds. I thought that this is common for a lot of people if they drink a lot of liquid until I saw this video.

Can somebody just tell me if they have a similar experience or if I need to see a doctor?

Reply · Like · Follow Post · November 22, 2013 at 8:04pm

Patrick Bertrand · SUNY Oswego

You may need a prostate exam.

Reply · Like · December 20, 2013 at 3:16pm
The Urinary system is a “A Scalable Hydrodynamic System”

• Can be applied to 10 Liters, 100 Liters, 1000 Liters
• Water towers, water backpacks, can be designed to drain faster
Guess what... You just learned:
- fluid mechanics (volume, pressure, boundary layers, Toricelli’s law)
- biology (the comparative approach)
- tabletop experiments, or doing science with junk
- an interdisciplinary approach
Research like this can promote lifelong learning

• 'Lifelong learning' is the "ongoing, voluntary, and self-motivated" pursuit of knowledge for either personal or professional reasons.
What can you do?

• Tell people about the Ig Nobel Prize

• Support Scientific Humor

• And remember

  “Better to be wrong than be boring.”
The Science of Animal Motion

- Fish that walk, elephants that run, snakes that fly, flies that avoid swats, and cheetahs that are robots, and chickens with no head
- Mike the Headless Chicken lived and walked for 2 years
Thanks! And students, give research a second thought.

Sponsors
- National Science Foundation (physics, biology, engineering, mathematics)
- Army Research Office (complex systems)
- L’Oreal
- Smithgall Watts Foundation
- Atlanta Zoo
- President’s Undergraduate Research Award

Collaborators
- Joe Mendelson (Atlanta Zoo)
- Mark Mandica (Atlanta Botanical Garden)
- Jennifer Leavney (Urban Honey Bee project)
- Angela Lin (IBB)
- Si-Qin Ge (Chinese Academy)
- Craig Tovey, ISYE
- Alberto Fernandez-Nieves, physics

Graduate Alumni
- Alex Alexeev (ME)
- Dan Goldman, physics
- Stanislav Gorb (Kiel)

Graduate Alumni
- Hamid Marvi (Prof at ASU)
- Nathan Mlot
- Andrew Dickerson
- Guillermo Amador
- Sulisay Phonekeo
Why does a minnow swim faster than Michael Phelps?
"Science is not finished until it is communicated."

Mark Walport
Math

M1. Make sense of problems & persevere in solving them
M2. Reason abstractly & quantitatively
M3. Construct viable arguments & critique reasoning of others
M4. Model with mathematics
M5. Use appropriate tools strategically
M6. Attend to precision
M7. Look for & make use of structure
M8. Look for & express regularity in repeated reasoning

Science

S1. Ask questions & define problems
S2. Develop and use models
S3. Plan & carry out investigations
S4. Analyze & interpret data
S5. Use mathematics & computational thinking
S6. Construct explanations & design solutions
S7. Engage in argument from evidence
S8. Obtain, evaluate & communicate information
E1. Demonstrate independence in reading complex texts, and writing and speaking about them
E2. Build a strong base of knowledge through content-rich texts
E3. Obtain, synthesize, and report findings clearly and effectively in response to task and purpose
E4. Construct viable arguments & critique reasoning of others
E5. Read, write, and speak grounded in evidence
E6. Use technology & digital media strategically & capably
E7. Come to understand other perspectives & cultures through reading, listening, and collaborations

ELA

N/A
Very few organs scales proportionally with body size

Mammalian allometry

\[ M_{\text{muscle}} \sim 40\% \text{ body mass} \]
\[ M_{\text{brain}} \sim M^{0.70} \]
\[ M_{\text{kidney}} \sim M^{0.84} \]
\[ M_{\text{lung}} \sim M^{0.99} \]
My academic grandpa and pa

PHYSICS PRIZE: Joseph Keller [USA], and Raymond Goldstein [USA and UK], Patrick Warren, and Robin Ball [UK], for calculating the balance of forces that shape and move the hair in a human scalp.

PHYSICS PRIZE: L. Mahadevan of Harvard University, USA, and Enrique Cerda Villablanca of Universidad de Santiago de Chile, for studying how sheets become wrinkled.