

Teaching Evolution in a Climate of Resistance & Misunderstanding

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Pressure to neutralize or weaken the teaching of evolution persist nationwide and threatens to damage the integrity of science teachers, science education, and public education. To resist this pressure and meet the challenges of providing appropriate instruction, teachers need: 1) support from administrators, parents, and policy-makers; 2) an understanding of the legal issues involved in teaching evolution; and 3) professional development that helps teachers meet the challenges of helping students develop an understanding of how evolution: a) accounts for the diversity & unity of life; b) impacts human health, agriculture, and present life; and c) unifies the study of biology. This presentation will provide background information aimed at meeting these needs.

**In the end we will
conserve only what we
love, we will love only
what we understand,
and we will understand
only what we are
taught.**

**Baba Dioum
Singalese
conservationist**



...VILLE BANNER, December 7, 1983.

Frank and Ernest



TODAY'S
TOPIC:
"INTELLIGENT
DESIGN"

DO YOU BELIEVE IN "INTELLIGENT
DESIGN"?

I DID UNTIL
I MET YOU.



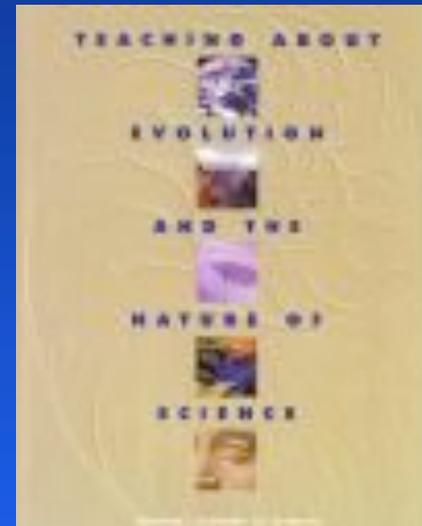
E-mail: BobTThaves@aol.com
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www.dorlands.com

9-21
THAVES

Theory:

In science, a well-substantiated explanation of some aspect of natural world that can incorporate facts, laws, inferences, and tested hypotheses.

National Academy of Science. (1998)
Teaching about Evolution and the Nature of Science. Washington, DC: National Academy



Evolution:

Change in the hereditary characteristics of groups of organisms over the course of generations. (Darwin referred to this process as “descent with modification.”)

THE THEORY OF EVOLUTION
BIO7

Natural selection in speciation, diversity, phylogeny, adaptation, behavior, and extinction. BIO7B

Structural and physiological adaptations of plants in their environments BIO13A

Analyze relationships among organisms & develop a model of hierarchical classification system based on similarities & differences using taxonomic nomenclature. BIO8B

Evolutionary change may be gradual or periodic

Evaluate the impact of research on scientific thought, society, & the environment. BIO 3C

The great diversity of organisms is the result of more than 3.5 billion years of evolution.

Evidence of change in species (fossils, DNA sequences, etc. BIO7A

Genetic variations observed in plants and animals. BIO6D

Research & describe the history of biology and contributions of science BIO 13F

Organisms that live on earth today are related by descent from common ancestors.

Compare variations, tolerances, & adaptations of plants & animals in different biomes. BIO12C

Changes in DNA cause variations BIO6C

Analysis, review, and critique of scientific explanations ... BIO3A

Classification

Characteristics, adaptations, & survival

Variation, Diversity & Change

Past Events

Methods of Science

represent knowledge statements



**Breakthrough of
the Year**

**Nothing in
biology makes
sense except in
the light of
evolution.**

**Theodosius
Dobzhansky**

The exciting thing about evolution is not that our understanding is perfect or complete but that it is the foundation for the rest of biology.

Kennedy, D. (2005). Breakthrough of the year, *Science*, 12/23

To teach biology without explaining evolution deprives students of a powerful concept that brings great order and coherence to our understanding of life.

National Academy of Science. (1998)
Teaching about Evolution and the Nature of Science. Washington, DC: National Academy Press.

Evolution is a cornerstone principle of the biological sciences on which biotechnology is based.

Vaccines (diphtheria, tetanus, polio, etc.)

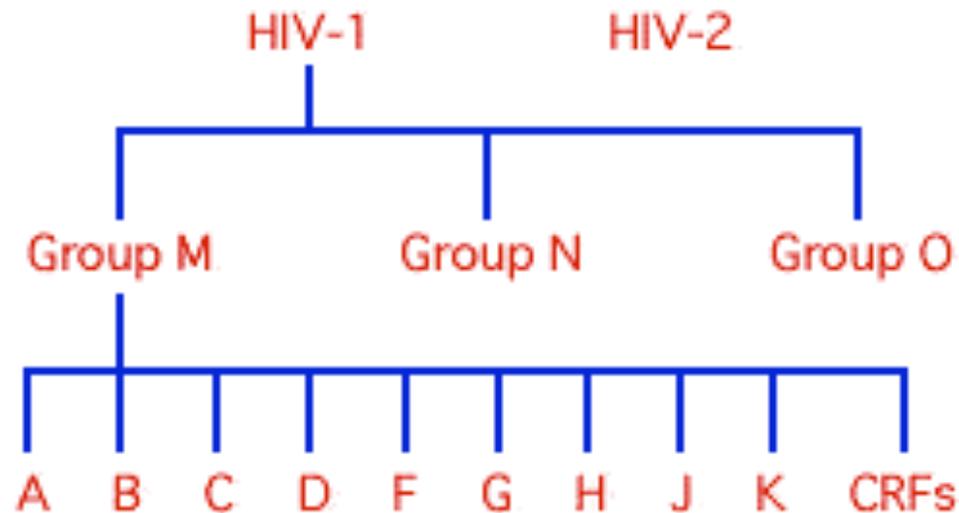
As pathogen adapt, vaccines must be updated.

Statement of the Biotechnology Institute on the Teaching of Evolution (8/26/06)

Outbreaks of new lethal viruses such as SARS are potentially predictable through evolutionary studies of gene-exchanging patterns among such viruses.

Comparative studies of the immune system of humans and chimpanzees have already proved major insights into therapies for AIDS, malaria, & other fatal diseases.

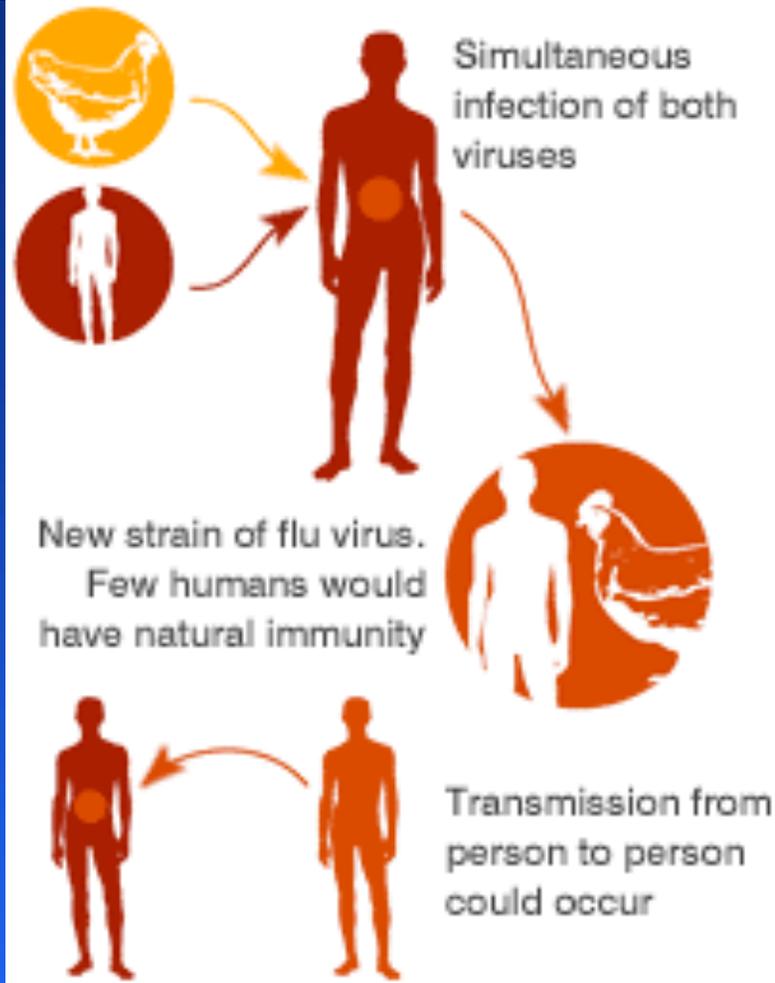
Statement of the Biotechnology Institute on the Teaching of Evolution (8/26/06)



HIV

- highly variable virus which mutates very readily
- many different strains of HIV, even within the body of a single infected person
- HIV-2 relatively rare
- 2 strains can combine in human body to form a new subtype
- HIV recently found in Gorilla feces

<http://www.avert.org/hivtypes.htm>



BBC News
news.bbc.co.uk/.../05/health_bird_flu/html/1.stm

Person with human strain of flu contracts avian virus

The viruses could join to create a previously unknown version not yet recognised by human immune systems.

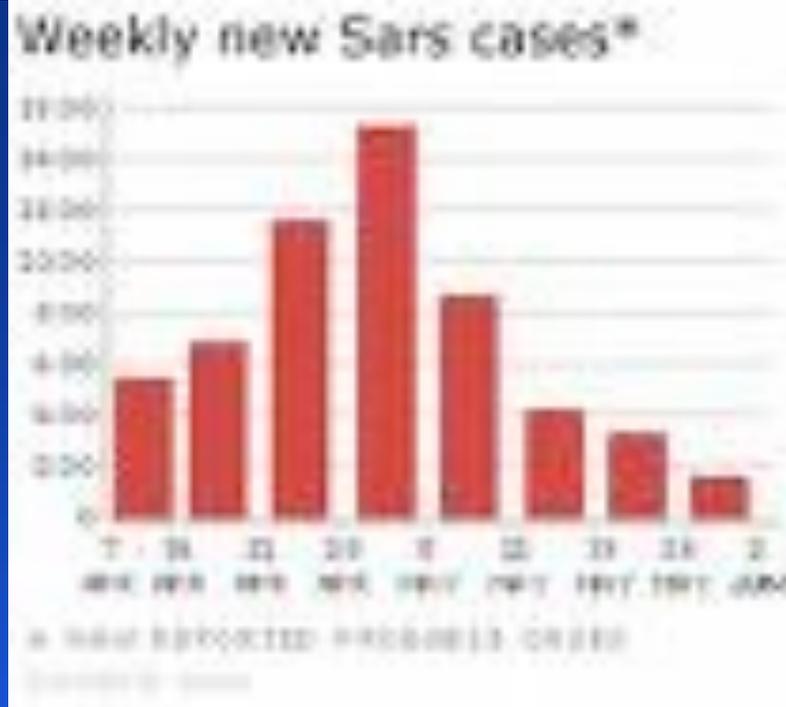
The new variant is likely to spread quickly and easily, triggering a deadly pandemic.

Experts predict it could kill more than 2m people and infect millions more.

News of the Week

**AVIAN INFLUENZA:
New H5N1 Strain Emerges in Southern
China**

Science, 11/3/06

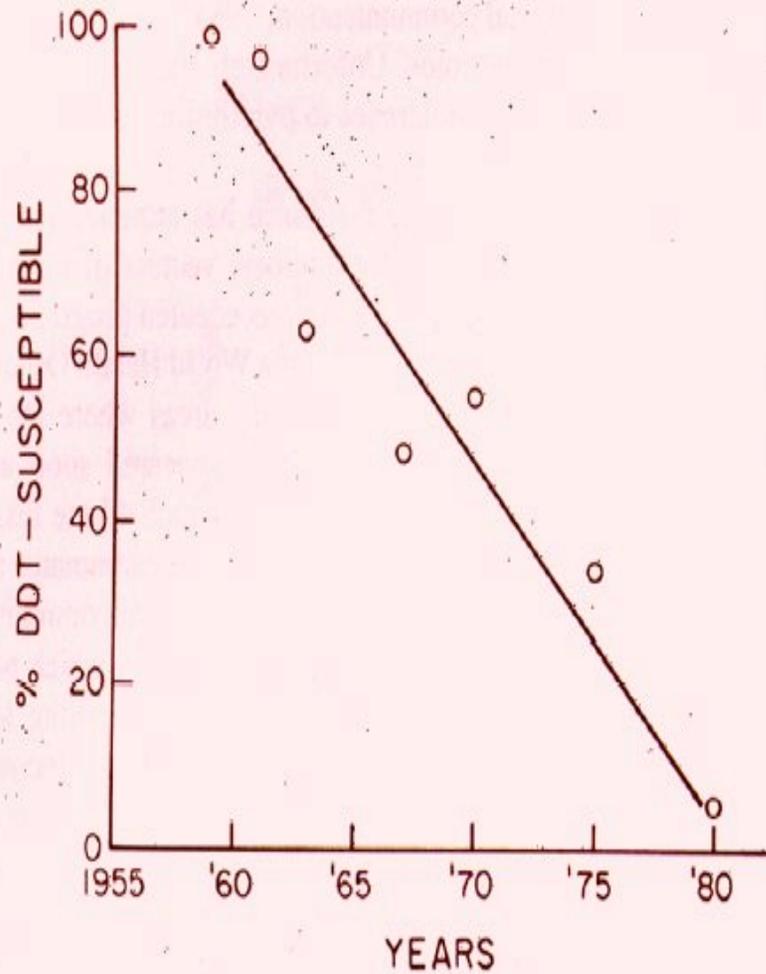


Without evolutionary science, we could not understand how HIV becomes so deadly, how to win the arms race with bacterial diseases, or how to prevent the next global flu epidemic. The value of science is that it is explanatory and predictive, leading to technology to enhance society.

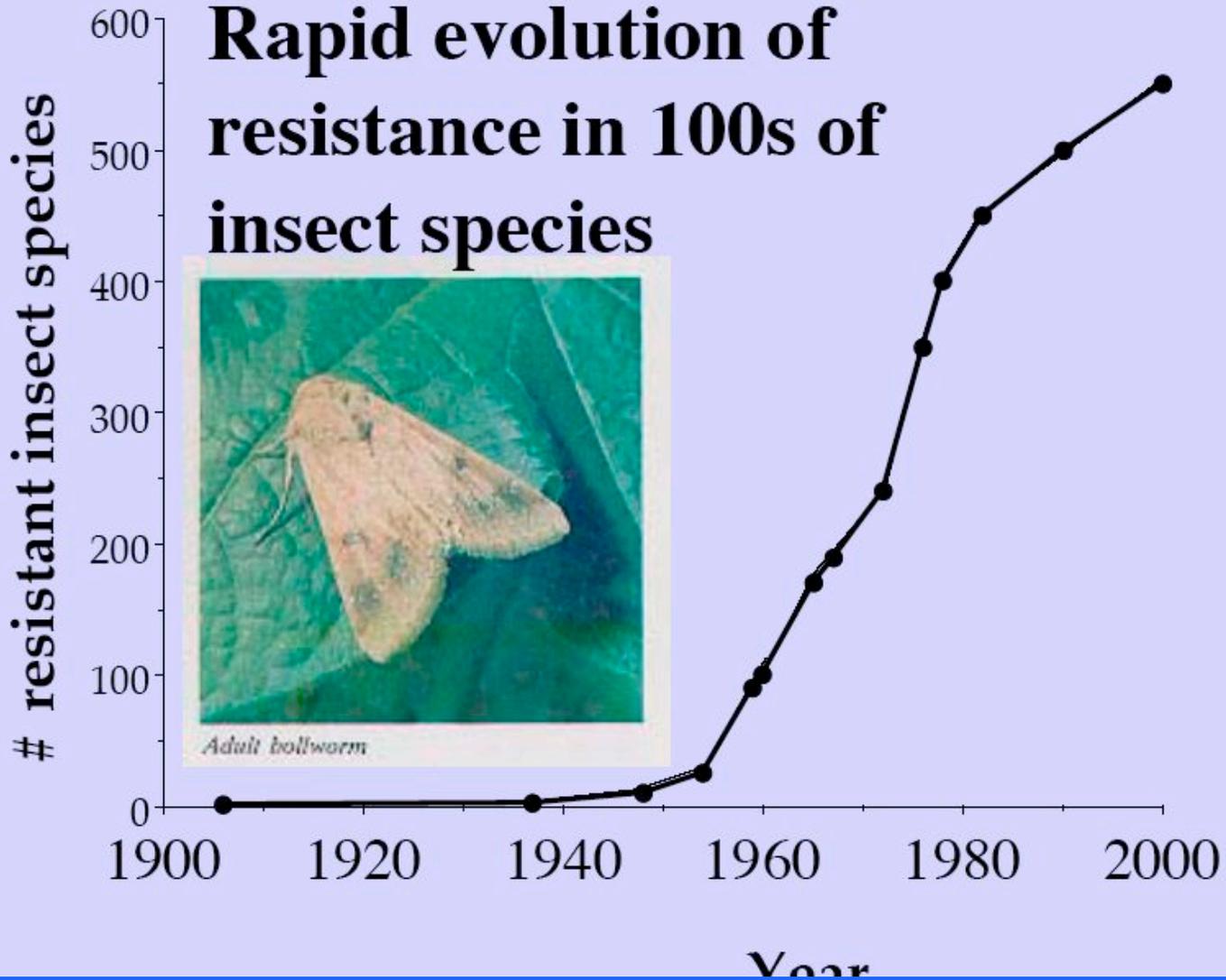
Stephen Palumbi, Hopkins Marine Station, Stanford University, Pacific Grove, CA; profile NABT SYMPOSIUM, OCTOBER 25, 2006

<http://www.aibs.org/special-symposia/2005-NABT.html>

DDT Susceptibility



Rapid evolution of resistance in 100s of insect species



Adult bollworm



Evolution explains the diversity of life.

The total number of species worldwide is estimated to be 3.4 million species even though there are estimates ranging from 3 million to over 30 million.

Biol. J. Linn. Soc. **73**, 279 (2001)

1/2 of plant and animal species are insects

1,700 species of beetles found on one tree in Peru

290,000 - 330,000 species of beetles.

Bacteria are very diverse but less than 5,000 species

Coral reef species probably total from 1 to 9 million.

Mertz, L. (2000). *Recent Advance and Issues in Biology*. Oryx Press: Phoenix

DARWIN'S WORLD

Basic Beliefs of Darwin's Time

A belief in a constant world. Except for minor perturbations (floods, volcanism, mountain building) the world had not changed materially since the world had been created rather recently.

A belief in a created world. Species and other taxa were believed to be unchanging, and therefore the existing diversity of the living world could only be due to an act of creation.

DARWIN'S WORLD

A belief in a world designed by a wise and benign creator. The adaptation of organisms to their physical and living environment was perfect because it had been designed by an omnipotent Creator.

A belief in the unique position of man in the creation. The world was anthropocentric in the eyes of the Christian religion as well as in the view of the foremost philosophers. Man had a soul, something animals did not have. There was no possible transition from animal to man. (38-39)

Mayr, Ernst (1991). *One Long Argument*. Cambridge: Harvard University

Darwin:

“The Galapagos seems a perennial source of new things.” (p. 82)

God could have created unique species for the Galapagos Islands, but “why were they created on American types of organizations?”

Larson, E. (2001). *Evolution's Workshop*. New York: Basic Books,

Observations in notebook:

- **The mixing bowl of sexual reproduction somehow allows creatures to vary**
 - **Offspring differ from their parents**
 - **Siblings differ from one another**
 - **Body patterns change from generation to generation Result: adaptation**
- **Quammen, D. (2006). *The Reluctant Mr. Darwin*. New York: W. W. Norton, p. 28**

Observations in notebook:

- Place a single pair of dogs or cats on an island**
- Increase the pressure of enemies**

“who will dare say what will result?”

“According to this view animals, on separate islands, ought to become different if kept long enough.”

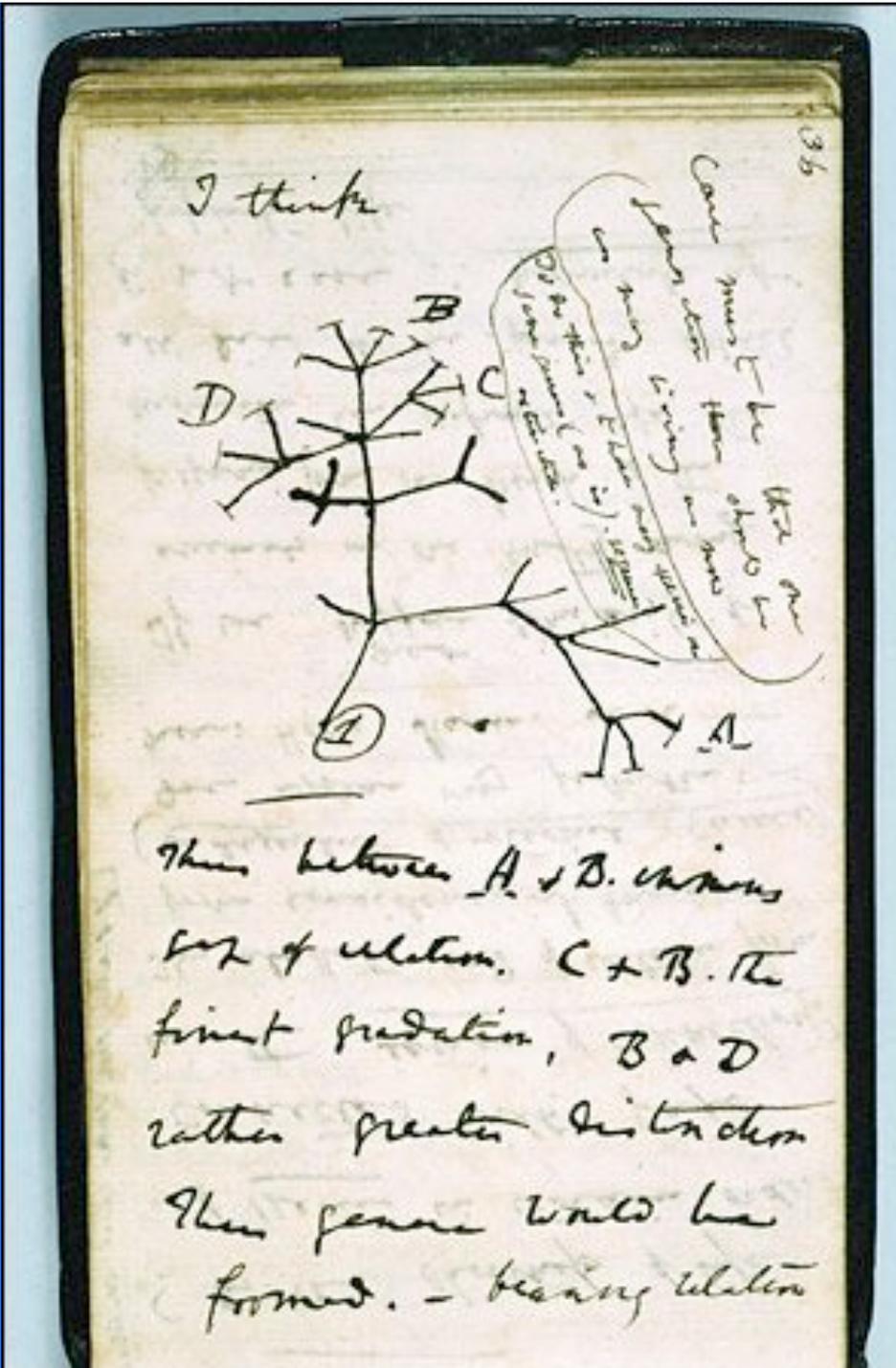
Quammen, D. (2006). *The Reluctant Mr. Darwin*. New York: W. W. Norton, p. 28

Observations in notebook:

In citing the Galapagos tortoises & mockingbirds & miniature foxes on the Falklands he noted:

“EACH SPECIES CHANGES”

Quammen, D. (2006). The Reluctant Mr. Darwin. New York: W. W. Norton, p. 29



Darwin:

**“Heaven knows
whether this
agrees with
Nature.”**

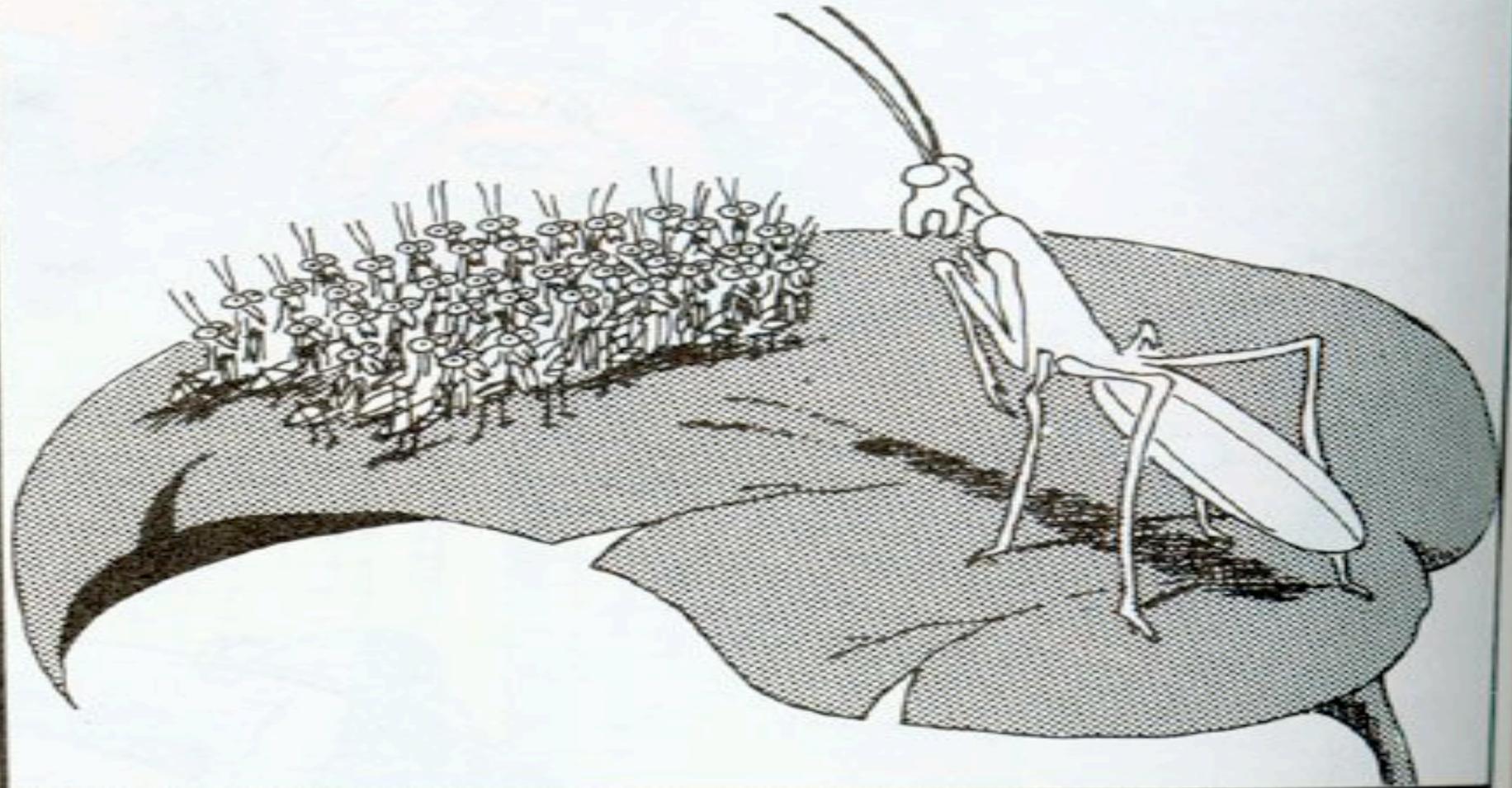
**Quammen, D. (2006).
The Reluctant Mr.
Darwin. New York:
W. W. Norton, p. 29**

Evolution is the consequence of the interactions of

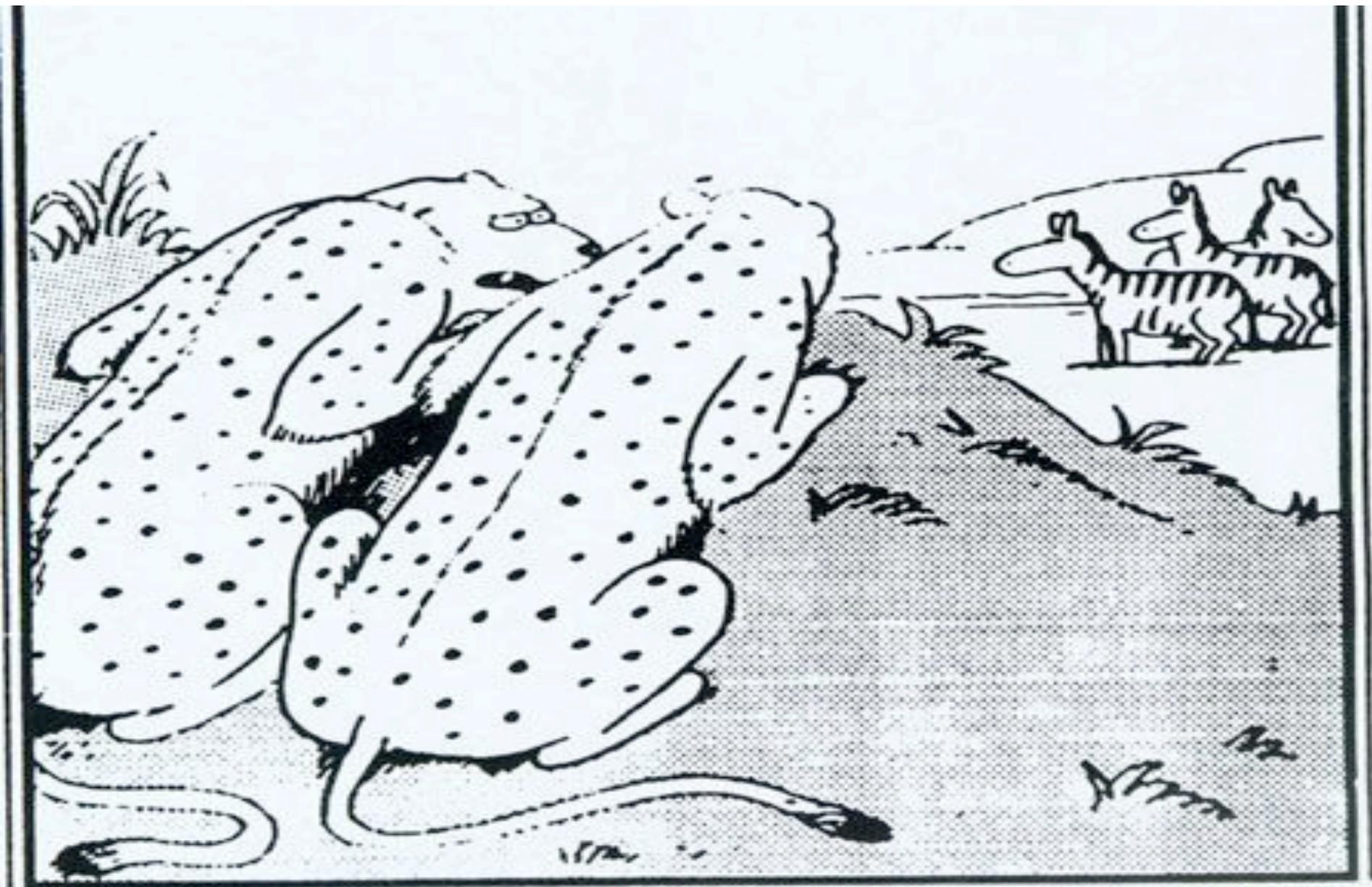
- the potential of a species to increase its numbers,**
- the genetic variability of offspring due to the mutation and recombination of genes,**
- a finite supply of the resources required for life, and**
- the ensuing selection by the environment of those offspring better able to survive and leave offspring.**

1986

Loren

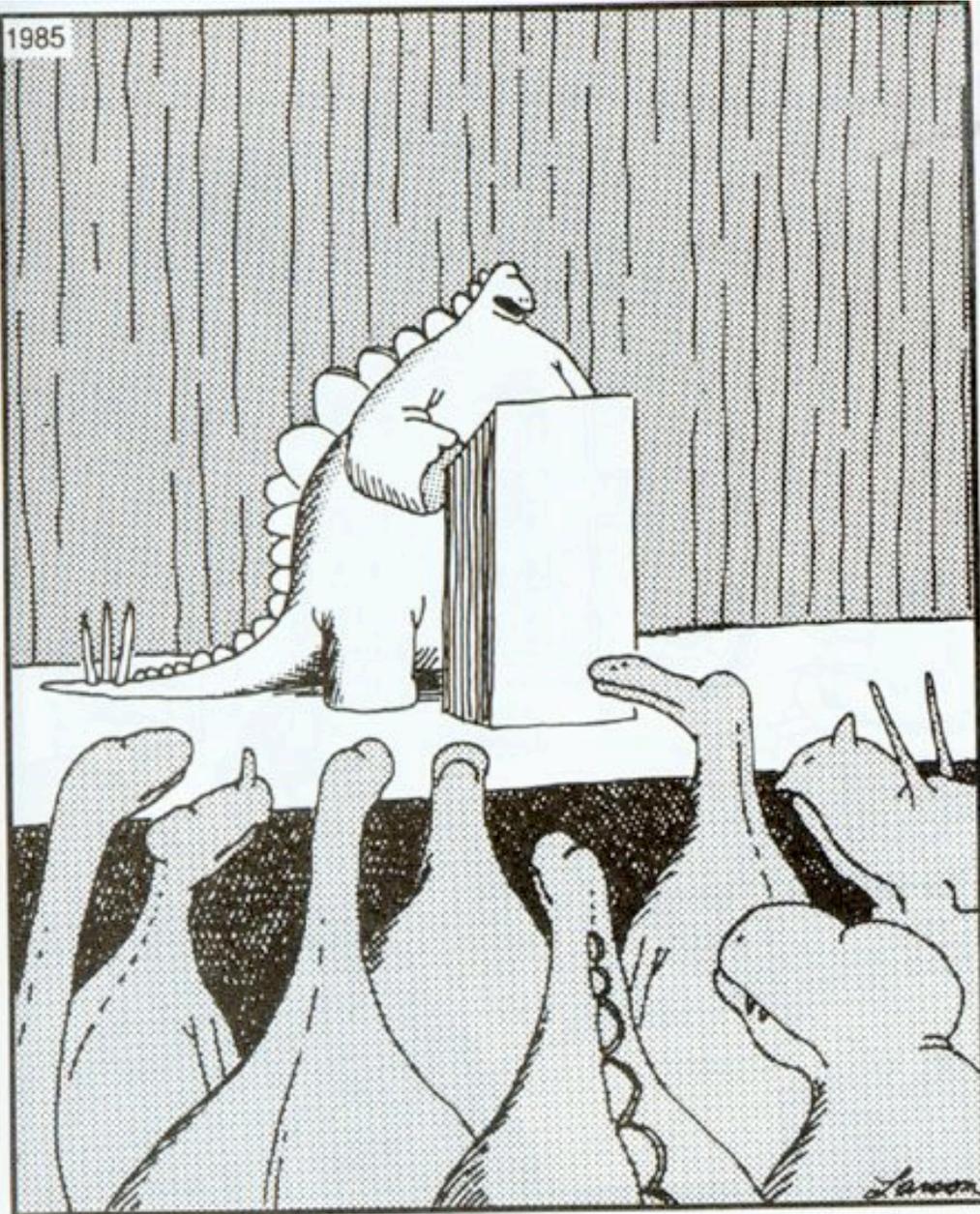


“Of course, long before you mature, most of you will be eaten.”



"Listen ... I'm fed up with this 'weeding out the sick and the old' business ... I want something in its prime."

1985



“The picture’s pretty bleak, gentlemen.... The world’s climates are changing, the mammals are taking over, and we all have a brain about the size of a walnut.”

Darwin was born in the static world of scripture, and he left us a turbulent world of perpetual change.

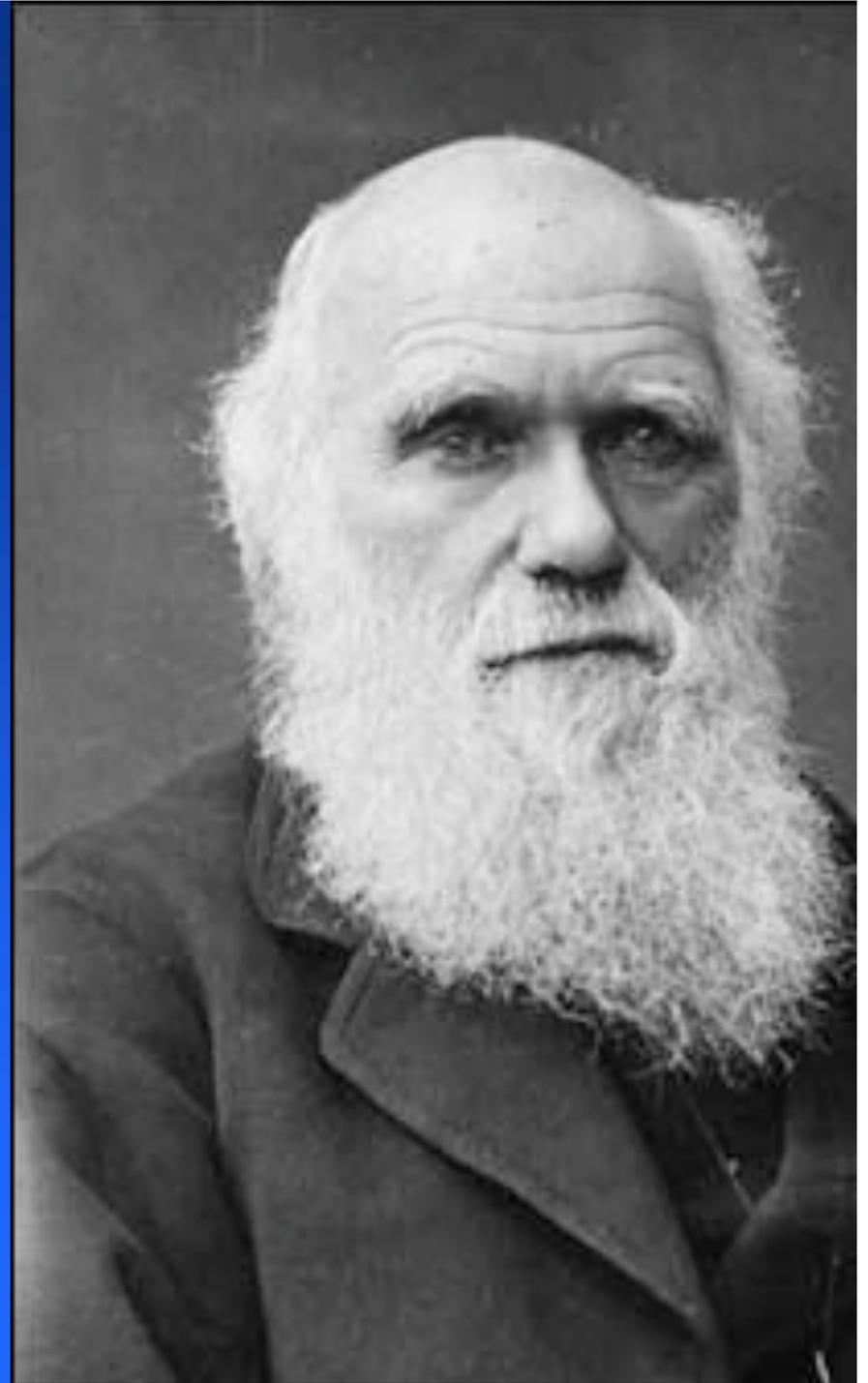
Weiner, J. (2000). From Surmise to Sunrise, *Scientific.com, February 20.*

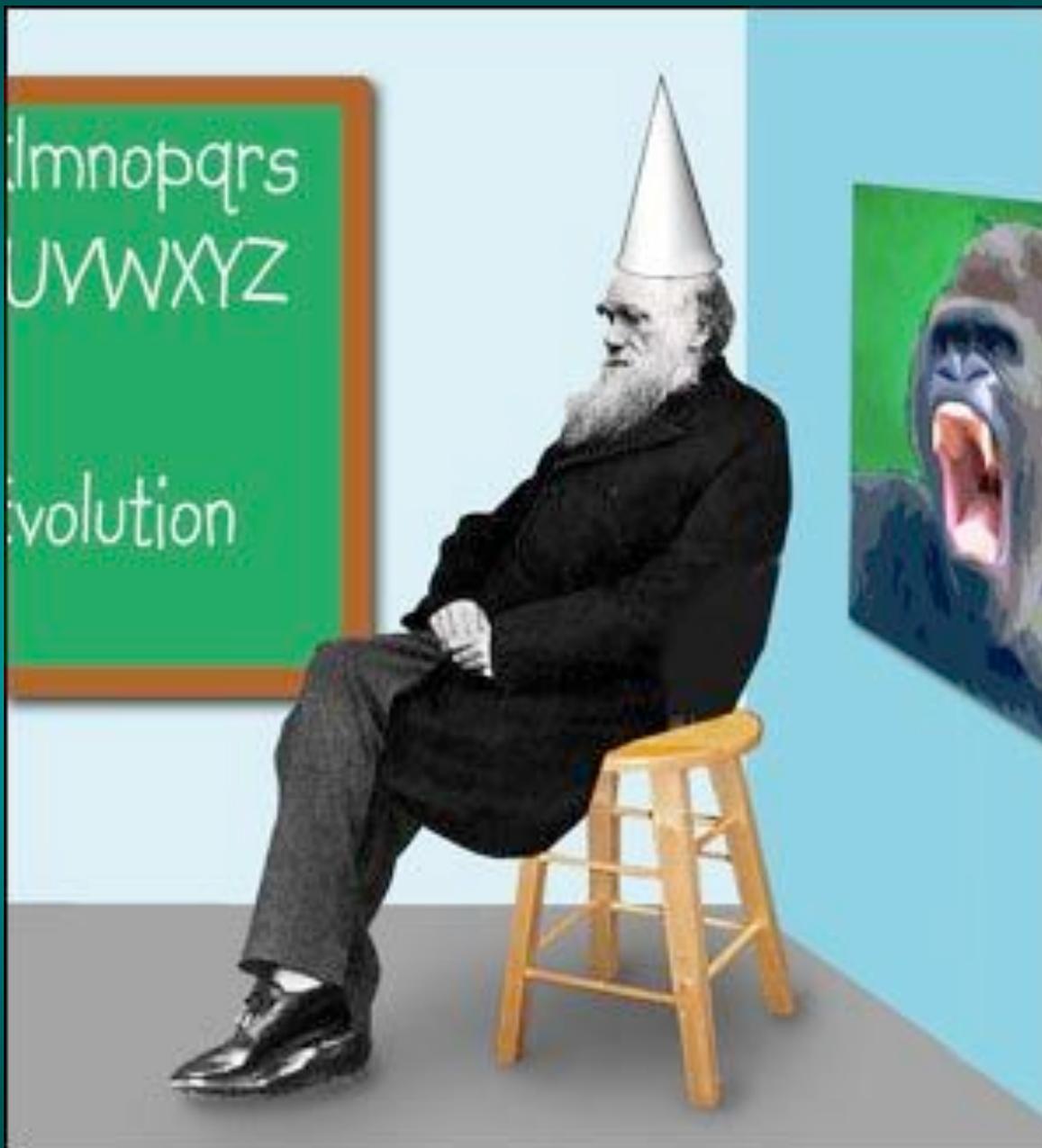
http://www.sciam.com/print_version.cfm?articleID=0005011C-5845-13F3-984583414B7F0101

Huxley in an 1860 review asserted that opinions about the *Origin of Species* varied widely but

...pietists whether lay or ecclesiastic, decry it with the mild railing which sounds so charitable; bigots denounce it with ignorant invective; old ladies of both sexes consider it a decidedly dangerous book, and even savants, who have no better mud to throw, quote antiquated writers to show that its author is no better than an ape himself.

Huxley, H.H.: 1886, *Lay Sermons, Addresses, and Reviews*, D. Appleton and Company, New York, p. 255..





THE BOGUS SCIENCE OF IDOL • THE MAKING OF HERO

WIRED

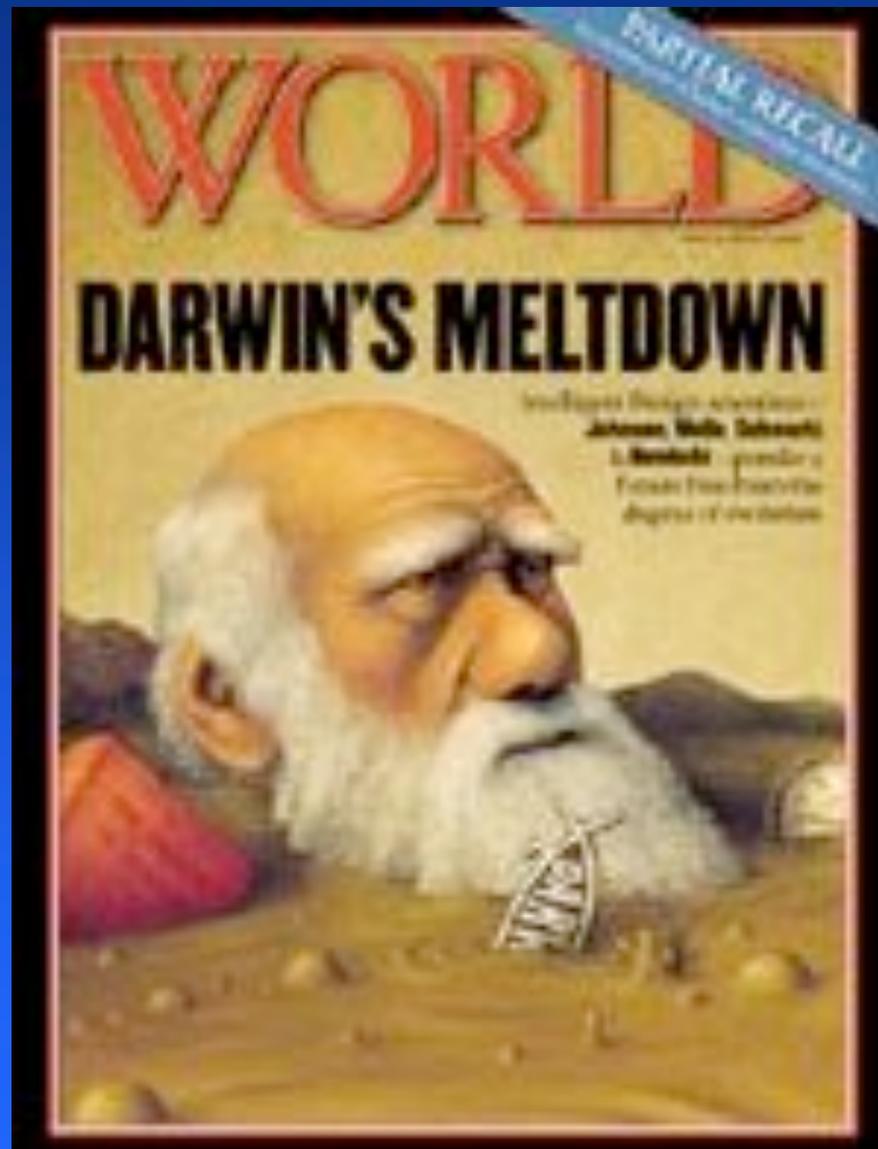
THE PLOT TO KILL EVOLUTION

Inside the Crusade to
Bring Creationism 2.0
to America's Classrooms

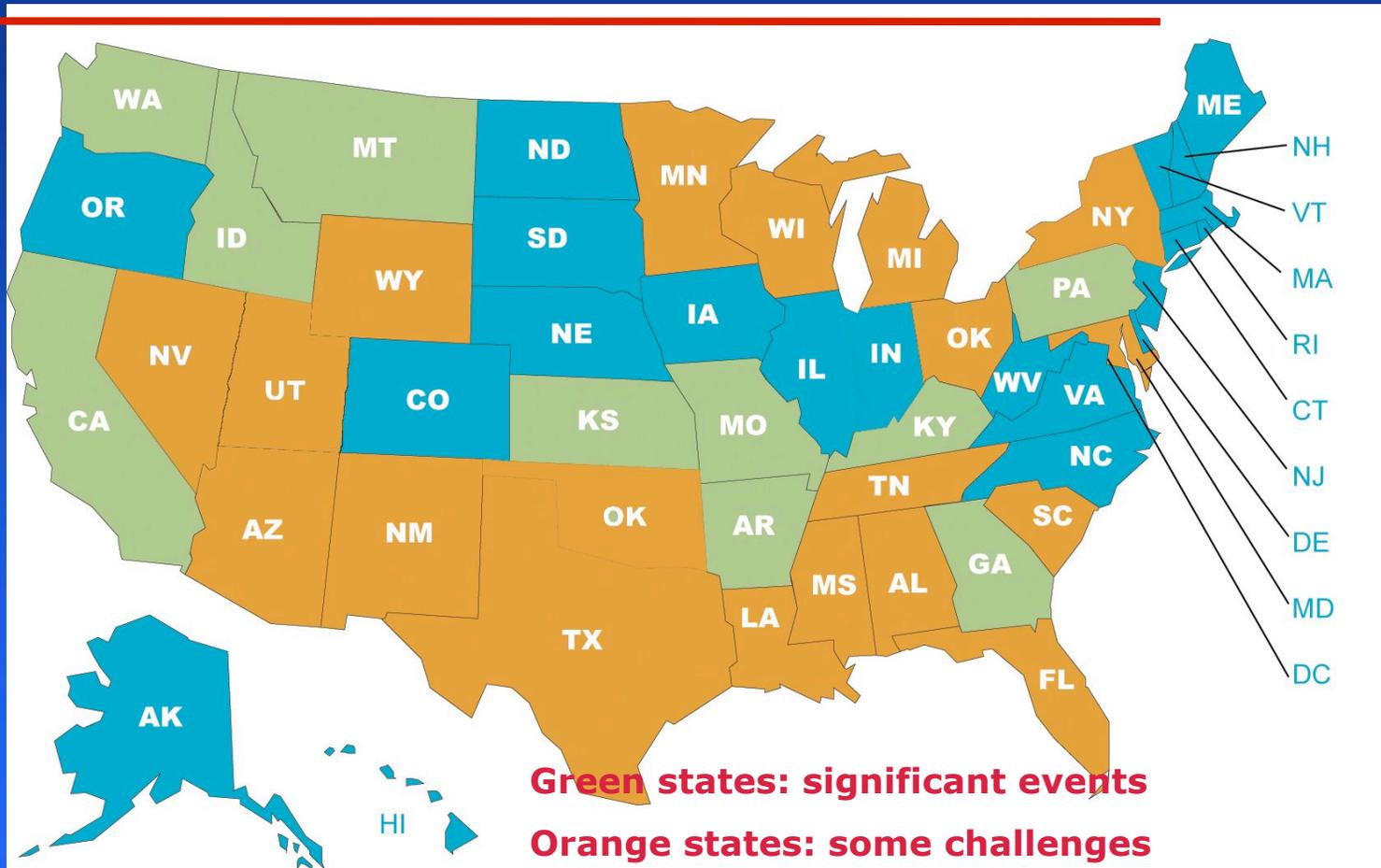


The Minutes Behind the 2005 Election
The Rise & Fall of the Internet
The World's Hottest & the New Science of Prodigies
Why Most Audiences Are the Future of Entertainment





America's Science Teachers: *Caught in Crossfire*



Source: G. Wheeler,
NSTA

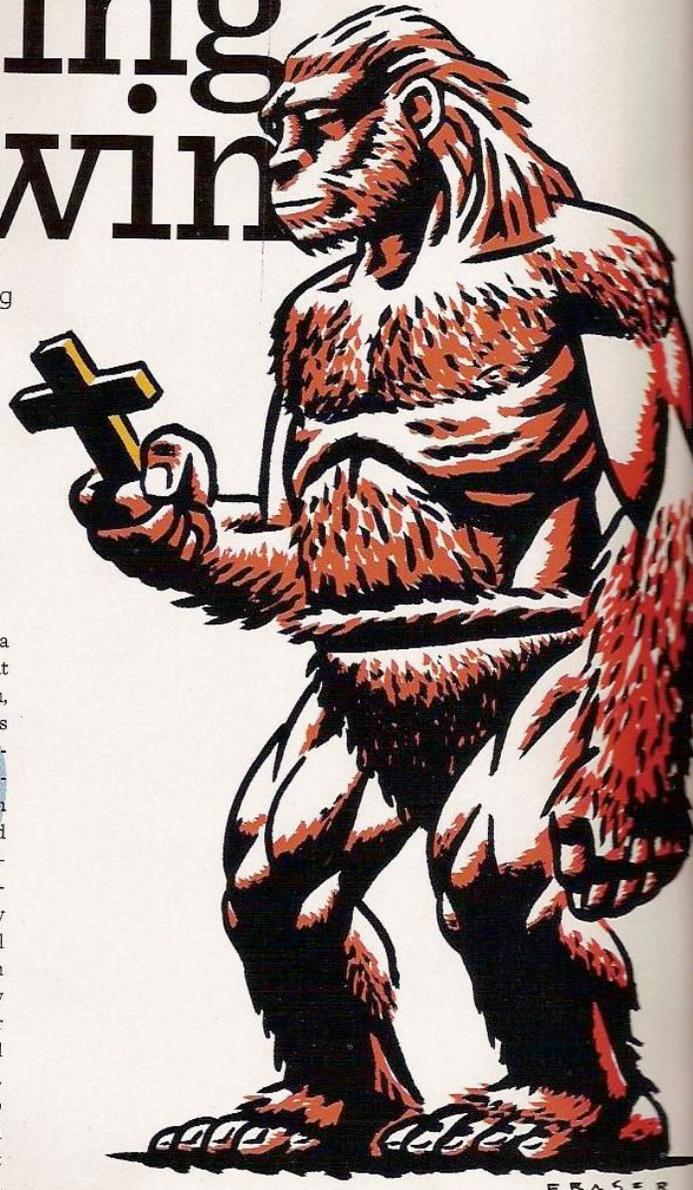
(MICHAEL ENNIS)

Dissing Darwin

As Texas grapples with the future of biotech, our long-standing hostility toward one of modern science's founding fathers is about to cost us plenty.

D

By all accounts, Charles Darwin was quite a nice English gentleman. A former divinity student who had once hoped to become a country parson, the reclusive naturalist was so concerned for his family and friends that he kept his theory of evolution to himself for a couple of decades; he was finally forced by a competitor to reluctantly publish *On the Origin of Species* in 1859. Still, that turned out to be at least 146 years too soon for most Texans, whose animus toward one of the founding fathers of modern science has been a remarkably enduring feature of our cultural and political landscape. ¶ While it would be political suicide in today's Texas to fling early-twentieth-century prejudices at African Americans, Hispanics, or women, this particular dead white male can still be bashed as blithely as he was eighty years ago. If anything, the vehemence has only amped up across the generations, from Governor Miriam "Ma" Ferguson, who vowed in the twenties that she was "not going to let that kind of rot go into Texas textbooks," to current House majority



understood how to find oil in rocks hundreds of millions of years old. But as T

Texas Republican Party Platform

The Party supports the objective teaching & equal treatment of scientific strengths & weaknesses of all scientific theories, including Intelligent Design..."

Texas Monthly 4/05

Intelligent Design: Present scientific evidence in our public schools supporting intelligent design, & not just evolution, & treat both theories as viable ones on the origin of life.

Rick Perry-R Gov	F
David Dewhurst-R L Gov	SF
Gregg Abbott-R A Gen	SF
Mike Burris-L Comptroller	SF
Susan Combs-R	F
Jerry Patterson-R Land Co	F
Todd Staples-R Ag Com	SF
Elizabeth Jones-R Rroad	F

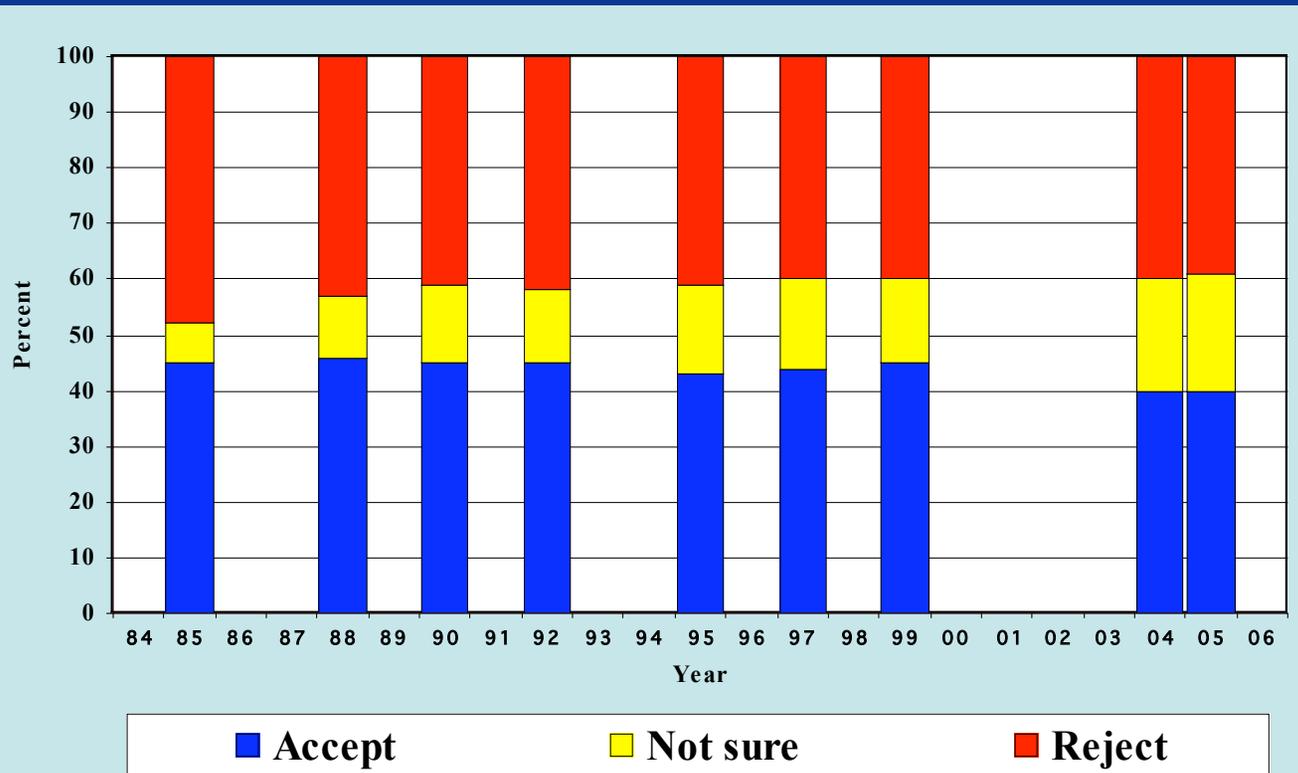
Free Market Foundation Voters' Guide 2006 General Election
www.freemarket.org/votersguide

Public "debate" is taking a toll on teachers

***Popular Science* summed up the situation when in 2005 it named a Kansas Biology Teacher to the infamous and dubious list of "Worst Jobs in Science," along side an Orangutan-Pee Collector, Manure Inspector and Lab Rat.**

From: G. Wheeler, NSTA, 2006

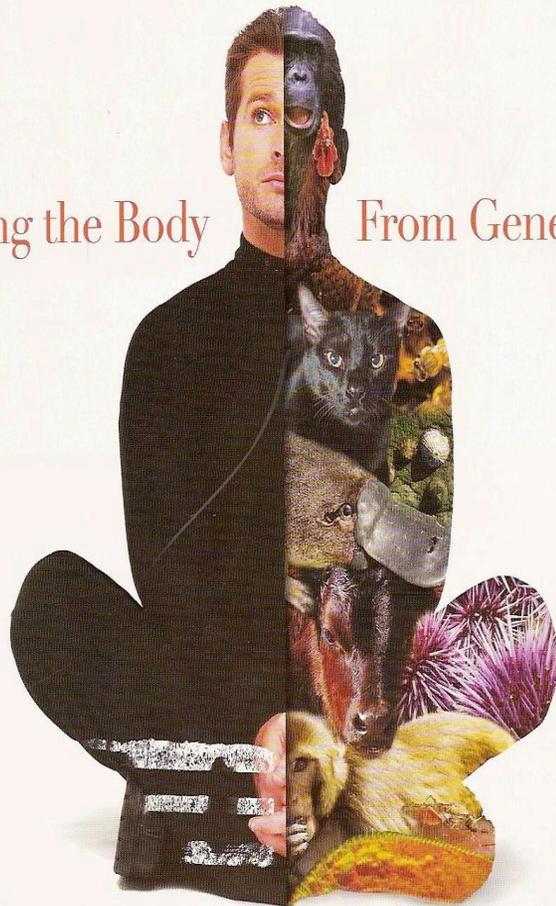
Acceptance or Rejection of Evolution



Science

29 September 2006 | \$10

Building the Body From Genes



AAAS

1/3rd of American adults agree that more than half of human genes are identical to those of mice

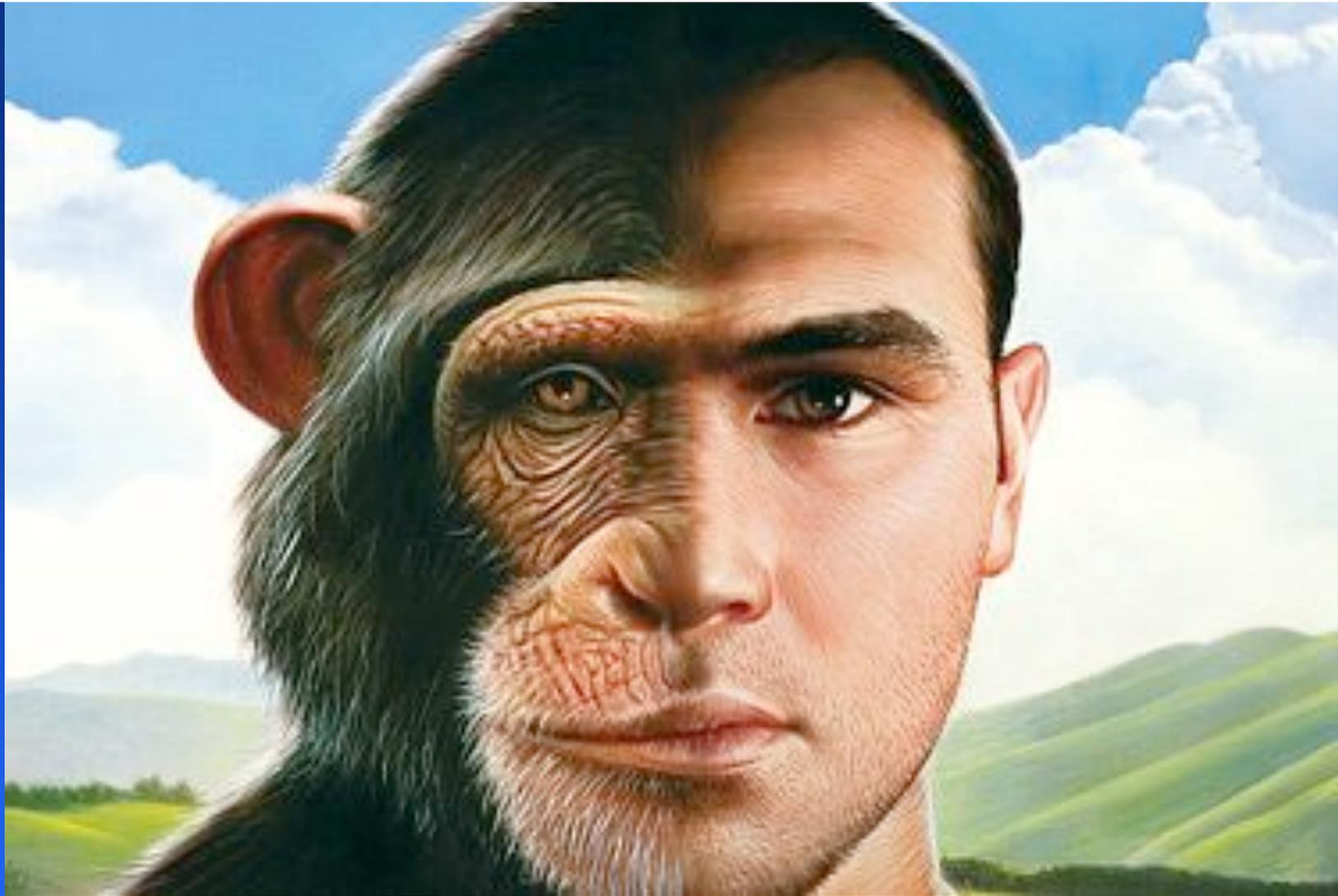
38% of adults recognize that humans have more than half of their genes in common with chimpanzees

Miller, J., Scott, E., & Okamoto, S. (2006). Public Acceptance of Evolution, *Science* 313(5788)765 - 766, August 11.

When it comes to DNA, a human is closer related to a chimp than a mouse is to a rat.

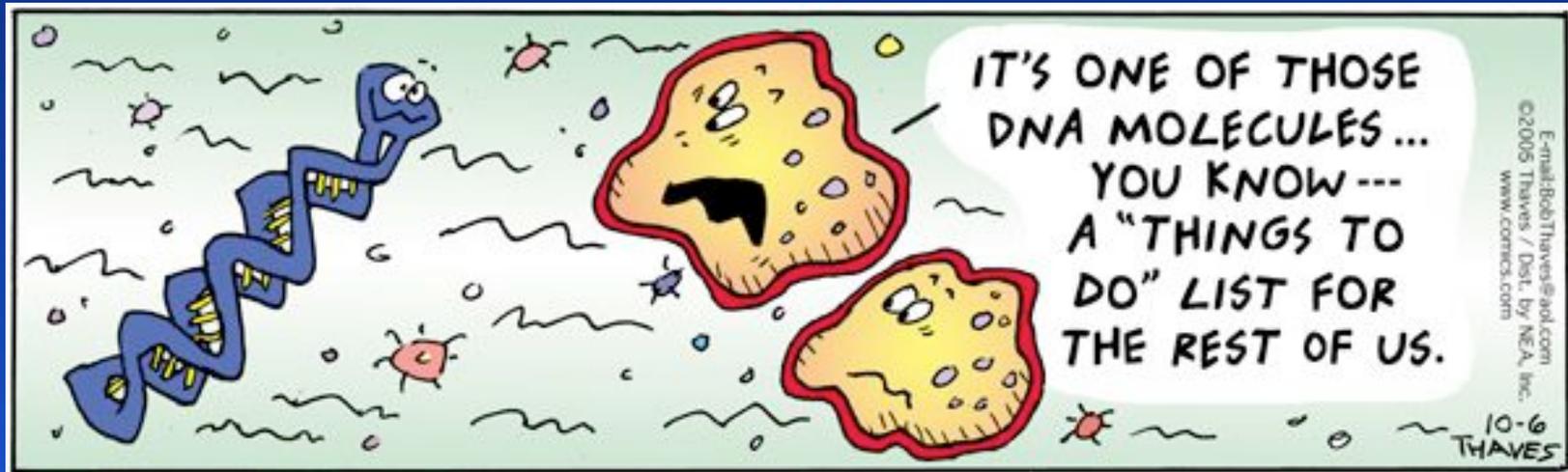
Lemonick, M. & Dorfman (2006) What makes us different? *Time* 168(15) 44-53, October 8v





**3 billion base pairs in the human genome.
1.23% that are different in the chimp genome.**

**Lemonick, M. & Dorfman (2006) What makes us different? *Time*
168(15) 44-53, October 8**



fewer than half of American adults can provide a minimal definition of DNA. .

Miller, J., Scott, E., & Okamoto, S.(2006). Public Acceptance of Evolution, *Science* 313(5788)765 - 766, August 11.

2005 Pew Research Center poll found that:

- 42 percent of Americans hold strict creationist views that living things have existed in their present form since the beginning of time**
- 64 percent said they were open to the idea of teaching creationism in addition to evolution in public schools**
- 38 percent said they think evolution should be replaced by creationism in biology classrooms.**

Conflict over what constitutes “official” knowledge impacts teacher decisions

Data from several studies:

As many as 30% of biology teachers give some emphasis to creationism and/or intelligent design

Reasons:

- **fairness**
- **scientific evidence**
- **as a historic idea or religious doctrine**

No evidence that the amount of emphasis on creationism and ID is substantial

Considerable evidence that biological evolution is not emphasized in a manner commensurate to its importance in understanding the natural world.

Bilica, K. (2001). *Factors which influence Texas biology teachers' decisions to emphasize fundamental concepts of evolution*. Unpublished Dissertation. Texas Tech University.

Texas biology teachers did not emphasize evolution to a degree commensurate with its importance in understanding the natural world.

Texas biology teachers would choose to emphasize evolution more, given unlimited freedom to make decisions.

69% agreed that evolution was a central and underlying theme in biology.

79% agreed that evolution concepts are supported by scientific evidence.

53% substitute “change over time” for “evolution” to avoid conflict.

Note: When teachers verbally “frame” evolution to preempt resistance in the classroom, some students may interpret the words as equivocation. Teacher Focus Group, AAAS, 4/06 St. Louis

49.7% did not know if principal supported the teaching of evolution.

43.4% believe that the principal would request a de-emphasis in evolution if parents protested.

TEACHERS TEND TO REFLECT THE VALUES OF THE COMMUNITY WHERE THEY TEACH

By virtue of teaching in an upwardly mobile, affluent community, I'm protected from idiosyncratic knee-twitch policies originating from Topeka. Our patrons would revolt if we were to embrace the right-wing insanity that masquerades as policy. (suburban teacher with 21+ years of experience)

I don't teach evolution. The parents & a large majority of board members prefer it not be taught. (rural teacher with 1-5 years experience)

Fairness & Open-Mindedness

I don't like teaching a topic without giving both sides. I teach in a small rural community with strong religious beliefs. I feel that if I teach evolution thoroughly then I should also teach creationism.

Evolution is a theory just as creationism is a theory. . .I will continue to teach students about evolution & creationism. The students will make up their own decisions about whether they believe in the theory of evolution or creationism. (male, rural, 6-10 years)

Public “debate”

“Fairness” is very persuasive and powerful, and difficult to challenge

“It is undemocratic to only discuss ONE view.”

NSTA survey: March '05

NSTA’s Message ...*It is unfair to our students ...*

to present non-scientific ideas as science

**to be put at a competitive disadvantage in the new
competitive world.**

G. Wheeler, NSTA, 2006

What is fair?

Fair if it conforms or confirms the claims of a particular religious tradition?

Which traditions?

Who should decide? Should all alternative viewpoints be considered competitive with scientific explanations?

Damage to reason be limited or controlled?

Judicial Decisions

FIRST THEY TRIED TO BAN THE TEACHING OF EVOLUTION...

THEN THEY DEMANDED EQUAL TIME FOR CREATIONISM...

NOW THEY MAKE US LOOK LIKE CENSORS FOR BANNING THEIR "INTELLIGENT DESIGN" SHOW!

MIGOD! THEY'RE EVOLVING!

KNIME
PUBLIC TV

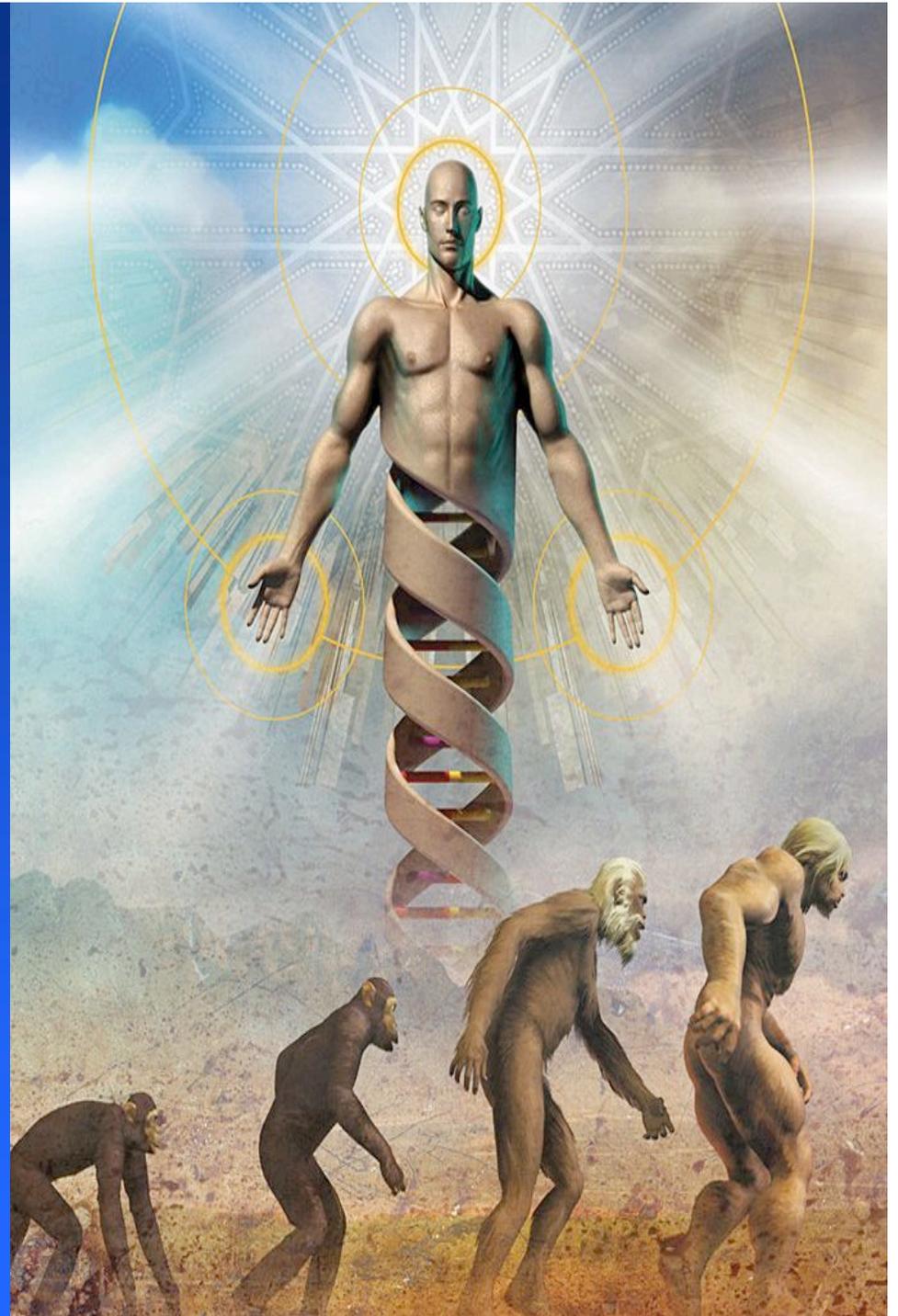
YOU REPORT
WE DECIDE

©2005
REAR
#BEFOREJOURNAL



Intelligent design is a scientific inference based on empirical evidence, not on religious texts. The theory proposes that many of the most intricate features of the natural world (like the amazing molecular machines within the cell) are best explained as the product of an intelligent cause rather than an undirected process like natural selection.

**West J. G.:Intelligent design is based on science, not religion But it doesn't belong in schools - yet.
9/4/05 Discovery Institute**





**HAVE YOU BEEN TOUCHED
BY HIS NOODLY APPENDAGE?**

www.venganza.org

Biochemical systems were designed not by the laws of nature, not by chance and necessity; rather, they were planned. The designer knew what the systems would look like when they were completed, then took steps to bring the systems about.

The Biochemical Challenge to Evolution



DARWIN'S
BLACK BOX

"No one can propose to defend Darwin without meeting the challenges set out in this superbly written and compelling book."

—David Berlinski, author of A TOUR OF THE CALLOSUS

MICHAEL J. BEHE



Suppose you drove someone who'd never seen Mount Rushmore to look at it. They would immediately apprehend that the mountain had been designed, formed by intelligent activity. Now, most people would think that designer would be God ... but where the designer came from is a separate question." Behe

In October, 2004 the Dover, PA school board passed this motion:

"Students will be made aware of gaps/problems in Darwin's theory and of other theories of evolution including, but not limited to, intelligent design. Note: Origins of Life is not taught."

Copies of *Of Pandas and People* placed in the library

On cross-examination, Professor Behe admitted that: “there are no peer-reviewed articles by anyone advocating for intelligent design supported by pertinent experiments or calculations which provide detailed rigorous accounts of how intelligent design of any biological system occurred.

It is our view that a reasonable, objective observer would, after reviewing both the voluminous record in this case, & our narrative, reach the inescapable conclusion that ID is an interesting theological argument, but that it is not science. (p. 89)

TAMMY KITZMILLER, et.al. v. DOVER AREA SCHOOL DISTRICT, et. al., Case No. 04cv2688 US District Court for the Middle District of Pennsylvania

...defense experts concede that ID is at best “fringe science” which has achieved no acceptance in the scientific community. (p. 70)

ID is at the bottom premised upon a false dichotomy, namely, that to the extent evolutionary theory is discredited, ID is confirmed. (p. 71)

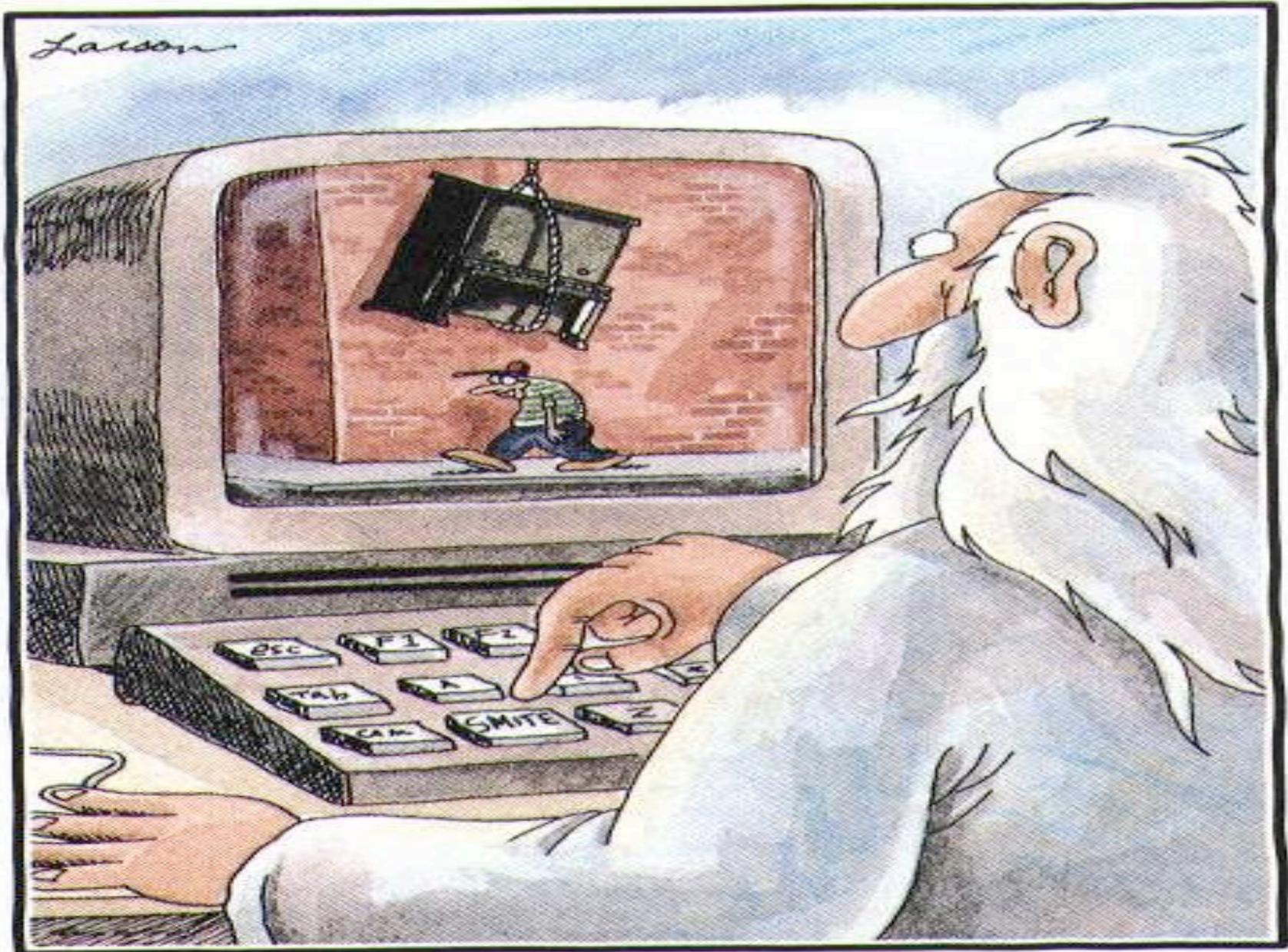
Irreducible complexity is a negative argument against evolution, not proof of design, a point conceded by defense expert Professor Minnich. (p. 72)

TAMMY KITZMILLER, et.al. v. DOVER AREA SCHOOL DISTRICT,et. al., Case No. 04cv2688 US District Court for the Middle District of Pennsylvania



Denton (1998) *Nature's Destiny: How the Laws of Biology Reveal Purpose in the Universe* Free Press.

But although the journey was long, the route often slow and tortuous, the evidence increasingly suggests that the end was never in doubt, that we followed a path already charted to an end foreseen and that our success was not in the least a matter of contingency. Like pilgrims seeking the source of their own transcendence, we have been drawn along a predetermined path from the discovery of fire to the birth of science to the revelation of our own centrality in the order of nature. We have deciphered the meaning of the constellations, and in science the cosmos has called us home.



God at His computer



....the plague is nothing but 'the will of God rightfullie punishing wicked men'.

Thomas Pullein, preacher, 1608

Nicolson, A. (2003) *God's Secretaries*. New York: Harper Collins p. 25

Overall, if the natural world and human history are the result of a plan and choices made by an intelligent agent, causality and contingencies are eliminated out of necessity. As a result, causal forces in nature do not exist or are limited and "the things of the world cause nothing."

Olding, 1991



CHALLENGES:

- 1. The breadth and complexity of the knowledge related to evolution & the nature of science in the national and state science standards.**
- 2. Providing effective courses and professional development experiences.**
- 3. Gaining support of policy-makers, administrators, colleagues, and parents.**
- 4. The magnitude of the need**
 - Number of biology teachers in the nation**
 - Attrition rate of biology teachers**
 - Number of out of field & non-certified teachers**

<http://www.hhmi.ttu.edu/resources>

Traveling Labs

Evolution Activities

Web references

PBS Evolution

Access Excellence

www.nsta.org

position paper

background information

aaas.org

background information

If Islamists are willing to embrace ijihad — unfettered reasoning — and critical investigation of the natural world, they could help unlock the great human potential of the Muslim world. This is not a question of simply importing Western ideas. They can draw inspiration also from the diverse attitudes of fellow Muslim states, reclaiming a great Islamic past in which new knowledge was valued and scholars were free to pursue all lines of enquiry.

Nature, 11/1/06



THANK YOU

GERALD SKOOG

GERALD.SKOOG@TTU.EDU

ACCEPTANCE & UNDERSTANDING OF EVOLUTION

Over billions of years all plants & animals on Earth (including humans) descended (evolved) from a common ancestor (e.g., a one-celled organism).

	S00	F01	S02
Agree	65%	67%	61% pre-course
	77%	70%	74% post-course

Mostly junior and senior Biology majors

Ingram, E. & Nelson, C. (2006) Relationship between achievement & students' acceptance of evolution or creation in an upper-level evolution course, *Journal of Research in Science Teaching* 43(1)7-24

A supreme being (e.g., God) created humans pretty much in their present form; humans did not evolve from other forms of life (e.g., fish and/or reptiles).

	S00	F01	S02
Agree	23%	34%	30% pre-course
	13%	27%	17% post-course

Instruction had a strong effect on students' acceptance of evolution for those students who changed their responses between the pre-course survey & the post-course survey. (p. 15)

Ingram, E. & Nelson, C. (2006) Relationship between achievement & students' acceptance of evolution or creation in an upper-level evolution course, *Journal of Research in Science Teaching* 43(1)7-24

Major status (non-majors/biology majors) does not appear to influence the acceptance of evolution.

The majority of participations in this study reported a religious identification; they might resist evolutionary thinking for fear of renouncing their religious beliefs.

Understanding can be achieved despite a negative attitude toward evolution.

Understanding is more importance than acceptance.

Ingram, E. & Nelson, C. (2006) Relationship between achievement & students' acceptance of evolution or creation in an upper-level evolution course, *Journal of Research in Science Teaching* 43(1)7-24

Selection of Mathematics/Science Content

The most frequently cited influences on lesson content are:

- 1. state/district curriculum standards (3 of 4 teachers)**
- 2. textbook/program designated for the class (1 of 2 teachers)**
- 3. state/district accountability systems (1 of 2 teachers)**

Weiss, I. (2003). Looking Inside the Classroom: A Study of K-12 Mathematics & Science Education in the United States. Chapel Hill: Horizon Research, Inc.