

# CRITICAL THINKING

about Science-in-Society



# Critical Thinking

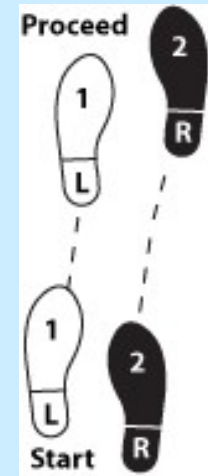
Is It True?

(Being Skeptical ...then using...“The Method”)



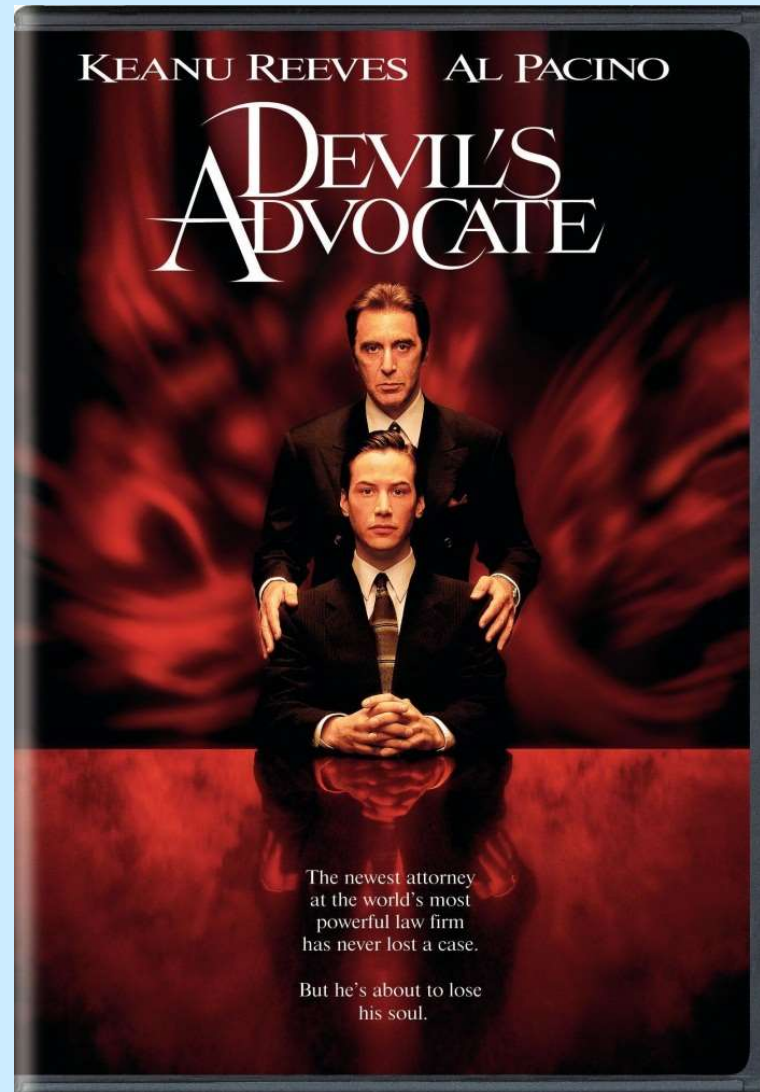
## Critical Thinking

1. Skeptical - "Is it true?"
2. Calculate - Check the facts ...  
AND  
... check the argument



## Opposing Viewpoints - seek them out!

Real Science doesn't follow fashionable trends or popularity ...  
it follows the scientific method and logical arguments.



## Ask Probing Questions

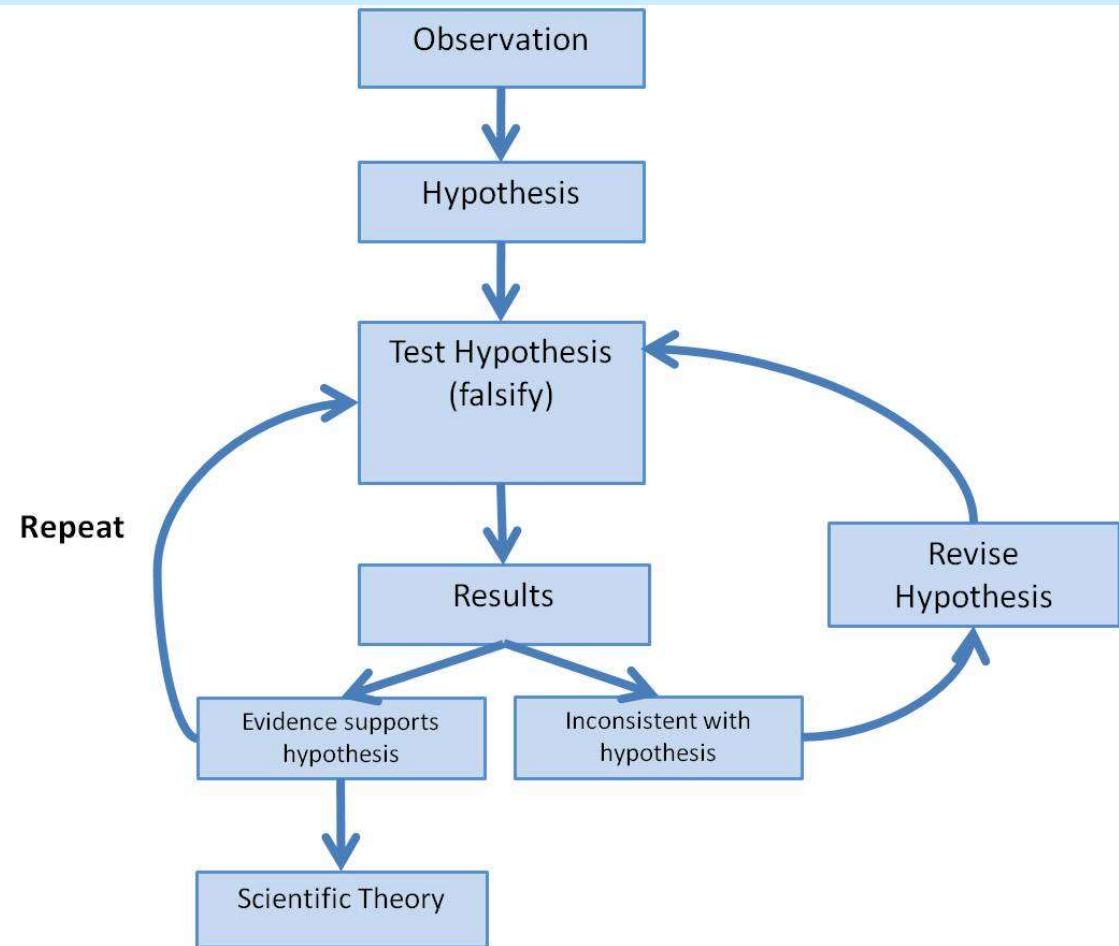
Prepare to be unpopular in following the thin red line of truth



## The Scientific Method



**KEEP  
CALM  
AND USE THE  
SCIENTIFIC  
METHOD**



# Avoid these ...

## strawman

**Misrepresenting someone's argument to make it easier to attack.**  
By exaggerating or oversimplifying, or just completely fabricating someone's argument, it's much easier to present your own position as being reasonable, but the first of dishonesty serves to undermine rational debate.  
After Will said that we should put more money into health and education, Warren responded by saying that he was surprised that Will hates our country so much that he wants to leave it defenseless by cutting military spending.

## false cause

**Presuming that a real or perceived relationship between things means that one is the cause of the other.**  
Many people confuse correlation (things happening together or in sequence) for causation (one thing actually causes the other to happen). Sometimes correlation is coincidental, or it may be attributable to a common cause.  
Pointing to a fancy chart, Roger shows how temperatures have been rising over the past few centuries, whilst at the same time the numbers of plagues have been decreasing. Thus plagues cool the world and global warming is a hoax.

## slippery slope

**Asserting that if we allow A to happen, then Z will consequently happen too, therefore A should not happen.**  
The problem with this reasoning is that it avoids engaging with the issue at hand, and instead shifts attention to baseless extreme hypotheticals. The merits of the original argument are then dismissed by unsubstantiated conjecture.  
Cain Coedel asserts that if we allow same-sex couples to marry, then the next thing we know we'll be allowing people to marry their parents, their cars and even monkeys.

## ad hominem

**Attacking your opponent's character or personal traits in an attempt to undermine their argument.**  
Ad hominem attacks can take the form of overtly attacking somebody, or casting doubt on their character. The result of an ad hominem attack can be to undermine someone without actually engaging with the substance of their argument.  
After Sally presents an eloquent and compelling case for a more equitable taxation system, Sam asks the audience whether we should believe anything from a woman who isn't married, was once arrested, and smokes a bit weed.

## special pleading

**Moving the goalposts or making up exceptions when a claim is shown to be false.**  
Humans are funny creatures and have a foolish aversion to being wrong. Rather than appreciate the benefits of being able to change one's mind through better understanding, many will invent ways to cling to old beliefs.  
Edward Johns claimed to be psychic, but when his abilities were tested under proper scientific conditions, they tragically disappeared. Edward explained this saying that one had to have faith in his abilities for them to work.

## loaded question

**Asking a question that has an assumption built into it so that it can't be answered without appearing guilty.**  
Loaded question fallacies are particularly effective at derailing rational debates because of their inflammatory nature - the recipient of the loaded question is compelled to defend themselves and they appear flustered or on the back foot.  
Grace and Helen were both romantically interested in Brad. One day with Brad sitting within earshot, Grace asked in an inquisitive tone whether Helen was having any problems with a fungal infection.

## the gambler's fallacy

**Believing that 'runs' occur to statistically independent phenomena such as roulette wheel spins.**  
This commonly believed fallacy can be said to have helped create a city in the desert of Nevada USA. Though the overall odds of a big run happening may be low, each spin of the wheel is statistically independent from the last.  
Red had come up six times in a row on the roulette wheel, so Craig knew that it was close to certain that black would be next up. Judging an economic form of natural selection with this thinking, he soon lost all of his savings.

## bandwagon

**Appealing to popularity or the fact that many people do something as an attempted form of validation.**  
The flaw in this argument is that the popularity of an idea has absolutely no bearing on its validity. If it did, then the Earth would have made itself fat for most of history to accommodate this popular belief.  
Shamus pointed a drunken finger at Sean and asked him to explain how so many people could believe in leprechauns if they're only a silly old superstition. Sean, however, had had a few too many Guinness himself and fell off his chair.

## black-or-white

**Where two alternative states are presented as the only possibilities, when in fact more possibilities exist.**  
Also known as the false dilemma, this rhetorical tactic has the appearance of forming a logical argument, but under closer scrutiny it becomes evident that there are more possibilities than the either/or choice that is presented.  
Whilst rallying support for his plan to fundamentally undermine citizens rights, the Supreme Leader told the people they were either on his side, or on the side of the enemy.

## begging the question

**A circular argument in which the conclusion is included in the premise.**  
This logically incoherent argument often arises in situations where people have an assumption that is very ingrained, and therefore taken in their minds as a given. Circular reasoning is bad mostly because it's not very good.  
The world of Zorbo the Great is flawless and perfect. We know this because it was close to certain that black would be next up. Judging an economic form of natural selection with this thinking, he soon lost all of his savings.

## appeal to nature

**Making the argument that because something is 'natural' it is therefore valid, justified, inevitable, good, or ideal.**  
Many 'natural' things are also considered 'good', and this can bias our thinking, but 'naturalness' itself doesn't make something good or bad. For instance, murder could be seen as very natural, but that doesn't make it justifiable.  
The medicine man rolled this into on his bandwagon offering various natural remedies, such as very special plain water. He said that it was only natural that people should be wary of artificial medicines like antibiotics.

## composition/division

**Assuming that what's true about one part of something has to be applied to all, or other, parts of it.**  
Often when something is true for the part it does also apply to the whole, but because this isn't always the case it can't be presumed to be true. We must show evidence for why a consistency will exist.  
Daniel was a precocious child and had a talent for logic. He reasoned that atoms are indivisible, and that he was made of atoms and therefore indivisible too. Unfortunately, despite his thinking skills, he lost the game of hide and seek.

## anecdotal

**Using personal experience or an isolated example instead of a valid argument, especially to dismiss statistics.**  
It's often much easier for people to believe someone's testimony as opposed to understanding variation across a continuum. Scientific and statistical measures are almost always more accurate than individual perceptions and experiences.  
Jason said that that was all cool and everything, but his grandfather smoked like 30 cigarettes a day and lived until 97 - so don't believe everything you read about media analyses of sound studies showing proven causal relationships.

## no true scotsman

**Making what could be called an appeal to purity as a way to dismiss relevant criticisms or flaws of an argument.**  
This fallacy is often employed as a measure of last resort when a point has been lost, seeing that a criticism is valid, yet not wanting to admit it, new criteria are invented to disassociate oneself or one's argument.  
Angus declares that scottmen do not put sugar on their porridge, but Jackson points out that he is a scottman and puts sugar on his porridge. Funnily, like a true Scot, Angus yells that no true scottman sugar his porridge.

## the texas sharpshooter

**Cherry-picking data clusters to suit an argument, or finding a pattern to fit a presumption.**  
This false cause fallacy is coined after a marksman shooting at barns and then painting a bullseye target around the spot where the most bullet holes appear. Outliers naturally appear by chance, and don't necessarily indicate causation.  
The makers of Sugartea Candy Drink claim to research showing that of the five countries where Sugartea drinks sell the most units, three of them are in the top ten healthiest countries on Earth, therefore Sugartea drinks are healthy.

## middle ground

**Saying that a compromise, or middle point, between two extremes must be the truth.**  
Much of the time the truth does indeed lie between two extreme points, but this can bias our thinking, sometimes a thing is simply untrue and a compromise of it is also untrue. A half-way between truth and a lie, is still a lie.  
Holy said that vaccinations caused autism in children, but her scientifically minded husband Caleb said that this claim had been debunked and proven false. Their friend Alice offered a compromise that vaccinations caused some autism.

# UNSCIENTIFIC METHOD

- STEP 1 - DEFINE QUESTION
- STEP 2 - FORM HYPOTHESIS
- STEP 3 - PERFORM TEST
- STEP 4 - ANALYZE DATA AND DRAW CONCLUSION
- STEP 5 - ~~REPORT YOUR RESULTS~~
- STEP 6 - ~~REPEAT AND VERIFY~~

Ignore contrary evidence  
Silence critics  
Scare the public  
enact legislation

We just want to bring some method to the madness.

# ... like the Plague!

## appeal to emotion

**Manipulating an emotional response in place of a valid or compelling argument.**  
Appeals to emotion include appeals to fear, envy, hatred, pity, guilt, and more. Though a valid and reasonable argument may sometimes have an emotional aspect, one must be careful that emotion doesn't obscure or replace reason.  
Luke didn't want to eat his sheep's brains with chopped liver and Brussels sprouts, but his father told him to think about the poor starving children in a third world country who weren't fortunate enough to have any food at all.

## the fallacy fallacy

**Presuming a claim to be necessarily wrong because a fallacy has been committed.**  
It is entirely possible to make a claim that is false yet argue with logical coherence for that claim, just as it is possible to make a claim that is true and justify it with various fallacies and poor arguments.  
Recognising that Amanda had committed a fallacy in arguing that we should eat healthy food because a nutritionist said it was popular, Alyse said we should therefore feed babies cocaine cheeseburgers every day.

## tu quoque

**Avoiding having to engage with criticism by turning it back on the accuser - answering criticism with criticism.**  
Literally translating as 'you too' this fallacy is commonly employed as an effective red herring because it takes the heat of the accused having to defend themselves and shifts the focus back onto the accuser themselves.  
Nicole identified that Hannah had committed a logical fallacy, but instead of addressing the substance of her claim, Hannah accused Nicole of committing a fallacy earlier on in the conversation.

## personal incredulity

**Saying that because one finds something difficult to understand, it is therefore not true.**  
Subjects such as biological evolution via the process of natural selection require a good amount of understanding before one is able to properly grasp them; this fallacy is usually used in place of that understanding.  
Ike drew a picture of a fish and a human and with effusive disdain asked Richard if he really thought we were stupid enough to believe that a fish somehow turned into a human through just, like, random things happening over time.

## burden of proof

**Saying that the burden of proof lies not with the person making the claim, but with someone else to disprove.**  
The burden of proof lies with someone who is making a claim, and is not upon anyone else to disprove. The reality, or discrimination, to disprove a claim does not make it valid. However we must always go by the best available evidence.  
Bertrand declares that a leopard is, at this very moment, in either around the Sun between the Earth and Mars, and that because no one can prove him wrong his claim is therefore a valid one.

## ambiguity

**Using double meanings or ambiguities of language to mislead or misrepresent the truth.**  
Politicians are often guilty of using ambiguity to mislead and will later point to how they were technically not caught lying if they come under scrutiny. It's a particularly thorny and defended fallacy to commit.  
When the judge asked the defendant why he hadn't paid his parking fine, he said that he shouldn't have to pay them because the sign said 'fine for parking here' and so he naturally presumed that it would be fine to park there.

# thou shalt not commit logical fallacies

A logical fallacy  
Don't be fo

A logical fallacy is a flaw in reasoning. Logical fallacies are like tricks or illusions of thought, and they're often very sneaky used by politicians and the media to fool people. Don't be fooled! This website has

media, and others to fool people.  
logicalfallacyis.com/strawman



# Critical Thinking for beginners

Pan for the gold nuggets of truth.



## Science Critical Thinking Question #1 Rain Forests Increasing? or Decreasing?



Don't be a sponge, believing everything said by anybody.

### Tear down the Amazon rainforest idol 'Save the trees' more political myth than environmental truth

*New York Times (29 Jan 2009)* Here, and in other tropical countries around the world, small holdings like Ms. Ortega de Wing's — and much larger swaths of farmland — are reverting to nature, as people abandon their land and move to the cities in search of better livings. These new "secondary" forests are emerging in Latin America, Asia and other tropical regions at such a fast pace that the trend has set off a serious debate about whether saving primeval rain forest — an iconic environmental cause — may be less urgent than once thought. By one estimate, for every acre of rain forest cut down each year, more than 50 acres of new forest are growing in the tropics on land that was once farmed, logged or ravaged by natural disaster.

### Amazon rainforest vanishing at twice rate of previous estimates

*UK Guardian (21 Oct 2005)* The Amazonian rainforest is being destroyed at double the rate of all previous estimates, according to research published today in the journal Science. The destruction is leaving the forest more prone to fires and allowing more carbon dioxide to be released into the atmosphere, according to scientists. A new analysis of satellite images of the Brazilian part of the Amazon basin, which forms part of the largest contiguous rainforest on Earth, shows that on average 15,500 sq km (6,000 square miles) of forest is being cut down by selective logging each year. This is besides a similar amount clear-cut annually for cattle grazing or farming.



Is it true?



Dirty test tube?



### Are rainforests drastically decreasing?

From the two articles above ...

- 1) Write 3 facts "for" and 3 facts "against".
- 2) What do you think and why?

Pan for the gold nuggets of truth.



## Science Critical Thinking Question #3 Arsenic Alien DNA ... or Not?



Don't be a sponge, believing anything said by anybody.

### 'Life as we don't know it' discovery could prove existence of aliens

*Telegraph UK (1 Dec 2010)* The discovery could prove the theory of "shadow" creatures which exist in tandem with our own and in hostile environments previously thought uninhabitable. The "life as we don't know it" could even survive on hostile planets and develop into intelligent creatures such as humans if and when conditions improve.

*NASA funded research discovers life built with toxic chemical*  
*NASA (2 Dec 2010)* Researchers conducting tests in the harsh environment of Mono Lake in California have discovered the first known microorganism on Earth able to thrive and reproduce using the toxic chemical arsenic. The microorganism substitutes arsenic for phosphorus in its cell components.

*Incredible microbe found in California Lake*  
*Daily Mail UK (3 Dec 2010)* The excitement centres on the bug's ability to thrive on arsenic, one of the most toxic elements on the planet. It can even incorporate arsenic into its DNA, making it part of its very being. As every other form of known life uses phosphorus rather than arsenic as a key building block of its DNA, the find suggests that a second form of life is with us. And if one alien life-form exists, enthusiasts argue, it is highly likely that there are others out there.



*"This Paper Should Not Have Been Published"*  
*Scientists see fatal flaws in the NASA study of arsenic-based life.*  
*Slate (7 Dec 2010)* "Low levels of phosphate in growth media, naive investigators and bad reviewers are the stories here," said Norman Pace of the University of Colorado, a pioneer of identifying exotic microbes by analyzing their DNA.

*Fallout from Nasa's 'arsenic bacteria'*  
*Guardian UK (7 Dec 2010)* "When the Nasa scientists took the DNA out of the bacteria, for example, they ought to have taken extra steps to wash away any other kinds of molecules. Without these precautions, arsenic could have simply glommed to the DNA, like gum on a shoe. 'It is pretty trivial to do a much better job,' said Rohwer."

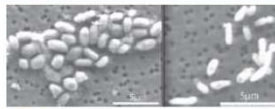
*Arsenic and post-haste*  
*WUWT Blog (7 Dec 2010)* Harvard microbiologist Alex Bradley, the NASA scientists unknowingly demonstrated the flaws in their own experiment. They immersed the DNA in water as they analyzed it, he points out. Arsenic compounds fall apart quickly in water, so if it really was in the microbe's genes, it should have broken into fragments. But the DNA remained in large chunks — presumably because it was made of durable phosphate. NASA scientists were feeding the bacteria salts which they freely admit were contaminated with a tiny amount of phosphate. It's possible, the critics argue, that the bacteria eked out a living on that scarce supply.



Is it true?



Dirty test tube?



### Has Arsenic built DNA been found?

From the news articles above ...

- 1) Write 3 facts "for" and 3 facts "against".
- 2) Write 2 paragraphs explaining each side of the argument.
- 3) What do you think and why?

NASA scientist collecting "arsenic bacteria"

"Arsenic bacteria" both growing on a little bit of phosphorus

Pan for the gold nuggets of truth.



## Science Critical Thinking Question #2 Animal Biodiversity Decreasing Dangerously ... or Not?



Don't be a sponge, believing anything said by anybody.

### Biodiversity Crisis

*Guardian (21 May 2010)* In every corner of the globe the evidence of the global biodiversity crisis is now impossible to ignore... Around the world the picture is as bad or worse: the International Union for the Conservation of Nature believes one in five mammals, one in three amphibians and one in seven birds are extinct or globally threatened, and other species groups still being assessed that are showing similar patterns. Simon Stuart, a senior IUCN (Red List) scientist, has warned that for the first time since the dinosaurs humans are driving plants and animals to extinction faster than new species can evolve.

### Mass Lizard Extinctions Looming

*One in five lizard species predicted to vanish by 2080.*  
*National Geographic (13 May 2010)*... The scientists created a computer model incorporating temperature data back to 1975... Global warming will hit lizards in the Amazon and Madagascar especially hard, the computer model predicted. "The number of local extinctions we're seeing [in the Amazon], based on the model, is through the roof," Sinervo said. "It's 60, 70, 80 percent even in some places."



An Extinct Real Dodo

Is it true?



Dirty test tube?

### Are Animal Species decreasing catastrophically?

From the news articles above ...

- 1) Write 3 facts "for" and 3 facts "against".
- 2) What do you think and why?



An Extinct Computer Model Dodo

Pan for the gold nuggets of truth.



## Science Critical Thinking Question #4 Oceans Dangerously Acidic ... or Not?



Don't be a sponge, believing anything said by anybody.

### Oceans "under new threat"

*BBC Radio4 (26 Jan 2010)* Scientists are warning of the dangers of ocean acidification which is beginning to have an impact on the fundamental biology of marine ecosystems. In the 250 years since the start of the industrial revolution the acidity of the seas has increased by 30 percent.

*Jellyfish are taking over the oceans: Population surge as rising acidity of world's seas kills predators*

*UK Mail (3 Dec 2010)* The new report, published by the UN Environment Programme during the Climate Change talks in Cancun, Mexico, warns that the acidification of oceans makes it harder for coral reefs and shellfish to form skeletons — threatening larger creatures that depend on them for food... *tropical coral reefs will be extinct within the next 50 years.*

*UK Telegraph (11 Jan 2011)* A rise in temperature in the water causes coral bleaching as the algae that live inside the skeletons are no longer able to survive. Increased carbon dioxide in the atmosphere is also causing ocean acidification, which makes it difficult for corals to build their calcium carbonate skeletons. The last year is estimated to be one of the worst years for coral bleaching with more than 16 per cent of coral reefs suffering from the condition. Professor Jonathan Ballie, Director of Conservation Programmes at ZSL, warned that coral reefs will be "functionally extinct" within the lifetime of our grandchildren.



Dead coral caused by more CO2 making acidic oceans

Is it true?



Dirty test tube?

### Are the Oceans becoming dangerously acidic?

From the news articles above ...

- 1) Write 3 facts "for" and 3 facts "against".
- 2) Write 2 paragraphs explaining each side of the argument.
- 3) What do you think and why?

### 'Everything dead by tomorrow' warns Zoological Society of London

*UK Telegraph (11 Jan 2011)* If the ZSL wants to make a list of pretty corals, why can't it just distribute it with facts about their habitats and their formation, maybe with lots of nice shiny pictures for us all to wonder at? Why must they lace their message with doom... is this another of those overblown eco-panics...?

*Ocean Acidification: Chicken Little of the Sea Strikes Again*  
*US WUWT Blog (10 Jan 2011)*... when sudden increases of atmospheric CO2 have been tested under laboratory conditions, "otoliths (aragonite ear bones) of young fish grown under high CO2 (low pH) conditions are larger than normal, contrary to expectation (Checkley et al. 2009). The low pH levels from 60 mya to 40 mya include the infamous Paleocene-Eocene Thermal Maximum (PETM). E ven then, the oceans did not actually "acidify," the lowest pH was 7.42 (still basic).

*Oceans on Acid again*  
*UK Times (4 Nov 2010)* Environmentalists like to call this a 30% increase in acidity, because it sounds more scary than a 0.3 point (out of 14) decrease in alkalinity, but no matter. It is still well within the bounds of normal variation over space and time. Before I started looking into this, I assumed the evidence for damage from ocean acidification must be strong because that is what the media kept saying. I am amazed by what I have found.



Coral likes water with higher CO2 levels





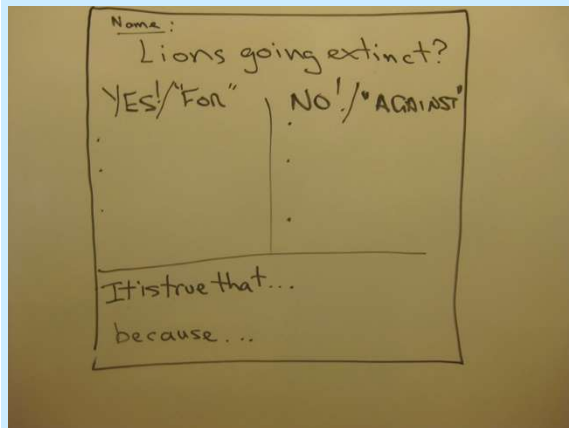
## African Lions Should Not Be Listed as Endangered

Is the condition of the lion really that dire? Fortunately, the most recent scientific data say no. A [comprehensive study](#) published last December concluded that there are between 32,000 and 35,000 lions living in the wild in Africa. The lion population is spread across 27 countries, with nine countries having populations of at least 1,000 lions. (See "[The Serengeti Lion](#)." ) Of greatest significance is the fact that 24,000 of the lions, which is at least 68 percent of the total population, live in what the study terms "strongholds." Strongholds are areas that meet "the necessary requirements for [the] long-term viability" of their lion populations.

This is simply not the portrait of a species that is "in danger of disappearing in our lifetimes." The best scientific data do not support the notion that the lion is currently in danger of extinction.

Indeed, at a recent lion workshop convened by the Fish and Wildlife Service, the three lion experts invited to address the assembly—Paula White, director of the [Zambia Lion Project](#); Jason Riggio, principal author of the study cited above; and [Craig Packer](#) of the University of Minnesota—were unanimous in their opinion that the lion is not currently in danger of extinction.

Are Lions going extinct ... or not?



## The circle of life is closing in on the king of the jungle.

When [Minnesota dentist Walter Palmer killed Cecil the lion](#), the Internet exploded with outrage. But scientists who have studied lions say the big cats have been in big trouble for years.

They've watched the African lion population shrink by more than half since 1980 and dwindle even faster in East Africa, where lions used to be most abundant. They've seen trophy hunting like Palmer's - promoted as a way of raising cash to preserve wildlife populations- fail to live up to its promise.

And even more importantly, they've seen lion habitat shrink and many beasts killed by local residents because of conflict with livestock and agriculture.

When humans and lions clash, the king of the jungle usually loses.

"We should be very worried," said Oxford University lion researcher Hans Bauer, who is based in Ethiopia.

"The numbers are clear. [They are in dramatic decline.](#)"

Experts estimate there were about 75,000 African lions in 1980; now there are between 20,000 and 32,000. Last year the United States Fish and Wildlife Service proposed placing African lions on the threatened-but-not-endangered list. On its red list of species in trouble, the International Union for the Conservation of Nature calls the lion "vulnerable," [one step away from endangered.](#)



Human "GroupThink" is an Evolutionary Stable Strategy  
(stay in the group, run with the herd ... and you survive and reproduce)



Why We Fear the Things We Shouldn't—  
and Put Ourselves in Greater Danger

*The*  
SCIENCE  
*of*  
FEAR



DANIEL GARDNER

Are we are running with the herd ... again ...  
...& stampeding over the cliff of missing scientific evidence?





# SWEDEN: AN EASILY TRICKED COUNTRY?

Swedes are now THE most "aware" or "scared" in Europe about "saving-the-environment"

Are we leading the way or going the wrong way? 1 step ahead or 2 steps behind?

Public opinion in the European Union

Autumn 2015

Standard Eurobarometer 84

Tables of results

QA4a And personally, what are the two most important issues you are facing at the moment?

(%)

	The environment, climate and energy issues		Pensions		Working conditions		Living conditions	
	Aut. 2015	Diff. Aut. 2015 - Sp. 2015	Aut. 2015	Diff. Aut. 2015 - Sp. 2015	Aut. 2015	Diff. Aut. 2015 - Sp. 2015	Aut. 2015	Diff. Aut. 2015 - Sp. 2015
<b>EU28</b>	5	0	14	-1	8	-1	8	0
<b>EURO AREA</b>	5	0	14	-1	8	-2	7	0
<b>NON-EURO AREA</b>	5	0	15	-1	8	0	10	-1
BE	9	1	16	0	6	-1	6	-1
BG	3	0	20	-1	8	-1	18	0
CZ	6	0	18	2	10	-2	8	1
DK	12	3	7	-2	8	-2	4	0
DE	6	-1	12	-5	5	-3	6	0
EE	3	0	18	-2	7	0	9	-1
IE	5	2	9	0	6	-1	4	0
EL	1	0	22	5	5	-3	6	-2
ES	3	2	14	1	11	0	7	2
FR	7	-1	15	2	8	-1	5	-2
HR	4	3	15	-2	10	0	14	1
IT	3	0	13	0	12	1	11	1
CY	1	0	7	3	8	1	5	-5
CY(tcc)	3	1	N.A.	N.A.	3	-5	8	-4
LV	1	0	19	-1	7	-2	6	-2
LT	1	0	16	1	7	0	5	0
LU	9	2	6	-2	9	2	5	-1
HU	3	0	17	-2	10	-2	13	-2
MT	16	-1	14	-3	8	-4	6	1
NL	14	0	14	0	9	0	5	0
AT	5	-4	14	0	11	1	12	1
PL	3	1	16	-2	11	0	13	-3
PT	1	0	18	-1	12	4	17	8
RO	3	-1	18	-2	11	-1	19	3
SI	4	1	18	3	11	0	14	0
SK	4	1	16	0	9	0	7	0
FI	10	-3	13	-1	10	3	9	0
SE	22	-3	11	-3	9	1	9	-2
UK	5	0	14	1	5	1	4	-1
TR	2	-2	9	0	7	-2	17	2
MK	4	1	7	1	13	2	19	2
ME	7	4	10	-1	8	-1	14	-2
RS	3	-1	16	2	10	0	18	-3
AL	6	-3	2	-2	9	1	12	-3

## An "Evidence-Based Science" trend to a bright happy future society



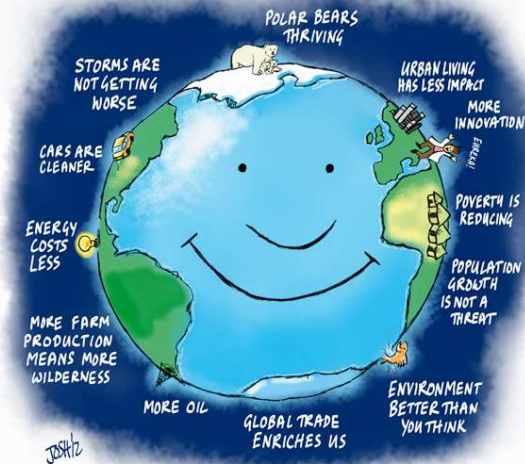
### More of everything:

- More energy use
- More consumption
- Cleaner environment
- More people
- More live in cities
- More wilderness
- Healthier people
- Happier people
- Longer lives

(Check the evidence ...  
... not the emotion :-)  
(Check the facts ...  
... not the fiction :-)



## PLANET UNDER ~~NOT MUCH~~ PRESSURE

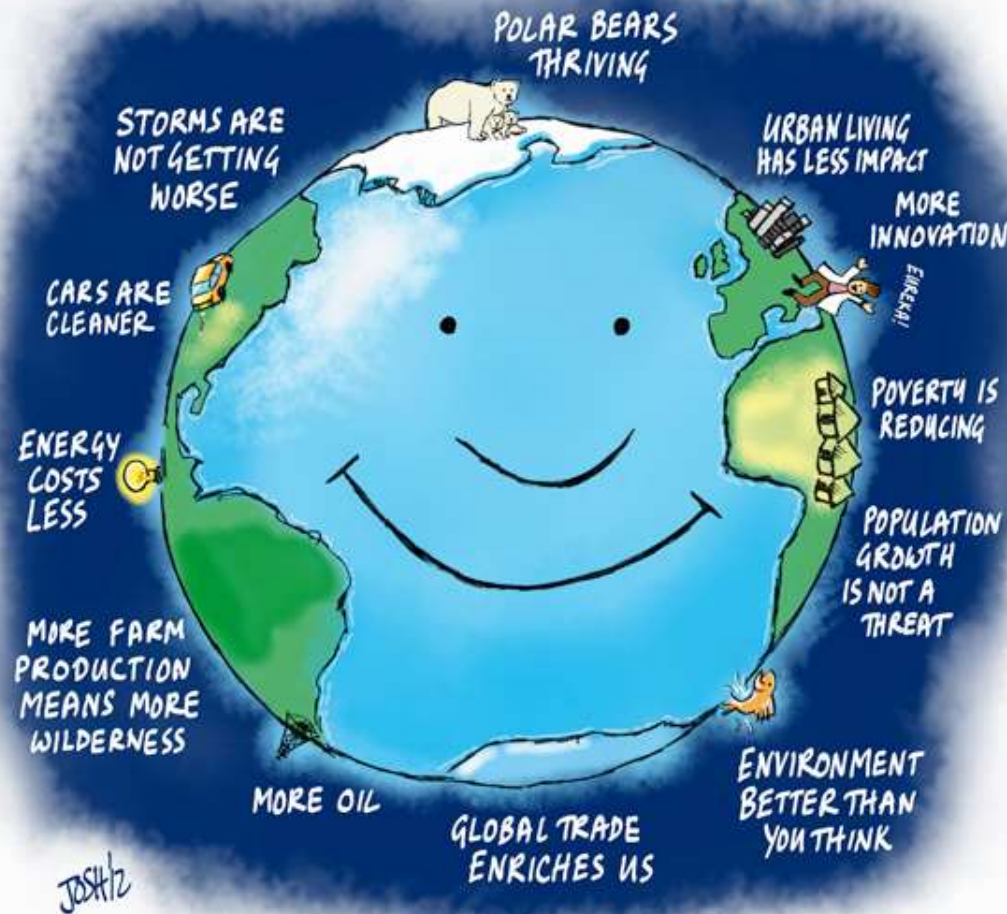


**A DOZEN REASONS TO BE CHEERFUL**  
(FOR LOTS MORE SEE 'THE RATIONAL OPTIMIST' BY MATT RIDLEY)

<http://www.rd.com/best-of-america/cheer-up-17-reasons-its-a-great-time-to-be-alive/>  
<http://bishophill.squarespace.com/blog/2012/4/2/optimistography-josh-159.html>  
<http://www.rationaloptimist.com/blog/reader's-digest.aspx>



# PLANET UNDER **NOT MUCH** PRESSURE



**A DOZEN REASONS TO BE CHEERFUL**  
(FOR LOTS MORE SEE 'THE RATIONAL OPTIMIST' BY MATT RIDLEY)



## Källkritiska tips och tankar kring naturvetenskap

En av skolans uppgifter är att utveckla elevernas kritiska tänkande och vetenskapliga förhållningssätt. Källkritik och kritiskt tänkande innebär bland annat att kunna förhålla sig kritisk gentemot forskning inom ett visst ämnesområde. I den här artikeln får du läsa mer om källkritik inom ämnet naturkunskap.

# Kolla Källan

Se även

- Lathund i källkritik
- Sök domäner

Hämta dokument

- Kolla källans litteraturlista, 2011 (43 kB)

Andra webbplatser

- Källkritik på Internet (iis.se)
- Källkritik (Mediekompass)
- Källkritik (Lunds universitet)



I grundskolans kursplaner för de naturorienterade ämnena (biologi, fysik och kemi) står det att undervisningen ska "bidra till att eleverna utvecklar ett kritiskt tänkande kring sina egna resultat, andras argument och olika informationskällor. Genom undervisningen ska eleverna också utveckla förståelse för att påståenden kan prövas och värderas med hjälp av naturvetenskapliga arbetsmetoder."

I ett vetenskapligt förhållningssätt ingår dock att även kritiskt granska vetenskapens metoder och resultat, vilket ämnesplanen också betonar. <http://www.skolverket.se/skolutveckling/itiskolan/kollakallan/kallkritik/artikelarkiv/2012/naturvetenskap-1.165842>

Det kan finnas konkurrerande teorier som stöds av andra forskare. Andra saker som kan styra forskningsresultat är finansiering och det är **viktigt att ställa frågan om den institution eller det företag som finansierar forskningen har någon särskild agenda**. Ytterligare en faktor som kan komplicera tillförlitligheten är konkurrens inom forskarvärlden.

När de är väl förtrogna med vetenskapliga metoder samtidigt som de stärker sitt kritiska förhållningssätt så har de tagit ett stort kliv närmare läroplanens mål att utveckla "ett alltmer vetenskapligt sätt att tänka och arbeta"

**Låt eleverna studera några konkurrerande teorier inom ett aktuellt forskningsområde, exempelvis växthuseffekten och klimathotet. Hur skiljer sig teorierna från varandra? Vilka fakta grundar de sig på? Hur kan forskarna komma till så olika slutsatser? Har någon av teorierna fått ett större utrymme i media?**



# The Climate Debate ... is it true?



Emotion



Evidence



Lake Tahoe Surface Station,  
official NOAA weather station



## Globala uppvärmningen visar sitt fula tryne

08:00 | 15-11-02

Kommentera



Skriv ut TIPS!

Bienvenue, välkommen till framtiden! Ta en promenad i det vackra höstvädret. Eller är det sensommarvädret?

<http://www.unt.se/uppland/uppsala/globala-uppvarmningen- visar-sitt-fula-tryne-3951304.aspx>



## Global warming 'hiatus' debate flares up again

Researchers now argue that slowdown in warming was real.

Jeff Tollefson <http://www.nature.com/news/global-warming-hiatus-debate-flares-up-again-1.19414#/b2>

## Making sense of the early-2000s warming slowdown

John C. Fyfe, Gerald A. Meehl, Matthew H. England, Michael E. Mann, Benjamin D. Santer, Gregory M. Flato, Ed Hawkins, Nathan P. Gillett, Shang-Ping Xie, Yu Kosaka and Neil C. Swart

It has been claimed that the early-2000s global warming slowdown or hiatus, characterized by a reduced rate of global surface warming, has been overstated, lacks sound scientific basis, or is unsupported by observations. The evidence presented here contradicts these claims.



# Phosphorus Scare = Bad Maths

Emotion

Evidence



## THE CONVERSATION

Academic rigour, journalistic flair

JUN 27, 2013 @ 12:59 PM 11,329 VIEWS

## There Is No Phosphorus Shortage



Tim Worstall, CONTRIBUTOR

I have opinions about economics, finance and public policy.



Charly Faradji

Marie Curie Research Fellow,  
School of Chemistry, University of  
Bristol



Marissa de Boer

Researcher VU Amsterdam,  
Project Manager SusPhos, VU  
University Amsterdam

### How the great phosphorus shortage could leave us all hungry

February 11, 2016 12.20pm GMT

**World Resources:** Some world reserves were reported only in terms of ore and grade. Phosphate rock resources occur principally as sedimentary marine phosphorites. The largest sedimentary deposits are found in northern Africa, China, the Middle East, and the United States. Significant igneous occurrences are found in Brazil, Canada, Finland, Russia, and South Africa. Large phosphate resources have been identified on the continental shelves and on seamounts in the Atlantic Ocean and the Pacific Ocean. **World resources of phosphate rock are more than 300 billion tons.** [http://minerals.usgs.gov/minerals/pubs/commodity/phosphate\\_rock/mcs-2016-phosp.pdf](http://minerals.usgs.gov/minerals/pubs/commodity/phosphate_rock/mcs-2016-phosp.pdf)

World phosphate rock production was expected to increase incrementally from 223 million tons in 2015 to 255 million tons in 2019. The leading areas of growth were planned in Africa and the Middle East. In Morocco, mine production capacity was expected to double owing to expansion of existing mines and development of a new mining complex. Phosphate-processing plants are planned to triple in capacity by 2018 through construction of new facilities. In Saudi Arabia, a new 5.3-million-ton phosphate mining and processing complex was under construction with completion expected by late 2016.

$$\frac{300 \text{ billion}}{223 \text{ million}} = 1345 \text{ years}$$

“enough to keep us going past the heat death of the universe” 😊

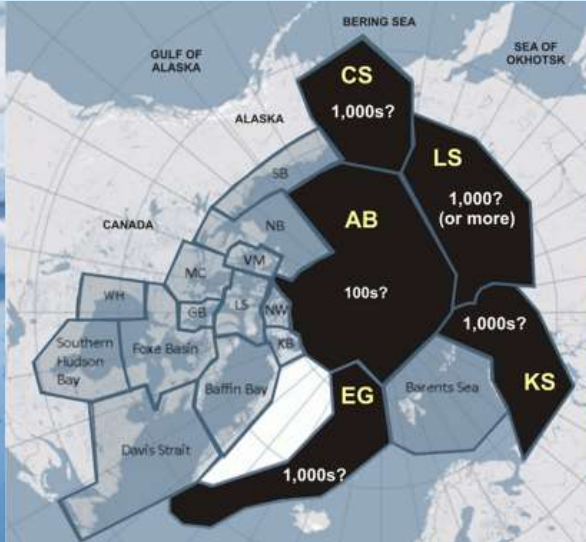
<http://www.bishop-hill.net/blog/2016/2/16/flogging-the-phosphorus-horse.html>



# The Polar Bear Debate: Going Extinct ... or "Fats as Pigs" ?



Emotion



Evidence



## Melting Ice Means No Dinner for Polar Bears—So They're Eating Each Other

For polar bears, melting ice means limited seal-hunting.



A polar bear and her cub smile for the camera at a German zoo in 2008. (Photo: Getty Images)

<http://www.takepart.com/article/2013/03/25/will-your-suv-wipe-out-all-polar-bears>

While polar bears *may* be negatively affected by declines in sea ice sometime in the future, so far **there is no convincing evidence that any unnatural harm has come to them.** Indeed, global population size (described by officials as a "tentative guess") appears to have grown slightly over this time, as the maximum estimated number was 28,370 in 1993 (Wiig and colleagues 1995; range 21,470-28,370) but **rose to 31,000 in 2015** (Wiig and colleagues 2015, [pdf [here](#)] aka [2015 IUCN Red List](#) assessment; range 20,000-31,000).

<https://polarbearscience.com/2016/02/25/ten-dire-polar-bear-predictions-that-have-failed-as-global-population-hits-20-31k/>

## Contradictory Save-the-Planet eaters



Emotion



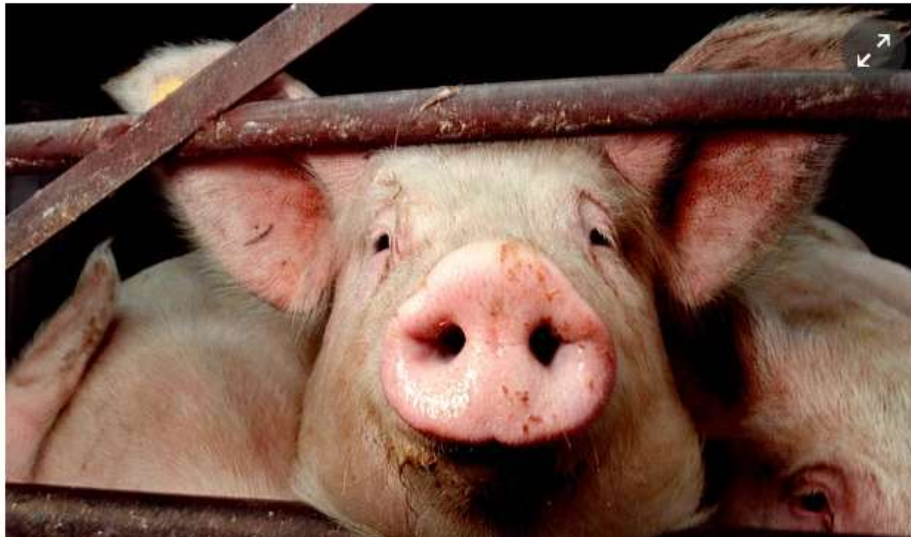
Evidence

A New Year resolution that's good for you and the planet: stop eating meat

Raising beef cattle requires 160 times more land and causes 11 times more greenhouse gas emissions when compared to crops like wheat, rice or potatoes

Lettuce 'three times worse than bacon' for the environment, scientists claim

Greenhouse gas emissions from lettuce production are three times higher per calorie than from bacon, study finds





# Politics & Business is NOT Science

Majority Wins



Evidence & Logic Valued

Death by Business PPPs



Life by Science PPPs 😊

I'm Right!

I'm Right!

I'm Right!

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So, VOTE! VOTE! VOTE! for ME! ME! MEEEEEE!

I'm Right!

I'm Right!

I'm Right!

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So, BUY! BUY! BUY!

FOR:

Scientific Evidence 1?

Scientific Evidence 2?

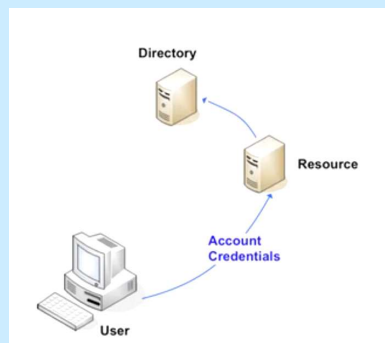
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Logical Conclusion 1?

AGAINST:

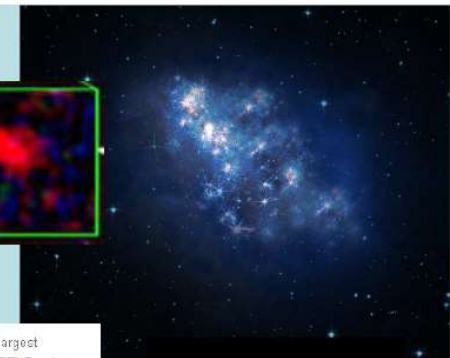
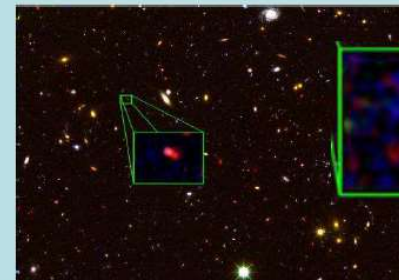
Scientific Evidence 3?

Scientific Evidence 4?

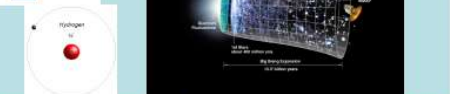
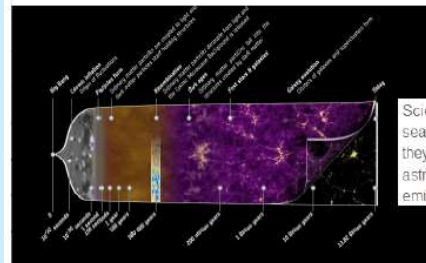
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Logical Conclusion 2?



Farthest confirmed galaxy at 13.1 Gy



The team used Keck Observatory's Keck I telescope in Hawaii, one of the largest optical/infrared telescopes in the world, to measure the redshift of the CANDELS galaxy designated z8\_CND\_5296 at 7.51, the highest galaxy redshift ever confirmed. The redshift means this galaxy hails from a time only 700 million years after the Big Bang.



Scientists use hydrogen to calculate distances of galaxies. The research team searched for a hydrogen emission line in the 43 galaxies they observed, but they only saw the emission line in z8\_CND\_5296. This surprised the astronomers because they were expecting to find about six galaxies with the emission line.

<http://www.space.com/23305-ancient-galaxy-farthest-ever-seen.html>  
<http://www.bis.gov.uk/ukspacagency/news-and-events/2013/Mar/riankk-challenges-our-understanding-of-the-universe>

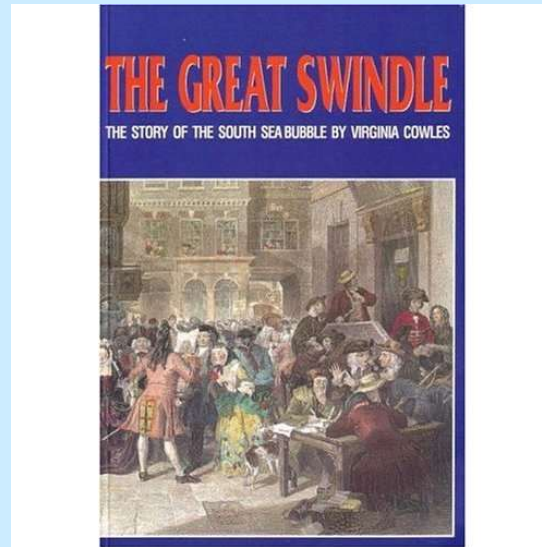
Politicians make policies on consensus **versus** Science checks the evidence and logic of arguments

There IS a difference

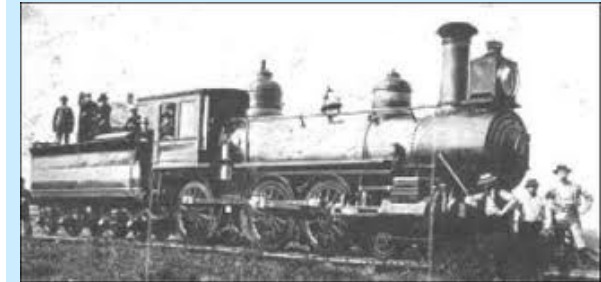
# Humans make more mistakes



The Great Tulip Bulb Mania  
– Holland 1637



The South Sea Bubble  
– England 1720



The Railway Stocks Bubble  
– USA 1893



Eugenics – 1910s



Prohibition – 1920s



Lysenkoism – Russia 1950s



## Calm Islands of Truth Seeking in Stormy Seas with Oceans of Emotion

**Schools** - Teach true statements  
Teach skills to find true statements  
Research to find new true statements

Teach students how to think, rather than what to think.  
Teach about ideas, rather than endorse ideas.  
Teachers are not in the "making good citizens" business,  
Teachers are in the "making educated citizens" business.



# Kvarngårdesskolan - Uppsala International School



UNIVERSITY *of* CAMBRIDGE  
International Examinations

Excellence in education

