Asking Questions to Foster **Critical Thinking in Science**

Refining questioning techniques to expose logical fallacies





HOW Can We use to expose logical fallacies in science?

Asking Questions to Foster Critical Thinking in Science

questioning techniques

Logical Fallacies Kahoot!

Login to the Kahoot! to preview logical fallacies.

Asking Questions to Foster Critical Thinking in Science



Logical Fallacies

0 plays • 0 players



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Discussion

Which logical fallacies have you seen in action?

Share an example.



Can you spot your logical fallacy?

Do any others apply?



ting someone's argument to make it easier to attack.

By exaggerating, misrepresenting, or just completely fabricating some argument, it's much easier to present your own position as being reasonable, but this kind of dishonesty serves to undermine rational debate. After Will said that we should be nice to kittens because they're fluffy and cute. Bill says that Will is a cat supremacist who we



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 merit of the original argument are then tainted by unsubstantiated conjecture Colin asserts that if we allow children to play video games, then the next thing you imow we'll be living a in a post-apocalyptic zomble wasteland with no money for guard rails to protect people from slippery slopes.



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 wron 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 magically disappeared. Edward explained this saying that one had to have faith in his abilities for them to work.



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 b low, each spin of the wheel is itself entirely independent from the last. Red had come up six times in a row on the roulette wheel, so Greg knew that it was close to certain that black would be next up. Suffering an economic form of natural selection with this thinking, he soon lost all of his savings.



Where two alternative states are presented as the only possibilities, when in fact more possibilities exist.

Also known as the false dilemma, this insidious 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 tallying 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



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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) or causation (that one thing actually causes the other to happen). Sometimes relation 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, while at the same time the numbers of pirates have been



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 hom attack can be to undermin one without actually engaging with the substance of their argument. After Saily presents an eloquent and competing case for a more equitable taxation system. Sam asks the audience whether we should believe anything rom a woman who isn't married and probably eats her own boogers



Asking a guestion 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 debate because of their inflammatory nature - recipients of a loaded question are compelled to defend themselves and may appear flustered or on the back foo 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 aving any problems with a fungal infection



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 n

earing on its validity. If it did, then the Earth would have made itself flat for ost of history to accommodate this popular belief.

hamus pointed a 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 vondered how so many people could believe in things based on popularity.

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 word of Zorbo the Great is flawless and perfect. We know this because it says so in The Great and Infallible Book of Zorbo's Best and Most Truest Things that are Definitely True and Should Not Ever Be Questioned.





Saying that because an authority thinks something, it must therefore be true.

It's important to note that this fallacy should not be used to dismiss the claims of sperts, or scientific consensus. Appeals to authority are not valid arguments, bu nor is it reasonable to disregard the claims of experts who have a demonstrated depth of knowledge unless one has a similar level of understanding. Unable to defend his argument that the Earth is flat, Bob said that his friend Terry was a qualified botanist who also believed the Earth to be flat, and had even see it from up in a tree.



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 mean it's justifiable. The medicine man rolled into town 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.



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 liking for logic. He reasoned that atoms are invisible, and that he was made of atoms and therefore invisible too. Unfortunately, despite his thinky skills, he lost the game of hide and go seek.



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 experience Jason said 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 meta analyses of well-designed studies showing proven causal relationships.





justify it with various fallacies and poor arguments

understand, it's therefore not true.

mislead or misrepresent the truth.

fallacy has been committed.

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 reasoned, argument may sometimes have an emotional one must be careful that emotion doesn't obscure or replace reaso Luke didn't want to eat his sheep brains with chopped liver and brussels sprouts, but his father told him to think about the poor, starving children in a third world ry who weren't fortunate enough to have any food at all.



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 off the accused having to defend themselves and shifts the focus back onto the accuser themselve 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.



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 inability, or disinclination, to disprove a claim does not make it valid (however we must always go by the best available evidence). Bertrand declares that a teapot is at this very moment, in orbit around the Sun between the Earth and Mars, and that because no one can prove him wrong his



Making what could be called an appeal to purity as a way to dismiss relevant criticisms or flaws of an argument. This failacy is often employed as a measure of last resort when a point has beer lost. Seeing that a criticism is valid, yet not wanting to admit it, new criteria an

nvoked to dissociate oneself or one's argument. Angus declares that Scotsmen do not put sugar on their porridge, to which Lachlan points out that he is a Scotsman and puts sugar on his porridge. Furious, like a true Scot, Angus yells that no true Scotsman sugars his porridge



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 ainting a bullseye target around the spot where the most bullet holes appear. Clusters naturally appear by chance, and don't necessarily indicate causatio The makers of Sugarette Candy Drinks point to research showing that of the five countries where Sugarette drinks sell the most units, three of them are in the top ten healthiest countries on Earth, therefore Sugarette drinks are healthy.



Judging something good or bad on the basis of where it comes from, or from whom it comes. To appeal to prejudices surrounding something's origin is another red herring fallacy. This fallacy has the same function as an ad hominem, but applies stead to perceptions surrounding something's source or context. Accused on the 6 o'clock news of corruption and taking bribes, the senator said that we should all be very wary of the things we hear in the media, because we all know how very unreliable the media can be.



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. Half way between truth and a lie, is still a lie. Holly said that vaccinations caused autism in children, but her scientifically well-read friend Caleb said that this claim had been debunked and proven fa Their friend Alice offered a compromise that vaccinations cause some autism

Download this poster at www.yourfallacy.is

Presuming a claim to be necessarily wrong because a

It is entirely possible to make a claim that is false yet argue with logical ency for that claim, just as it is possible to make a claim that is true and Recognising that Amanda had committed a fallacy in arguing that we shou

eat healthy food because a nutritionist said it was popular, Alyse said we should therefore eat bacon double cheeseburgers every day.



Saying that because one finds something difficult to

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. Kirk 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



Using double meanings or ambiguities of language to

Politicians are often guilty of using ambiguity to mislead and will later point to ow they were technically not outright lying if they come under scrutiny. It's a particularly tricky and premeditated fallacy to commit. When the judge asked the defendant why he hadn't paid his parking fines, he said that he shouldn't have to pay them because the sign said 'Fine for parkin here' and so he naturally presumed that it would be fine to park there.



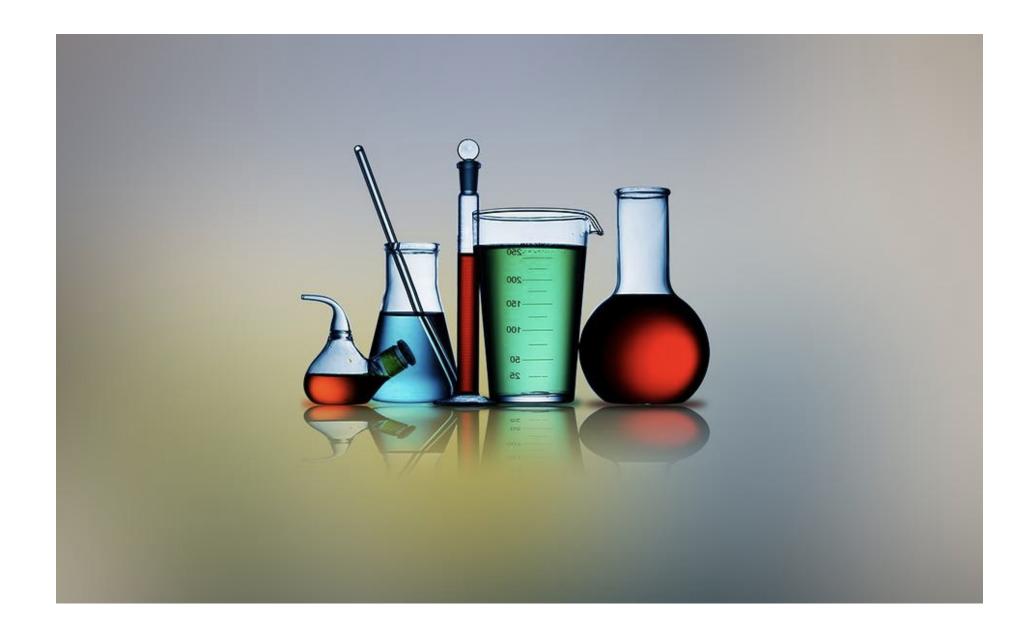




Are logical fallacies common in science?

Why or why/not?







Claims, Evidence and Reasoning

We use claims, evidence and reasoning to make sense of science.

If we don't have solid evidence and reasoning that logically links our claims and evidence, our claims risk becoming invalidated.

Science that isn't valid is BAD science!





Hypotheses are usually <u>claims</u>.

The data that you collect is <u>evidence</u> to support or disprove your claim.

<u>Reasoning</u> links your claims to your evidence. This is where critical thinking comes in!



Claim: Bigfoot Is Real!



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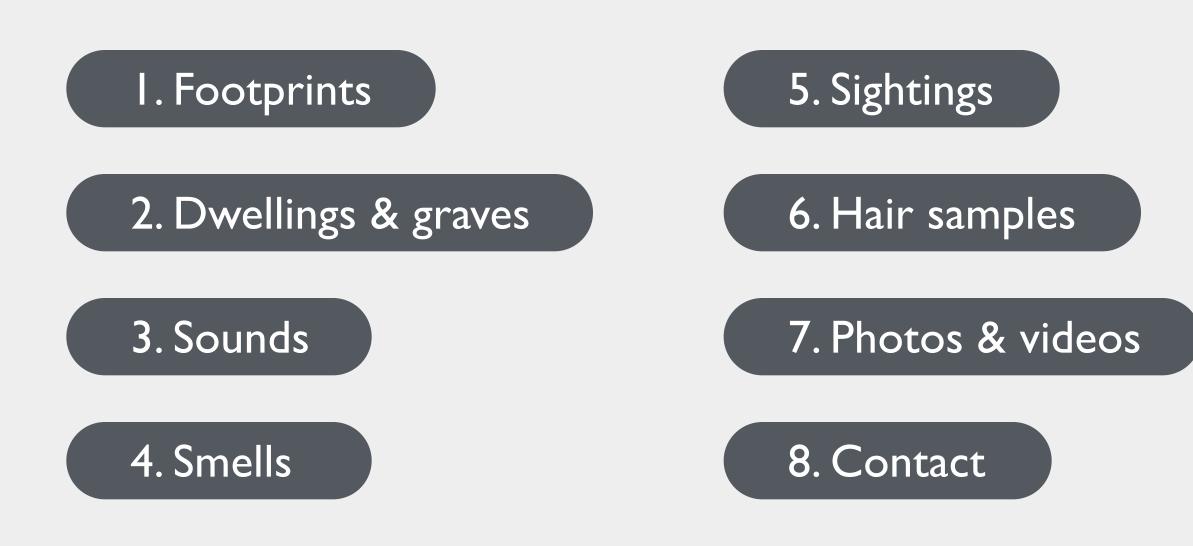
This video was taken in Northern California in 1967 by Roger Patterson and Bob Gimlin.

According to the Smithsonian, it is the most famous and contested piece of Bigfoot "evidence" to this day.

Smithsonian, 2022



Evidence for Bigfoot



liveabout.com/sasquatch-best-evidence-2593656





Reasoning for Bigfoot

Because evidence of footprints, dwellings & graves, sounds, smells, sightings, hair samples, photos & videos, and contact has been recorded of a Bigfoot-like creature, Bigfoot must exist.







Dig Deeper with Wonders

Create a <u>question</u> about Bigfoot that will result in exposing additional details about the evidence used to support the claim that "Bigfoot is real."

Jamboard Posts



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I. Post your wonder on the Jamboard.

2. Read through the other wonders.

3. Pick your THREE favorite wonders.

4. Use the pen feature to circle your top 3.



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Discussion

used to support the claim that "Bigfoot is Real?"

Why?

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Which of our wonders best digs deeper into the evidence



HOW Can We use to expose logical fallacies in science?

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questioning techniques



Be clear about what you are asking.

Make sure that you choose your words carefully so that there is no ambiguity about what you are wondering.

Example: Instead of saying "How did your research project go?" ask "Did your research findings support your claim?"

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Be Concise.

Keep it short and sweet- on focused on what is important to avoid confusion and distraction.

Example: Instead of asking "Your evidence seems to support your claim. What can youtell me about the your process for collecting evidence," say, "Please describe your data collection techniques."



Keep it open.

If you want more detail, ask open-ended questions to encourage answers that go beyond yes/no.

Example: Instead of asking, "Did your evidence support your claim," ask "How did your evidence support your claim?"



Follow up.

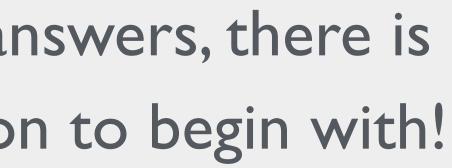
Add additional questions to encourage more details or to clarify muddy points.

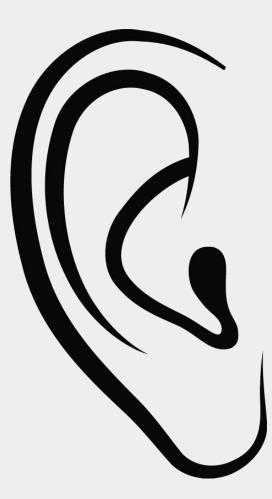
Example: "You said that your evidence supports your claim because you surveyed more than 100 people. How did you go about choosing this sample and population?"



Listen carefully.

If you aren't listening to the answers, there is no point in asking the question to begin with!







Logical Fallacies Kahoot!

Which of these logical fallacies apply to the Bigfoot scenario?

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discovery of Bigfoot.

What questions will you ask next?

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Asking good questions is what makes the discovery of dinosaurs different from the





