

CRITICAL THINKING  
AND "POP-SCIENCE"

UNM  
STEM GATEWAY

SURVEY

<http://goo.gl/4AD3OC>

Case sensitive

EASE WORKSHOP SERIES

<http://goo.gl/lcha0y>

EASE  
Essential Academic Skills Empowerment

Welcome to the EASE workshop series. We are here to help you succeed! We want to provide you with foundation skills that many STEM students struggle with.

In our every day lives, we are often exposed to the medias portrayal of STEM related stories, and it is important that we don't just take these at face value. In todays workshop, we will see how important it is to think critically, especially when it comes to our response to scientific information presented in the mass media.



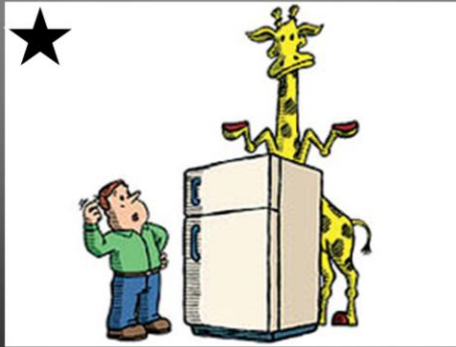
So, before we get into discussing critical thinking, I want to know where you currently stand on understanding the concept. It's always a good idea to assess what you already know and what you think of a topic before you learn more about it.

Any time you see a black star, it means you need to write the answer on your assessment sheet.

So, what are your initial thoughts are to the topic of "critical thinking". What does this mean to you? Take a minute and talk about this with your neighbor and write down what you come up with.

Who wants to share? What did you come up with? Those are all great answers. Keep these in mind as we move through the presentation.

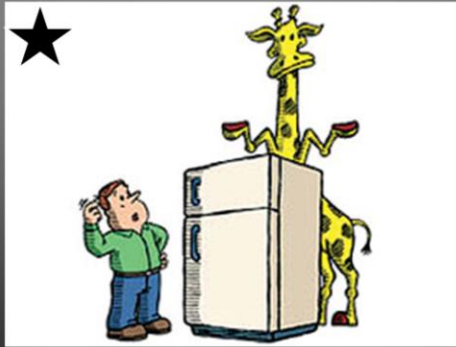
## HOW DO YOU PUT A GIRAFFE INTO A REFRIGERATOR?



Just to get your mind working, let's start out with a quick riddle that will help you reflect on how you think. If you've already seen these questions before, please don't ruin it for everyone else, especially since allowing each person to process the question and come up with their own answer has a point.

## HOW DO YOU PUT A GIRAFFE INTO A REFRIGERATOR?

- Open the refrigerator, put in the giraffe, and close the door



(\* ) The point of this is not to say that the answer is utilizing critical thinking, but more that your answer to this question gives insight into how you think. Was your answer more complicated than this? Do you do simple things in an overly complicated way? What is underlying your thought process? Although in life, the simplest answer is not always the best answer, it is a good starting point. Start simple then make it more complex as necessary. Take a second to reflect on this on your assessment sheet.

## METACOGNITION AND CRITICAL THINKING

- Awareness of your own thought process and strategies.
- Always ask:
  - Why?
  - How?
  - What if?



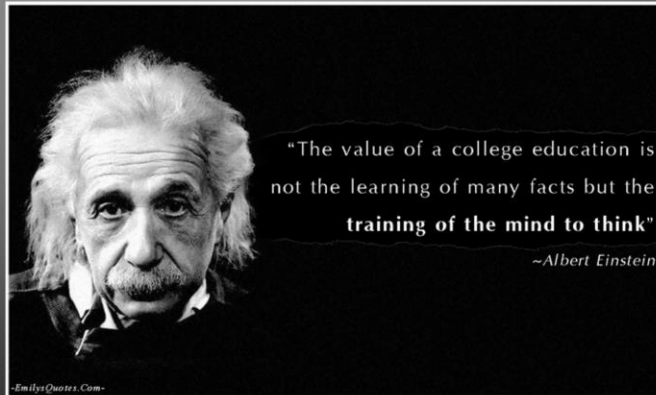
The idea of being aware of your own thought process and strategies is the concept of Metacognition. Essentially, think about how you think, reflect on your own thought process and strategies for building what you think, believe or do.

If you think about it, it's easy to sit through a class, memorizing some facts and working through assignments with minimal effort, without ever actually engaging with the scientific process that puts critical thinking into practice.

(\*) It is important that when presented with a concept or task, always ask yourself: why, how, and what if's about the topic

## METACOGNITION AND CRITICAL THINKING

- Learning  $\neq$  Thinking



Something to remember is that learning is not thinking. As Albert Einstein expertly put it, “the value of a college education is not the learning of many facts, but the training of the mind to think”.

Something that most people are not aware of is that critical thinking takes practice. The mind has to be trained to engage in critical thinking and this can be hard work. In order for someone to develop critical thinking skills, there are 6 stages they will go through to start training the brain and be a more conscious thinkers.

## CRITICAL THINKING DEVELOPMENT: A STAGE THEORY

### Stage 1: The Unreflective Thinker

- Concepts
- Points of view
- Reasonable assumptions
- Biases/delusions?



Each of the stages serves as a base for the next, in the case of stage one, we have what is known as the unreflective thinker. We all start in stage one were we are unaware of significant problems in our though process.

At this point the unreflective thinker is unaware of all the components that critical thinking requires such as putting together concepts, points of view, reasonable assumption and/or the fact that they may have biases or delusions that are guiding their thought process, and may affect how they put together thoughts, ideas and conclusions.

Considering this, lets go back to our refrigerator question...

WHAT WERE SOME REASONABLE ASSUMPTIONS YOU MADE TO ANSWER THIS QUESTIONS?



In order to answer this riddle we make the assumption that a giraffe can fit into a refrigerator. Is this a reasonable assumption? No, but let's try to make some reasonable ones to attempt an answer this questions, what do you think?

- Place the refrigerator horizontally and leave the door open for the giraffe to stick its neck out.
- Make a hole on fridge.
- An industrial fridge (very large) and a small giraffe (juvenile).
- The giraffe was dead therefore cut it into little small pieces.

All of this are good! You made reasonable assumptions in attempts to answer the riddle and along the way you employed critical thinking, but as you engage in critical thinking, are you aware of the weaknesses you may have in your thought process? This leads to stage 2...



## CRITICAL THINKING DEVELOPMENT: A STAGE THEORY

**Stage 1:** The Unreflective Thinker

**Stage 2:** The Challenged Thinker

- Concepts
- Points of view
- Reasonable assumptions
- Biases/delusions?



### The challenged thinker

At this stage the individual actually recognizing where he/she may have some have some difficulties in their thought process.

In the case of concepts, we may not know enough basic information when it comes to a specific subject. We may have a limited view about a topic, not knowing the opposing arguments or evidence.

It may just be that we have difficulty making reasonable assumptions because we have no practice in connecting information yet.

And in the case of possible biases/delusions, it is important to understand where you currently stand on the topic, so reflect to see if you have pre-formed opinions, and what is the root of those opinions because, again, they may influence our thought process.

Next slide...

## EXAMPLE: WHERE DO PLANTS GET THEIR FOOD?



Those pre-conceived thoughts can often influence our response to a question. For example, how do you think the “average person” would answer a question about where plants get their food?

## EXAMPLE: WHERE DO PLANTS GET THEIR FOOD?

- From the water, soil, and all over



(\* ) Perhaps something along the lines of “from the water, soil, and all over. This is because we are driven by our human centered concept of “food”.

## EXAMPLE: WHERE DO PLANTS GET THEIR FOOD?

- ~~From the water, soil, and all over~~
- They make their own food



But, if we really think about it, the more appropriate response is that they make their own food. So, being aware of what our opinions are founded on is an important component to critical thinking.

## CRITICAL THINKING DEVELOPMENT: A STAGE THEORY

How can we identify our challenges when it comes to critical thinking?

1. Decide what YOU think and WHY you think it.
2. Seek other views and more evidence.
  - Suggestion: Play Devil's advocate
3. Decide which view is more reasonable.



So, what can we do to identify our challenges when it comes to critical thinking?

(\*) First, decide what YOU think and WHY you think it? How many of you think eating apples is healthy? Okay, is it because you constantly heard “an apple a day keeps the doctor away”? Did you parents tell you they were healthy? What information have you come across that actually tells you apples are healthy?

Even if a course or topic is presented in a lector based format, you can try to expand your horizons past what you already know. You can even generate a list of questions and look for answers. If you don't have thoughts about the topic, talk about it with somebody else to see if their thoughts spark something. If you are not interested in the topic, find out why you are not interested in the topic.

(\*) Tied to this is to think about the topic in another way. Ask other people about their views, or seek out more evidence. Sometimes it helps to play Devil's advocate. Since this is only a 50 minute workshop we can't do this activity, but after you decide what you think and why you think it, SWITCH, become the advocate of the view opposite to yours. Find academic sources on the topic. Speak with other people to get a different perspective. How do your thoughts now compare to before doing this?

In this type of situation, it's healthy to doubt yourself and re-think about your conclusions, are you too rash, trying to find the "right" answer, were your interpretations correct?

(\*) Lastly, try to distinguish the different perspectives. Make pro/con or like/dislike lists. consider all evidence without bias. Which position is MORE valid? Which is more convincing, which is more realistic?

Any questions so far?

## CRITICAL THINKING DEVELOPMENT: A STAGE THEORY

**Stage 1:** The Unreflective Thinker

**Stage 2:** The Challenged Thinker

**Stage 3:** The Beginning Thinker

**Stage 4:** The Practicing Thinker

**Stage 5:** The Advanced Thinker

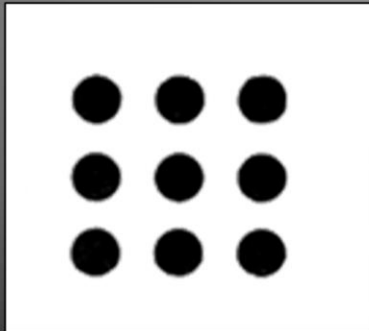


Stages 3 through 5 are engaging in your thought process, in other words actively thinking critically. This is done only after you have identified the weaknesses and strengths in your thought process. The stage numbers not only reflect the logical progression of thought, as you will see in a minute with Blooms Taxonomy, but also a ranking for the amount of time you generally spend implementing each process.

Again, engaging in critical thinking can be difficult initially because we are, to put it bluntly, lazy thinkers who often exposed to broad misconceptions. Unless you practice expressing and defending WHY you arrived at a particular conclusion, and listen critically to those of others, you will not critique your own beliefs and modify them, if appropriate, in light of what you learned.

To make the point, let me give you a brain exercise

## CRITICAL THINKING DEVELOPMENT: A STAGE THEORY



- Connect all the dots
  - Only up to 4 lines
  - Can't lift the pencil from the paper



This is an assessment question, take some time to connect all the dots, but there are a few requirements or rules.

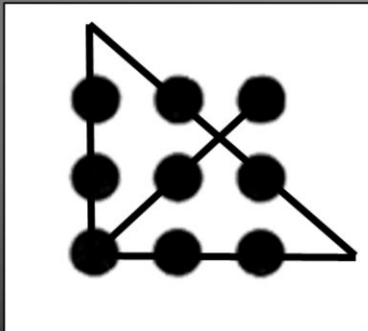
You can only use up to 4 lines and it has to be a continuous line. If you need to discuss with each other that is okay.

Does anyone have any ideas on how you can connect the dots?

What conclusions can you drive from this exercise? From your answer? Let's discuss...



## CRITICAL THINKING DEVELOPMENT: A STAGE THEORY

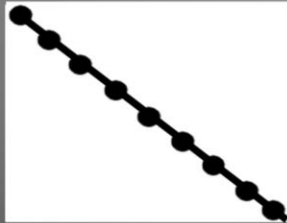


- Connect all the dots
  - Only up to 4 lines
  - Can't lift the pencil from the paper
- Any others?

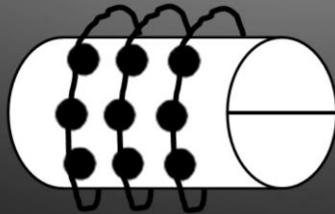
This is probably the most common answer, what conclusions can you draw from this? How about the limitations that you imposed on yourself when answering the question? I never said you couldn't draw outside the area of the dots. I have very few rules, can anyone think of another way of connecting all the dots?

How about...

## CRITICAL THINKING DEVELOPMENT: A STAGE THEORY



- Connect all the dots
  - Only up to 4 lines
  - Can't lift the pencil from the paper
- Any others?



You can cut out each dot and glue them in a line to connect them with a single line, if you have it on paper, you can fold it in a way that the line is continuous because we don't put a limitation to the size of the line.

The point I want to make is that when engaging in critical thinking keep an open mind, think outside the box because sometimes the only person placing limitations in your analysis is yourself.

Lastly...

## CRITICAL THINKING DEVELOPMENT: A STAGE THEORY

- Stage 1:** The Unreflective Thinker
- Stage 2:** The Challenged Thinker
- Stage 3:** The Beginning Thinker
- Stage 4:** The Practicing Thinker
- Stage 5:** The Advanced Thinker
- Stage 6:** The Accomplished Thinker

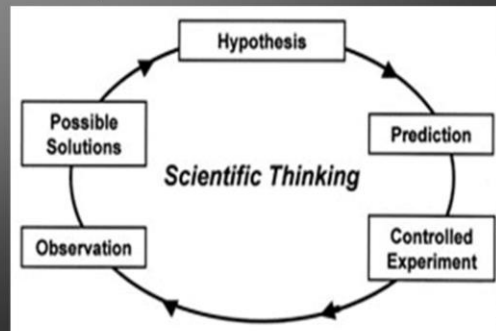


What critical thinking stage are you in?

Stage 6 will eventually become 2<sup>nd</sup> nature. So what critical thinking stage are you in?

## BENEFITS OF SCIENCE

- Reduce bias or delusion.
- ~~Accumulating scientific facts~~ → thinking scientifically



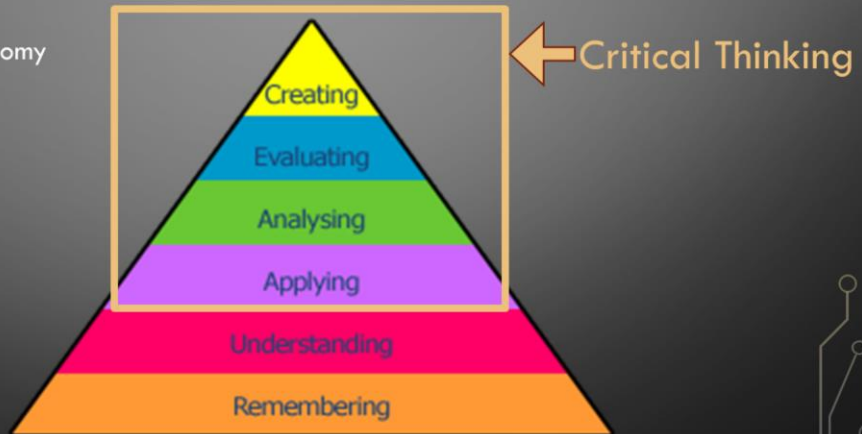
Let's now start connecting this to science, since that is the point of this workshop, after all...the benefit from using the scientific process. You have to remember, science is not the finished product that is often encountered, but a process of trial and error through the scientific method and critical thinking.

(\* Science is not black and white with definitive answers. So the scientific process in itself, and through peer-review, helps reduce the probability that our own viewpoints are influencing our conclusions.

(\* Sure, we need foundational knowledge to help us in this process, but it's more about the application of that knowledge into a new framework, than the facts themselves. Most of the wonderful scientific advancements we have today are a result of blunders, or progressive thinking that builds on the foundational knowledge, not regurgitation of facts.

## HOW TO DEVELOP CRITICAL THINKING

Bloom's Taxonomy



But, like I said, those facts are still critical to our ability to apply critical thinking. Let's work through an example of this using Bloom's taxonomy.

How many of you know what DNA is? Okay, all of you, good...let's consider that in your class you are presented with a method to study DNA, you already have some knowledge of what DNA, probably from various sources. And, may even know what may affect it, and different experiments to study it in, for example, a mammal, let say a mouse. That is remembering.

Then you choose a specific experiment and you UNDERSTAND how each step of that method affect the DNA molecule.

Now you can start thinking critically about all of this information. You decide to APPLY this method for a different mammal, maybe prairie dog.

You get data back that then you ANALYZE it using various methods.

You start connecting dots, looking at patterns, look at other evidence, claims, perspectives, etc. That is, you EVALUATE the data.

By the end you have contributed or CREATED something new, new data, information, maybe you alter the method slightly to make it work better, etc.

Any questions?

## CRITICAL THINKING – DO IT!

- Teacher doesn't use it? YOU still can
  - UNDERSTAND
  - REASON
- Failure → THINKING

When it comes to thinking critically, just do it!

(\*) Even if your teachers don't use critical thinking techniques in class, that doesn't mean YOU can't use them. During and after class, make sure you understand what is driving the concept, not just the points you have to remember

Question the reason behind the information presented, for doing what you do. For example, we all know that apples are good for us, right? But WHY do we "know" that? Is it because of the saying "an apple a day keeps the doctor away", or our parents told us so and we just went with it, or you actually looked up evidence to support this common claim?

(\*) and just remember that failure is OK, it gets us actually thinking about what went wrong and why. It's a regular part of the process, just make sure you use it to train your mind. Think of it this way, if you did a lab experiment and everything went well, have you actually thought about what each step is doing? But, if it failed, you have to think through each step, figure out what you can modify, and what the possible outcomes are. This is when you really THINK about what is happening. Within both failure and success, sometimes we pay too much attention to the details, and other times, not enough. You need to assess if the minor details are important or

not.

When it comes to critical thinking in science we ...

## CRITICAL THINKING – DO IT!

- Judge the credibility of the source and the quality of an argument
- Be open-minded and respectful
- Try to be well informed

(\* ) Judge the quality of the arguments, including the reasoning, assumptions, and evidence presented.

(\* ) Keep an open mind, since new information may shift preconceived notions, and make sure you are respectful of others. We need healthy debates to make us think outside of the box and fill in any gaps in our knowledge or understanding. That ties in to the last point.

(\* ) Be as well informed as is reasonable before taking a *strong* stance on an issue

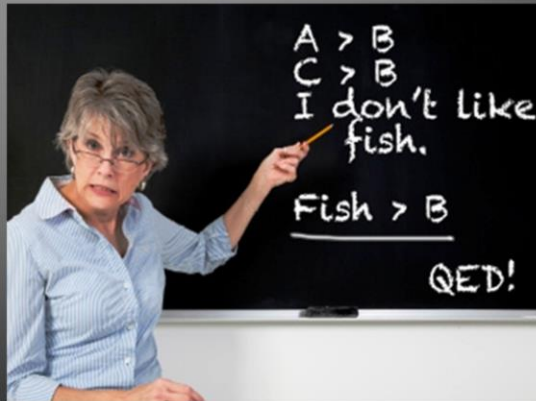
Okay, so what does critical thinking have to do with science and the media?



## WHY DOES POP SCIENCE GET MORE ATTENTION?



- What people want to be true
- What people want to hear
- Adds excitement or drama



Let's put this into the practical setting of your ever day lives. Why do you think pop-science get more attention than "true" science? Talk with your neighbor about this and write your thoughts on your assessment sheet. (discuss)

Some other reasons are:

- (\*) Take this image, for example. It could be what the woman wants to prove, thus she did, with no noticeable methods.
- (\*) another reason could be that it's what people want to hear, because it is already what they think, and we all like validation.
- (\*) And lastly, pop-science puts an exciting spin on things that gets the media attention.

(side note, not for stating unless asked: Q.E.D. is an initialism of the Latin phrase quod erat demonstrandum, meaning "which had to be demonstrated". The phrase is traditionally placed in its abbreviated form at the end of a mathematical proof or philosophical argument when what was specified in the enunciation — and in the setting-out—has been exactly restated as the conclusion of the demonstration. The abbreviation thus signals the completion of the proof. )

## FALLACIES

- A fallacy is a kind of error in reasoning. Some define a fallacy as an argument that is deductively invalid or that has very little inductive strength.
  - Unintentional
  - Intentional
  - False belief (lacking evidence)

A lot of the times, when it comes to STEM related fields, we encounter many fallacies in the media.

A fallacy basically consist of poor argumentation used as fact or evidence to prove a claim. (Read definitions on slide)

There are 216 recognized fallacies, I will mention a few but if you are interested in learning more there is a link on the EASE website.

Fallacies may be created unintentionally, or they may be created intentionally in order to deceive other people. Sometimes the term "fallacy" is used even more broadly to indicate any false belief or cause of a false belief.

When it come to pop- science and the media –coverage...



## BE AWARE OF THE FOLLOWING ARGUMENTS

- Uninformed
- Misinformed
- Cherry picking
- Urban Myth
- Non-scientific
- Fear, uncertainty, & doubt

Pop-science and media-coverage of hot topics are often biased, depending on who is presenting the information.

Along some of the fallacies the argument may contain are:

Arguments that come from uninformed or misinformed sources

The focus on only one side of the story, or limited view of evidence (cherry picking).

The information may stem from urban myths, have no scientific basis, or come from fear, uncertainty and doubt. The last 3 are big when it comes to pseudosciences...

## SUPPLEMENTAL INFORMATION

### 1. TED-Ed

- a. How Statistics can be Misleading:

<http://ed.ted.com/lessons/how-statistics-can-be-misleading-mark-liddell>

- a. How false news can spread:

<http://ed.ted.com/lessons/how-false-news-can-spread-noah-favlin>

### 2. Last Week Tonight with John Oliver: Scientific Studies

<https://www.youtube.com/watch?v=0Rnq1NpHdmw>

If you are interested in looking at additional information we provide some links of some video that address things that can be misleading sometimes, such as stats (1), and circular reporting (2). The third one is from the Last Week Tonight show with John Oliver, which we'll watch two short clips from.

## LAST WEEK TONIGHT WITH JOHN OLIVER: SCIENTIFIC STUDIES – CLIP 1



Here's the first clip. 19 sec-50 sec

## LAST WEEK TONIGHT WITH JOHN OLIVER: SCIENTIFIC STUDIES – CLIP 2



And the second; 5:12-6:41.

(When the clip is over) - You are welcomed to watch the entire video in your on time.

As you may or may not have picked up, this show in itself can be very bias sometimes, but this segment provided some good examples on how the media portrays scientific findings.

## PSEUDOSCIENCE

- A collection of beliefs or practices mistakenly regarded as being based on scientific method.
- Some things to look for:
  - Source
  - Agenda
  - Language
  - Testimonials vs scientific evidence
  - Claims of exclusivity
  - Conspiracy claims
  - Real scientific process

If you are not familiar with what pseudoscience is, they are define as a collection of beliefs or practices mistakenly regarded as being based on scientific method.

Some things to look for to identify if the information presented to you is truly scientific are:

Source? Is the person or entity making the claims someone with genuine expertise in what they're claiming.

Agenda? You must know this to consider any information in context. In a scientific paper, look at the funding sources.

Language? Does it use emotion words or a lot of exclamation points or language that sounds highly technical but that is really meaningless in the therapeutic or scientific sense.

Testimonials? If all the person or entity making the claims has to offer is testimonials without any real evidence of effectiveness or need, be very, very suspicious.

Exclusivity? It's quite rare that a new therapy or intervention is something completely novel without a solid existing scientific background to explain how it works, or that only one person figures it out.

Conspiracy? Claims such as, "Doctors don't want you to know" or "the government

has been hiding this information for years”.

The last item is the Scientific process. This is what takes us from the realm of pseudoscience into ‘real’ science. Scientific literature, peer review articles, evidence that has gone through many steps of a scientific process.

So when it comes to the media and the arguments presented, ENGAGE in critical thinking!



## KEEP IN MIND

- What is the quality of evidence supporting this claim?
- Weighing conflicting evidence.
- Science has its limitations.

(\* ) What is the quality of the evidence supporting the claim? So look at how the outcome was measured, was there a control? What about the sample size, bias, reproducibility and plausibility?

(\* ) If you encounter conflicting evidence, look at the quality of evidence on each side and weigh it appropriately.

(\* ) Lastly, keep in mind that some things are not going to be answered by science. Science can not answer questions of religion or the supernatural since it is based on observations, repeated experiments, and evidence to support its conclusions.

A WOMAN GIVES A BEGGAR 50 CENTS, THE WOMAN IS THE BEGGAR'S SISTER, BUT THE BEGGAR IS NOT THE WOMAN'S BROTHER. HOW COME?



So, let's engage in some active thinking. Take some time to answer this assessment question. Write YOUR answer down on your assessment sheet.

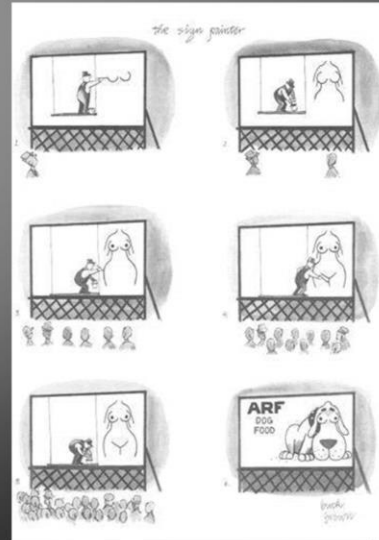
A WOMAN GIVES A BEGGAR 50 CENTS, THE WOMAN IS THE BEGGAR'S SISTER, BUT THE BEGGAR IS NOT THE WOMAN'S BROTHER. HOW COME?

- The beggar was the woman's sister.



(\* ) How many of you were initially stumped because you thought of the beggar as a man? How much of that was influenced by your pre-conceived notions of what a beggar is, or the image I put up? The media is constantly choosing imagery they know will elicit a desired response from us. This helps highlight how our what we are initially exposed to, and our pre-conceptions, thoughts, or opinions often drive our thought process.

DON'T JUMP TO CONCLUSIONS!



The main thing to remember is not to jump to conclusions. (pause so they can process the image).

## DON'T JUMP TO CONCLUSIONS!

- Example. Imagine a man and women are in an elevator having an argument. You enter the elevator to help get to your intended level within the building. During their argument you overhear them mention: 'the house' and 'the children' etc.



Take this example. (read). What is your initial conclusion on the relationship between the man and woman?

It would be perfectly natural from overhearing such statements to arrive at the conclusion that the people having the argument are husband and wife. However, the evidence does not directly support this and although such a conclusion may well appear natural and persuasive, these factors on their own do not make such conclusions correct. The couple could simply have been colleagues debating a newspaper story of a family, or even a family situation from a reality television program. Human reasoning often tries to fill in the blanks – and often does so by generating spurious conclusions to fit the incoming information. Sometimes the conclusion is correct, sometimes it is not. Due to the considerable scope for error in human reasoning scientists and philosophers have developed methods for reasoning about the world.

## CASE STUDY: VACCINES

Anti-vaccine arguments:

- Diseases that vaccines target have essentially disappeared. There is no reason to vaccinate against diseases that no longer occur in the United States.



Alright, now that you know a bit more about how to train your mind and what to look out for, let's look at a few real-world examples. Take the public conflict over vaccinations, for example.

Reading these arguments, what are some of the critical thinking strategies you can use? This is not to determine which side of the argument you are on, it is to see how we can apply critical thinking to a statement presented to us in the mass media. Discuss with your neighbor and write these down.

Who wants to share what they came up with?

Even without doing additional research on the topic, there are some things to consider: What does the word “essentially” mean? WHY have the diseases disappeared? Why is the argument limited to the US, when people travel to and from other countries? The statement “There is no reason” is very subjective. Are there citations for the claims in this statement? In other words, who said this statement? What is the source of this information?

This highlights how information is often selectively presented or misinterpreted. The training of the person making a claim is also extremely important to consider.

## EXAMPLE: HYPOTHETICAL CANCER



- This deadly cancer is at least three times more common among people who drink milk and has a 50% survival rate.



I want you to reflect on this statement on your assessment sheet. (read) Based on this statement, would you avoid drinking milk? How much was your initial reaction in response to the staggering statistic?

So, thinking critically, what are some questions you should ask? Discuss this with your neighbors.

Who wants to share what they came up with? (Brief discussion)

Now, what if I told you that it is extremely rare and occurs in less than 1 person in 100,000 and accounts for less than 1% of cancers in the US? Would you still avoid drinking milk, at least for this reason? How does this information change your initial response? Write your thoughts down.

How much was your initial reaction in response to the initial statistic? After hearing the actual occurrence, did your opinion change? Who wants to share?

I use this example to highlight the importance of watching out with statistics and how it can be used as a scare tactic or used to conveying a biased opinion. Taken alone,

some numbers seem very astounding. 3 times more common, wow! But, when you look at the bigger picture, avoiding milk decreases your overall chances of getting this hypothetical cancer by 0.75%. Just make sure to question what the statistics are actually saying, and **from previous examples**, use caution when making firm opinions based on images.



## CASE STUDY: CLIMATE CHANGE

- Anti-global warming arguments:
  - 31,000 scientists say "no convincing evidence".



Ok, let's try another example. Let's talk a bit about climate change. Again, the point of this is not to 'pick sides' but to think critically about ANY statement that is presented to us, especially in the media. An argument against 'global warming' is that "31,000 scientists say "no convincing evidence".

So, what is your next move? What are questions you might ask? (Discuss as a group)

The statement comes from an online petition and check a box that said stated your degree. The results are not verifiable. Also, area of study included engineers, medicine, chemistry, biology, etc. Not many of whom study climate science.

This report also failed to mention that of scientists working in the field of climate science, and publishing papers on the topic, 97% of the climate scientists surveyed believe "global average temperatures have increased" during the past century; and 97% think human activity is a significant contributing factor in changing mean global temperatures.

Again, pay attention to the original source of statistics, and even then, look at what they are REALLY saying.

## FROM POP SCIENCE TO PRIMARY LITERATURE

- What is the difference?



The case studies were from of pop science sources. How do these differ from primary literature? We briefly went over this, but lets discuss in a bit more detail.

(Discussion)

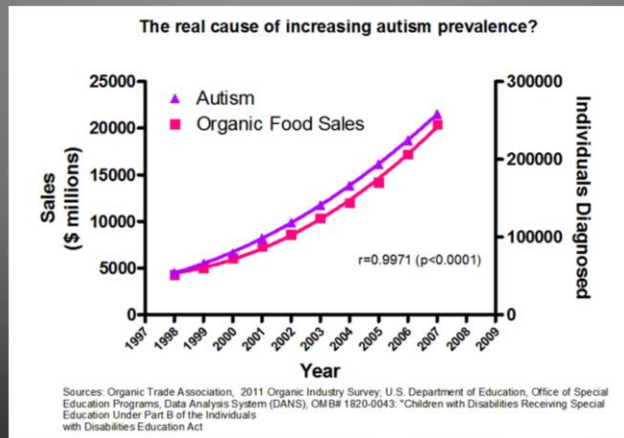
Regardless of what type of information you are reading, make sure you are paying attention to your thought process, metacognition, and critically thinking about what information is presented to you, even in reliable scientific journals.

The main thing to keep in mind is that there should be an original source for the information. If it is primary literature, you should find it and read it for yourself. Pay attention to where it was published and use these newly acquired skills when reading the original source. Although primary literature is peer-reviewed, that does not mean it is infallible.

So just remember young STEM Jedi masters, may the source be with you.

Now that your mind is warmed up, let's end with a few more brief discussions.

## CAUSATION VS CORRELATION



The differentiation between causation and correlation is important, but the media often takes advantage of the fact that most people don't know the difference, often assume cause and effect, or don't take the time to determine which it is.

What do you think "causation" is? (discuss) – It is when one action is the direct cause of a given result.

What about "correlation"? (discuss) – a relationship between two or more things.

(\*) Take this graphic, for example. The increase in sales of organic foods is highly correlated with the increase in number of autism diagnosis. What questions can you ask?

Some examples are: What other factors have influenced the increased number of diagnosis? For example, are there really more cases or is there a higher recognition of the disease or a broadening of the spectrum. For those diagnosed with autism, was the consumption of organic foods relevant to those families?

The point is, just because there is a strong correlation, or relationship, between two variables, it does not mean that one is causing the effect on the other.

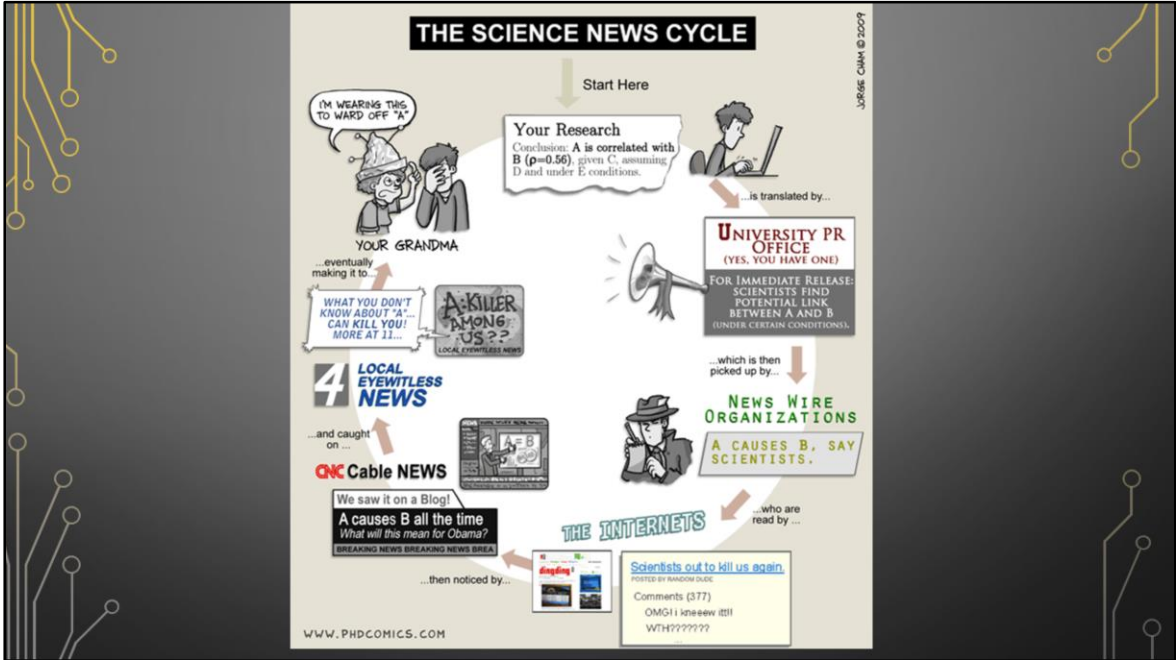
## CANNABIS

- Youth with an average grade of D or below were more than 4 times as likely to have used marijuana in the past year as youths who reported an average grade of A



So, keeping causation vs correlation in mind, respond critically to this statement (read). (Discuss; could include that the use of cannabis is the cause for the low grade, vs, students who do not perform as well academically are more prone to partake in cannabis)

This is not to say that cannabis does not have mental or physical health effects, but only to point out that there is always more to the story.



So be careful with causation and correlation when it comes to the media because sometimes (walk them through image) when a correlation is found, they may say that A causes B, some internet conspiracies may arise, and then later A causes B ALL THE TIME, which by the way, A is a killer and the initial interpretation from the research is lost in the process. Think of this circular reporting as the game Telephone, where the information gets distorted as information is recycled from the inappropriate source.



IF YOU HAVE TWO BLACK HOLES TOGETHER,  
WHAT DO YOU THINK WILL HAPPEN?

I'll send you off with this last question, knowing what you know of black holes, what do you think will happen?...

-Possible answers

1. The strongest hole will consume the other.
2. There will be a super nova explosion.
3. Nothing, the holes will collide and carry on.
4. A new galaxy will be form with all that energy.

There is no actual answer for this questions. Sometimes we fixate in trying to find the right answer, but as you move forward in your careers you will realize that in the case of science there is not just one single simple right answer most of the times. What we work on is hypothesis, trying to get a glance of what may be happening with the knowledge that we have.

Real answer, no one knows.



The graphic features a dark grey background with a white circuit board pattern on the left. At the top center, the word "QUESTIONS?" is written in white. In the top right corner is the UNM STEM Gateway logo. The center contains three silhouettes of heads: the first has a question mark, the second has gears, and the third has a lit lightbulb. To the right of these silhouettes is a QR code labeled "SURVEY" and a URL: <http://goo.gl/4AD3OC>. Below the silhouettes, the text "EASE WORKSHOP SERIES" is written in yellow, with another URL below it: <http://goo.gl/lcha0y>. In the bottom right corner is the EASE logo, which includes the Greek letter sigma and the letters "EASE" in a stylized font.

Are there any questions?

Just to remind you, this presentation is available through the EASE website if you want to refer back to you.