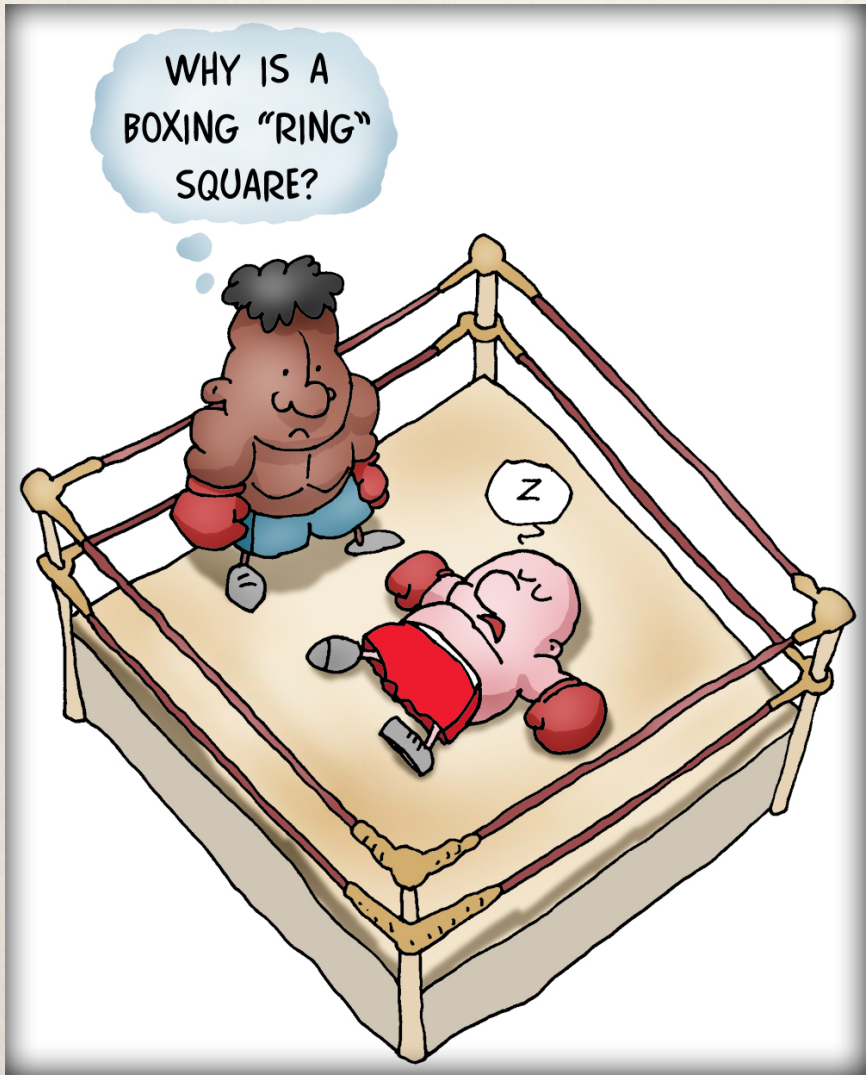
Using paradoxes to engage gifted learners

Intrinsic Value

* Interest and enjoyment that students experience when engaging in an activity.
* Generally, students are intrinsically motivated to pursue activities that are moderately **novel**, **enjoyable**, **exciting**, and **optimally challenging**.
* When schoolwork is too easy, students become bored. When tasks are too difficult, students become frustrated and anxious (Deci & Ryan, 1985).
* Teachers should create classroom environments that provide students with opportunities to engage in **interesting**, **personally relevant**, **challenging** activities.



Intrinsic Value

* Educators can also increase the intrinsic value of their classes by creating an enriching environment and providing opportunities for students to explore their interests.
* Self-selected enrichment projects based on students' interests as a systematic intervention for underachieving gifted students helped reverse academic underachievement in over half of the sample (Baum, Renzulli, & Hebert, 1995).
* To increase the intrinsic value in your class, plan learning activities that capture your students' attention and spark their **curiosity**, **creativity**, and **enthusiasm**.

The Engagement Premise

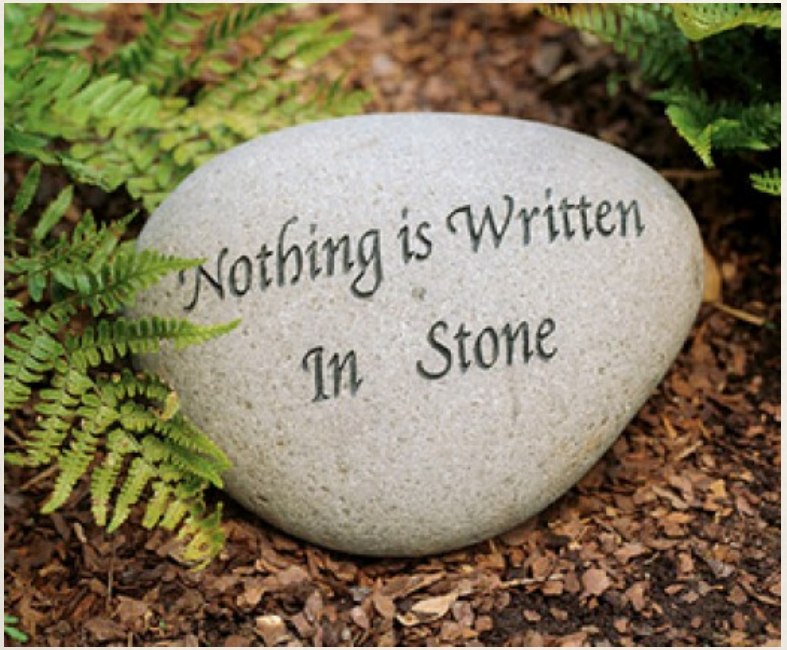
* "The engagement premise: The more students study a subject, the more they learn about it" (Kuh, 2003).

Lesson Design

* Start lessons with interest grabbing puzzles, mysteries, teasers, **paradoxes**, or demonstrations to immediately pull students into the upcoming material.
* These activities should connect to the learning outcomes.
* http://www.gifted.uconn.edu/siegle/goalvaluation/goalva02.html

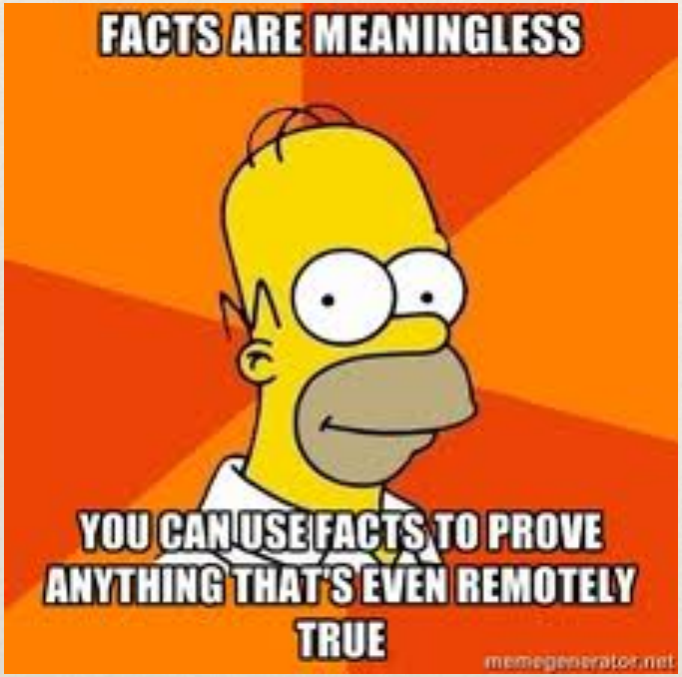
Piaget

* Create disequilibrium
  * an imbalance between what is understood and what is encountered.
* People naturally try to reduce such imbalances by using the stimuli that cause the disequilibrium and developing new schemes or adapting old ones until equilibrium is restored.
* This process of restoring balance is called equilibration.
* According to Piaget, learning depends on this process.
  * When equilibrium is upset, we have the opportunity to grow and develop.



Using Paradoxes

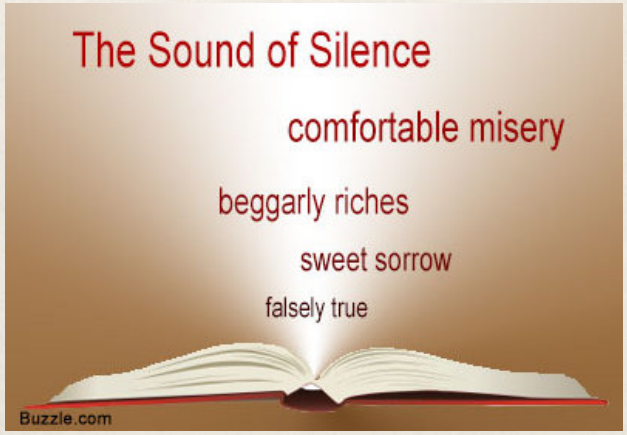
* Create intrinsic value in gifted learners!
* Create disequilibrium in gifted learners!



Paradox defined

* At the most basic level, a paradox is a statement that is self contradictory because it often contains two statements that are both true, but in general, cannot both be true at the same time.

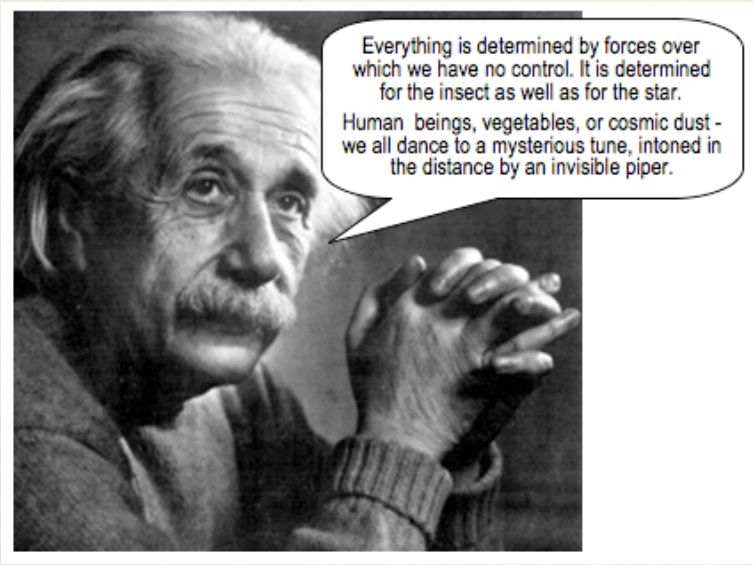
* Here are some examples of paradox in simple forms in order to further define the term "paradox":
  * I'm nobody.
  * "What a pity that youth must be wasted on the young."
    * George Bernard Shaw
  * Wise fool
  * Bittersweet
  * "I can resist anything but temptation."
    * Oscar Wilde
  * I'm a compulsive liar - am I lying when I say that?
  * A rich man is no richer than a poor man.



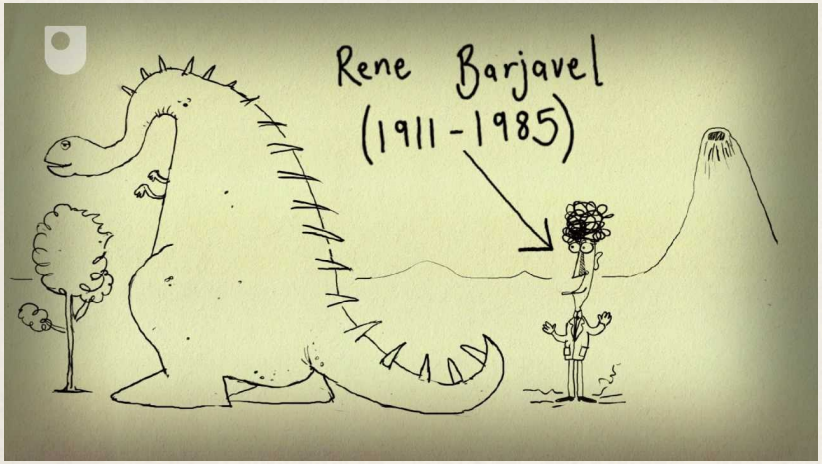
http://examples.yourdictionary.com/examples-of-paradox.html

Science and Math

* Grandfather Paradox
  * Physics, time travel
* Einstein's Twin Paradox
  * Physics, time travel
* Parrondo's Paradox
  * Math



Grandfather Paradox

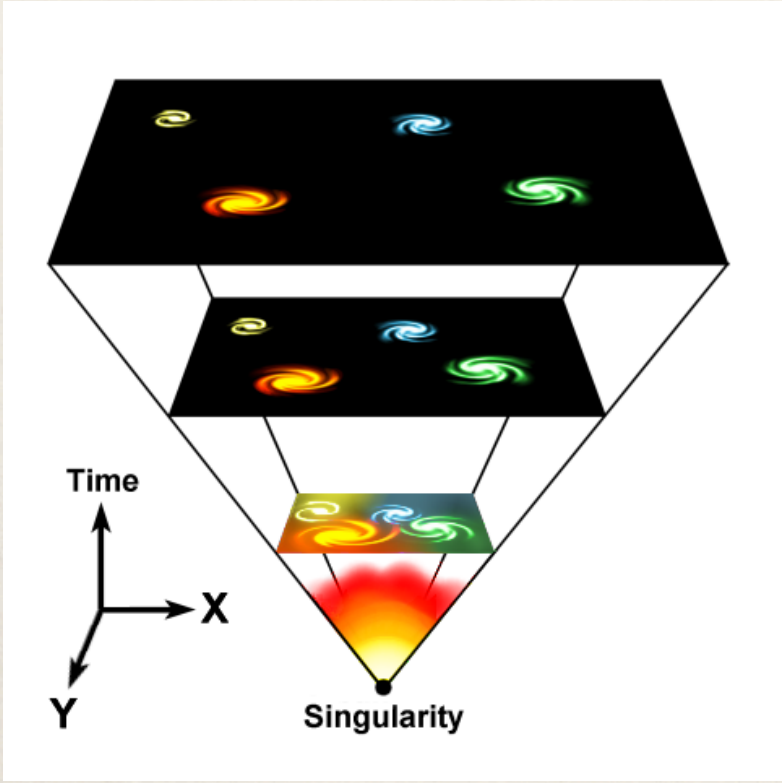


http://www.youtube.com/watch?v=Y6RjjaEy59I

* Rene Barjavel (1943) *Le Voyageur Imprudent*
* The time traveller went back in time before his grandfather had married.
* At that time, the time traveller kills his grandfather, and therefore, the time traveller was never born.
* If he was never born, then he was unable to travel through time and kill his grandfather.

Grandfather Paradox

* What happens if you go back in time and kill your grandfather before your father was conceived? Hawking (2013)
* The grandfather paradox has been used to argue that backwards time travel must be impossible.
* A way of avoiding the paradox has been proposed:
  * the timeline is fixed and unchangeable,
  * the time traveller will end up in a parallel timeline
  * while the timeline in which the traveller was born remains independent



Another grandfather paradox (I call it the time paradox):

A baby girl is mysteriously dropped off at an orphanage in Cleveland in 1945. "Jane" grows up lonely and dejected, not knowing who her parents are, until one day in 1963 she is strangely attracted to a drifter. She falls in love with him. But just when things are finally looking up for Jane, a series of disasters strike. First, she becomes pregnant by the drifter, who then disappears. Second, during the complicated delivery, doctors find that Jane has both sets of sex organs, and to save her life, they are forced to surgically convert "her" to a "him." Finally, a mysterious stranger kidnaps her baby from the delivery room.

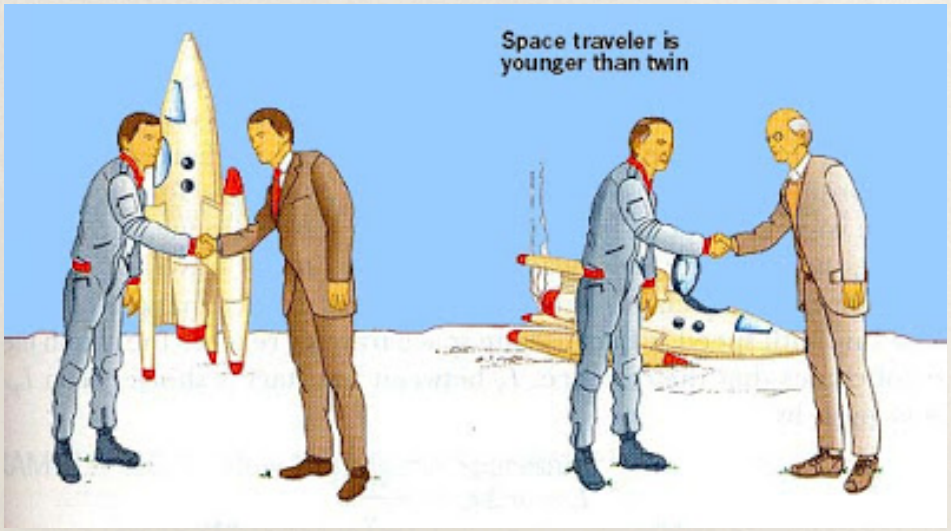
Reeling from these disasters, rejected by society, scorned by fate, "he" becomes a drunkard and drifter. Not only has Jane lost her parents and her lover, but he has lost his only child as well. Years later, in 1970, he stumbles into a lonely bar, called Pop's Place, and spills out his pathetic story to an elderly bartender. The sympathetic bartender offers the drifter the chance to avenge the stranger who left her pregnant and abandoned, on the condition that he join the "time travelers corps." Both of them enter a time machine, and the bartender drops off the drifter in 1963. The drifter is strangely attracted to a young orphan woman, who subsequently becomes pregnant.

The bartender then goes forward 9 months, kidnaps the baby girl from the hospital, and drops off the baby in an orphanage back in 1945. Then the bartender drops off the thoroughly confused drifter in 1985, to enlist in the time travelers corps. The drifter eventually gets his life together, becomes a respected and elderly member of the time travelers corps, and then disguises himself as a bartender and has his most difficult mission: a date with destiny, meeting a certain drifter at Pop's Place in 1970.

Einstein's Twin Paradox

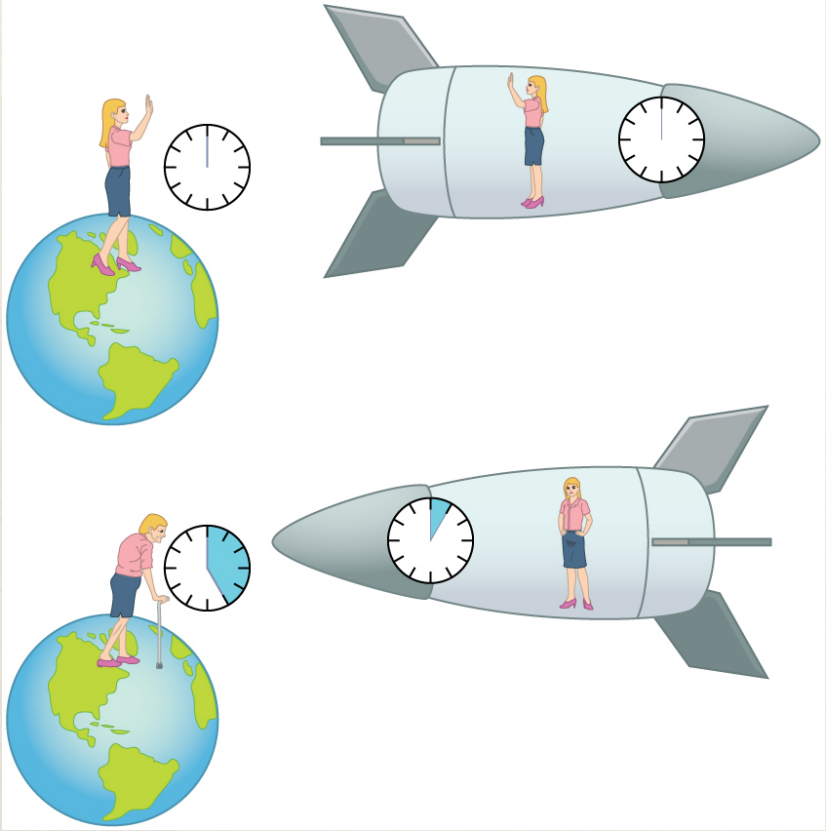
http://www.youtube.com/watch?v=oOL2d-5-pJ8

* Jane and Joe are twins. Jane travels in a straight line at a relativistic speed v to some distant location. She then decelerates and returns. His twin brother Joe stays at home on Earth.

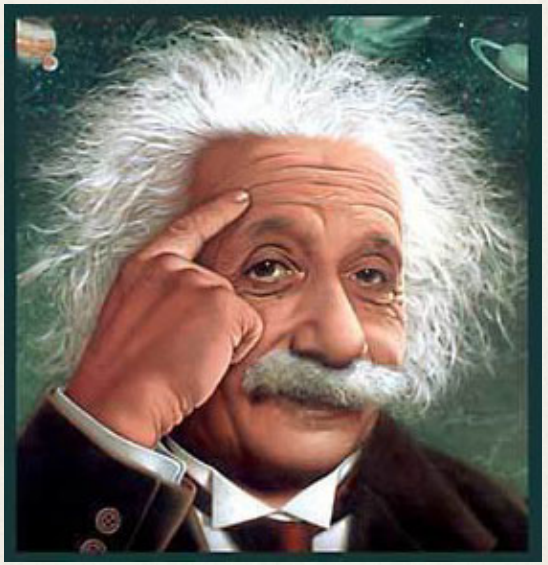


Einstein's Twin Paradox

* Joe observes that Jane's on-board clocks (including her biological one), which run at Jane's proper time, run slowly on both outbound and return leg.
* He therefore concludes that she will be younger than he will be when she returns.
* On the outward leg, Jane observes Joe's clock to run slowly, and she observes that it ticks slowly on the return run.
* So will Jane conclude that Joe will have aged less?
* And if she does, who is correct?



Einstein's Twin Paradox



* If Jane applies General Relativity as well as Special Relativity, she concludes that Joe will be older and thus resolves the paradox.
* It is important to point out, however, that appealing to General Relativity is not necessary to resolve the paradox, as demonstrated above.
  * In order to create the twin paradox, one must assume that Jane has been in a single inertial frame throughout her out-and-back trip.
  * As this assumption is false, there is no paradox.
* http://www.phys.unsw.edu.au/einsteinlight/jw/module4_twin_paradox.htm

Parrondo's Paradox

* JM Parrondo is a casino and con artist's worst nightmare. In the 1990s, he invented two games that are sure to lose you everything. They're both mathematically designed to make you go broke, but play them one after another and you are guaranteed to win.

* http://io9.com/5861287/parrondos-paradox-winning-two-games-youre-guaranteed-to-lose

Parrondo's Paradox

* The first game is simple and always the same.
  * You flip a coin, knowing that the two-faced, lying, no-good cheater you're playing against has weighted it so that your chance of winning is not fifty-fifty.
  * Instead your chance of winning is (0.5 - x), with x being whatever the cheater dared weight it with.
  * If you win, you get a dollar. If you lose, you lose a dollar.
  * Since whenever "x" is more than zero you'll lose slightly more than you'll win, you are guaranteed to lose over the long run.

* http://io9.com/5861287/parrondos-paradox-winning-two-games-youre-guaranteed-to-lose

Parrondo's Paradox

* Your second game is played for the same stakes (win or lose a dollar) but two different ways.
  * First, you look at the money you have in dollars and see if it's a multiple of three.
  * If it isn't, out comes another biased coin, and it gives you odds of winning at (0.75 - x).
  * That means your chance of winning is seventy-five percent, minus whatever "x" was in the initial game.
* If the money you have is *not* a multiple of three, then you play against the really bad coin.
  * This coin is weighted so that your chance of winning is (0.10 - x).
  * That is a less than a one-tenth chance of winning.
  * Since there are two times as many non-multiples of three than there are multiples of three, you will be playing with the coin that gives you an over-ninety percent chance of losing twice as much as the one that gives you a less-than seventy-five percent chance of winning.
* In other words, you will lose this game, and you will lose badly.

Parrondo's Paradox

* Tests have shown that, played one hundred times, either games results in lost money as long as "x" is bigger than zero.
* **You can't beat those odds!**
* But you can. Oh yes, you can.
* Switch between the games, playing the first one twice and then the next one twice, and you will win money!
  * It has been shown that, with x = 0.005, and with other values, depending on the sequence of the game, the winnings stack up.

Parrondo's Paradox

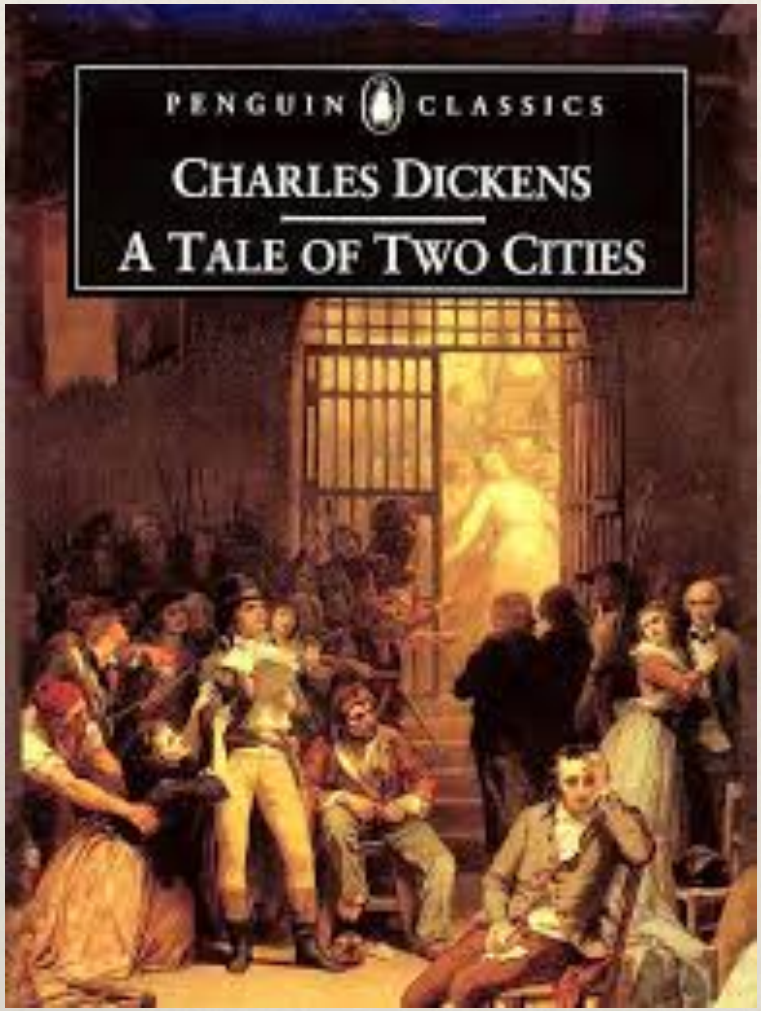
* This isn't just a mathematical abstraction that Parrondo came up with. It's based on a physics concept.
* If people placed water at the bottom of a long, gentle slope, the water would just stay there. If they placed it at the bottom of a spiky slope, like the one simulated by the second game, it would also just sit there. Any water placed at the top of either slope would roll down it.
* But if the slope flashed back and forth between its smooth and spiky counterpart, the water would actually travel uphill.

* Parrondo considered this physical finding, and translated it into a game to come up with his paradox.
* The paradox is now being studied by investors and financial analysts, eager to see how they, too can juggle losing assets to make the "slide uphill."

Paradoxes in Literature

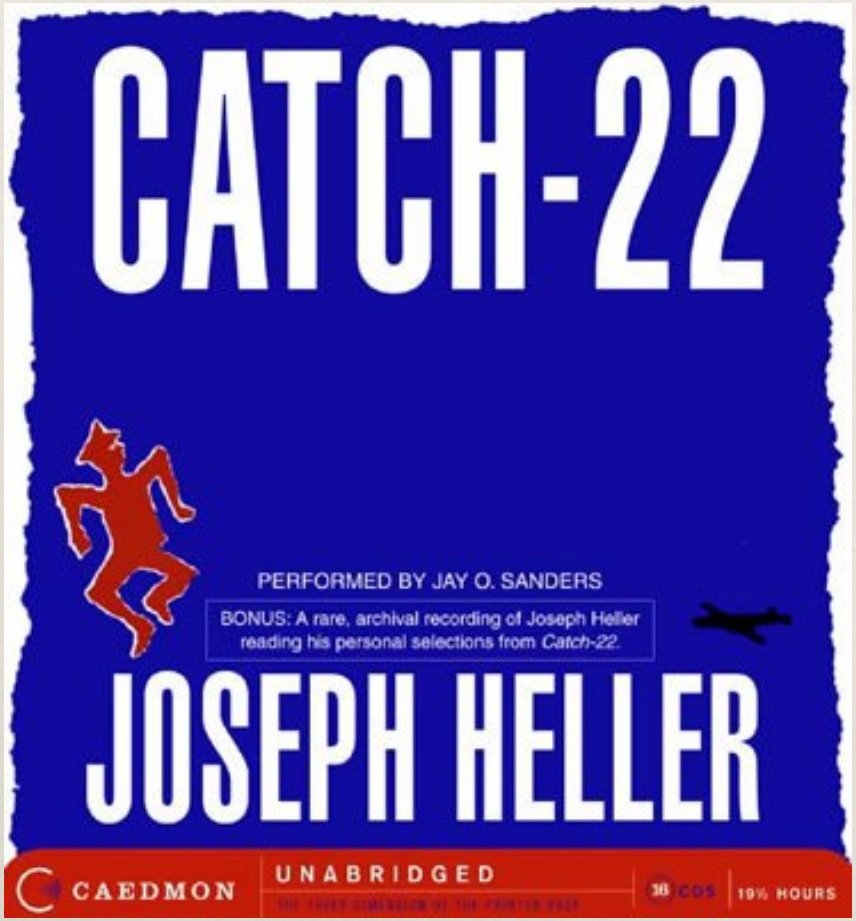
* Tend to be based on a contradiction
* The apparent contradiction generally helps a person gain insight
* For example:
  * "Life is much too important to be taken seriously" —Oscar Wilde
  * "The next sentence is false. The last sentence was true."
* Generally differ from an oxymoron (i.e., "bitter sweet" or "good grief") by virtue of having greater number of words

Charles Dickens



* "It was the best of times, it was the worst of times"

Joseph Heller

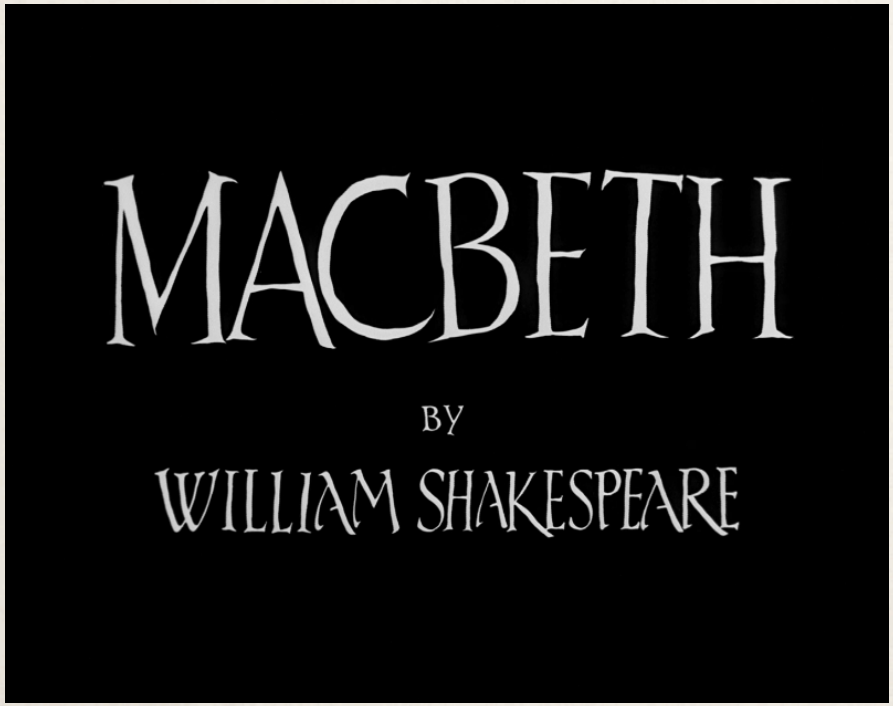


* The term "catch 22" has become a common way of describing being put in a contradictory and/or paradoxical state
* This term was popularized by the Joseph Heller book

Shakespeare

* “when the battle’s lost and won”

* “fair is foul, and foul is fair”



Shakespeare

* "Good night, good night! Parting is such sweet sorrow”

Shakespeare

* “I must be cruel to be kind.”

George Orwell

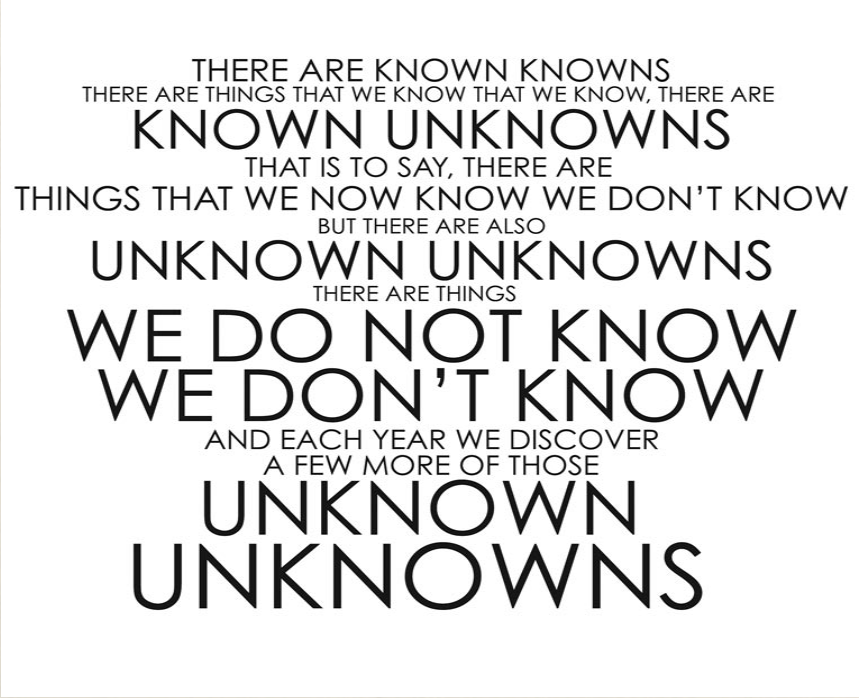
* "All animals are equal, but some are more equal than others"

Classroom Applications

* Lower difficulty—have students identify paradox/oxymoron incidences from texts
* Moderate difficulty—Use "Cloze method" by taking a list of paradoxical quotes and "white out words". Have students complete quotes with words of their own.
* Higher difficulty--Give students a list of quotations and have them convert quotations into paradoxes

Social Sciences

* Lessons Learned Paradox
  * History
* Observer Paradox
  * Psychology, Sociology, Anthropology, Linguistics



"Lessons Learned" Paradox

* "The lesson that we learn from history is that we do not learn lessons from history."
* Related thought: "History repeats itself."

Class Activities

* Debate/Discussion: Does history repeat itself?
  * Form two teams and allow each to formulate an argument for or against this topic.

* Compare and contrast two historical events.
  * Ask students to pick two historical events and pick out similarities and differences between them.
    * Ex) Lincoln and Kennedy assassinations

The Observer Paradox

* The phenomenon by which the observation of an event is influenced by the presence of the observer.
* We wish to study something naturally, but the presence of an observer creates unnatural circumstances.
* Related phenomenon: The Hawthorne Effect

Class Activities

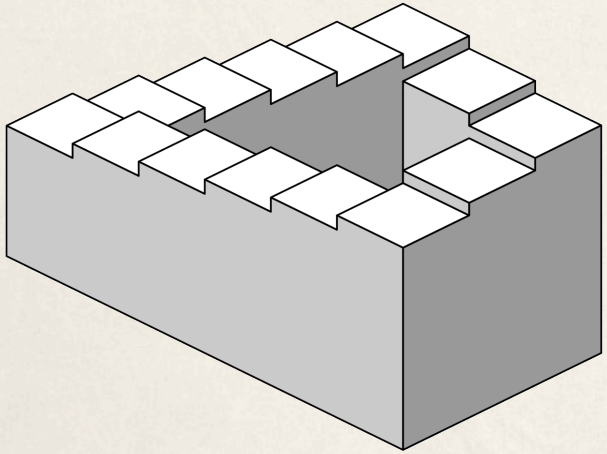
* Design and Experiment
  * Ask students to design, either individually or in groups, a social science experiment.
  * Present the experiment to the class, being sure to address how they plan to minimize observer presence.
* Biography: Jane Goodall
  * Introduce students to Jane Goodall's study of chimpanzees in Tanzania.
  * Discuss ways she was able to overcome the observer paradox.

Visual Paradoxes in Art

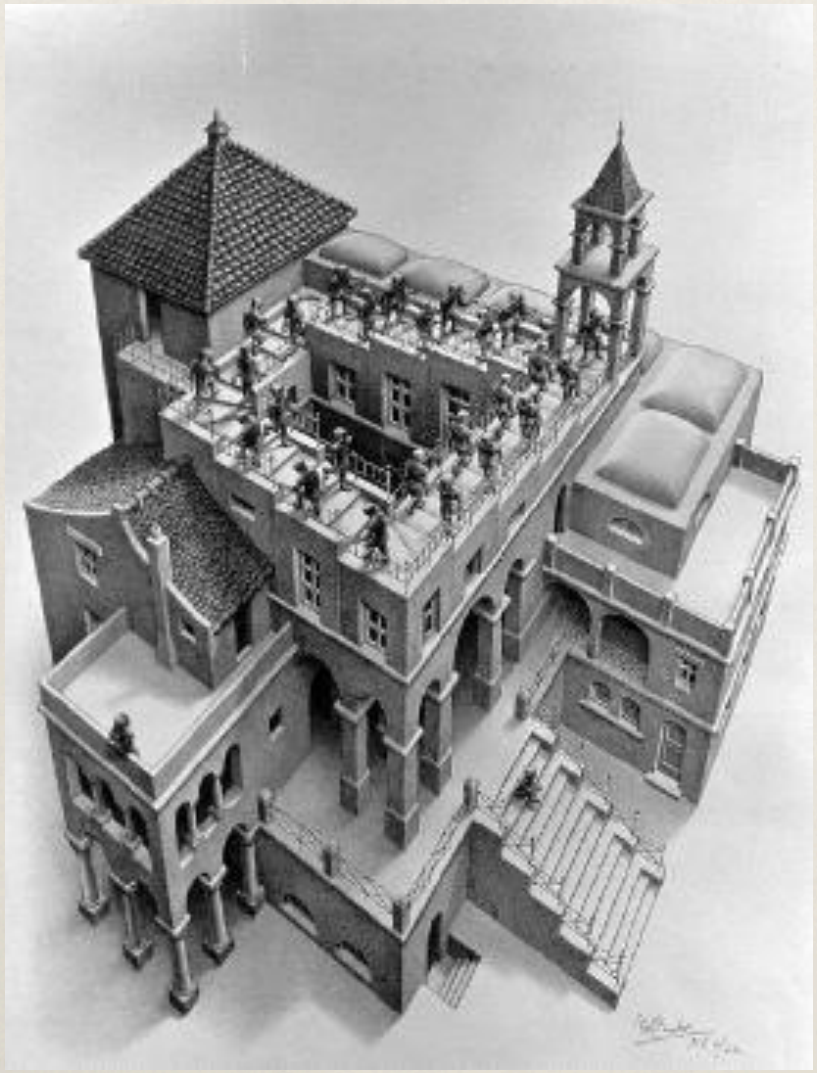
* Penrose Stairs, Lionel & Roger Penrose
* Ascending and Descending, M. C. Escher
* Drawing Hands, M. C. Escher

Penrose Stairs

* Penrose Stairs (1959), Lionel & Roger Penrose



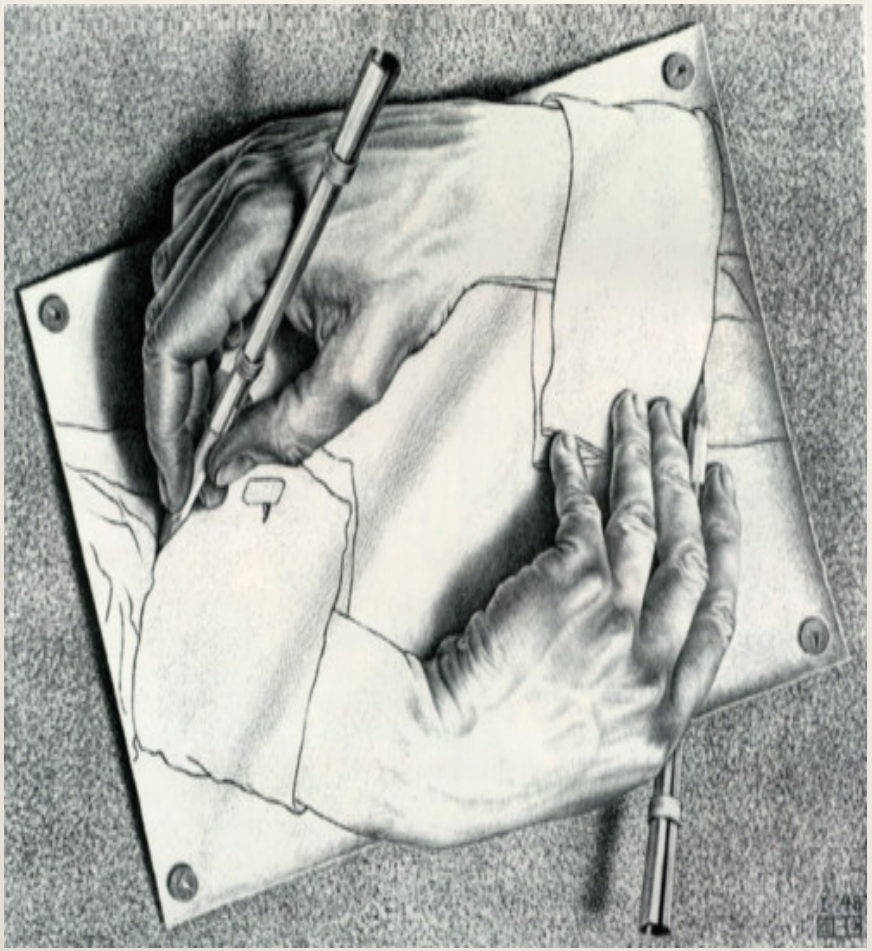
* Paradox:
  * Continuous staircase
  * Stairs make four 90-degree turns as the ascend or descend yet form a continuous loop
  * Impossible in three dimensions



* Ascending and Descending (1960), M. C. Escher
* Lithograph depicts a large building roofed by a continuous, never-ending staircase
* Escher utilizes conflicting proportions to create the visual paradox
* Paradox explained:
  * https://www.youtube.com/watch?v=7pPPWei2oEA
  * https://www.youtube.com/watch?v=uUzBIR-dOwg

Drawing Hands

* Drawing Hands (1948), M. C. Escher
* Paradox:
  * Two hands rise from sheet of paper, facing each other
  * Wrist remain flat on page
  * Paradoxical act of drawing other hand into existence
* Techniques:
  * Hands are more detailed and shaded closer to palm, which creates the illusion of realism



Questions

* Reffel, J. A., Monetti, D. M., Byrd, S. M. & Coffey, C. A. (2014, March). *Using paradoxes to engage gifted learners.* Paper presented at the annual meeting of the Georgia Association for Gifted Children, Athens, GA.

* Center for Gifted Studies at Valdosta State University:
  * http://www.valdosta.edu/colleges/education/psychology-and-counseling/center-for-gifted-studies/