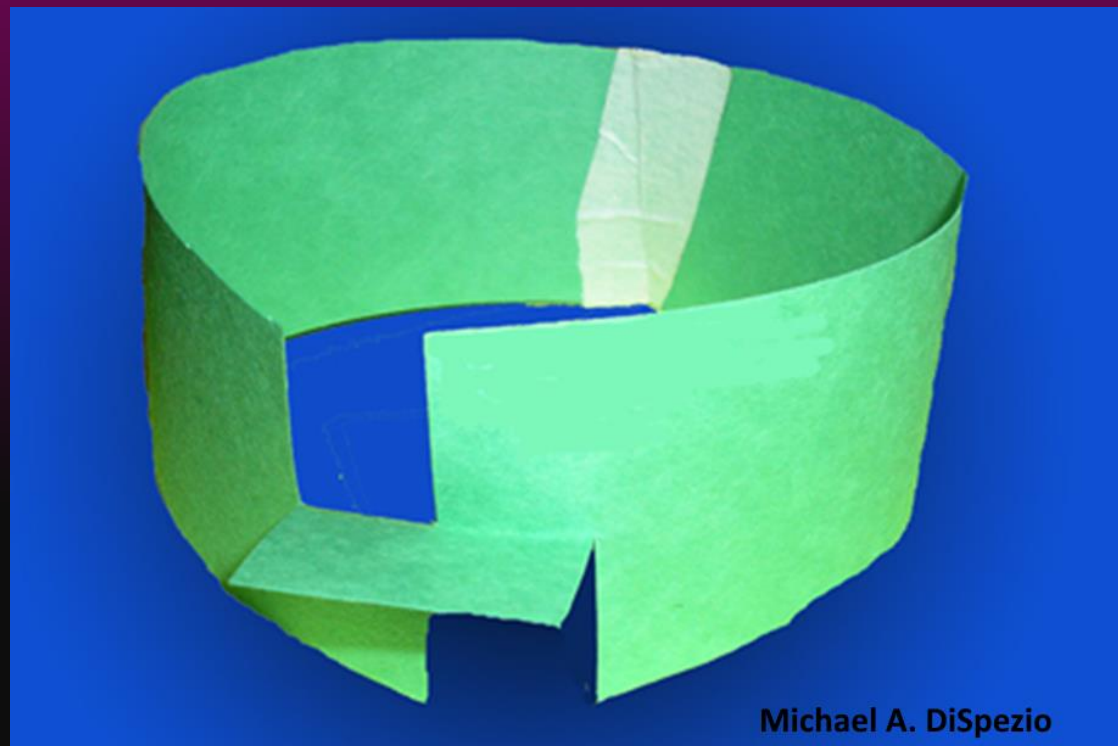


While you are waiting to enter this session, here's a challenge. Use a single strip of paper and construct the loop below. Take a critical look at the flap and the two associated spaces. Use only a single piece of tape (shown at back of loop) to secure the shape. Have fun!



Michael A. DiSpezio

WOW!



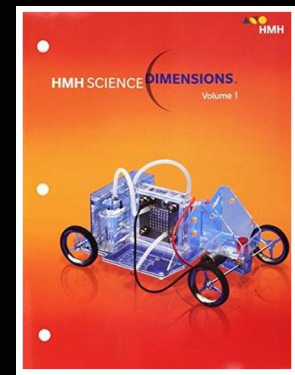
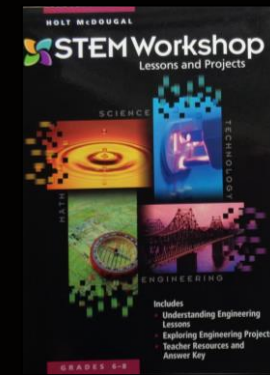
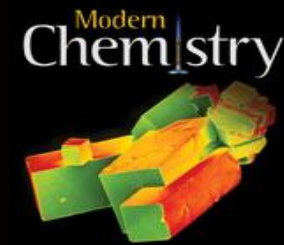
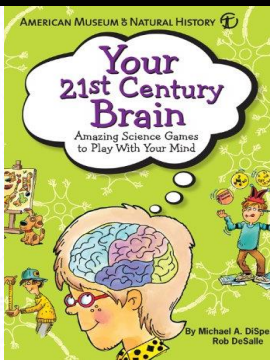
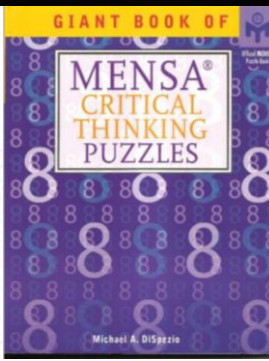
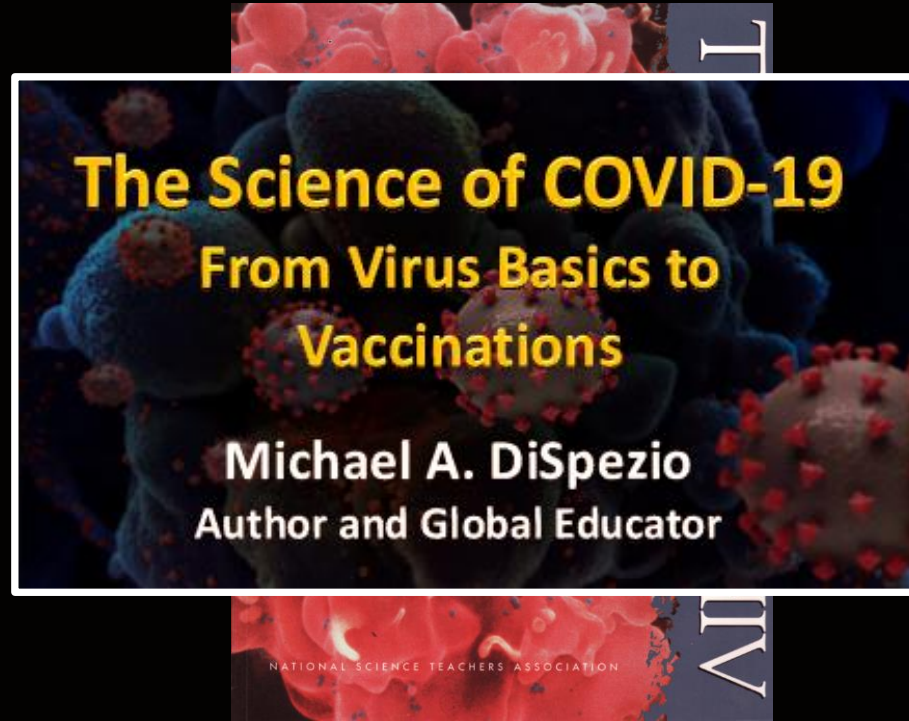
WOW!



# Tips, Techniques, and Tricks for Motivating Students

Michael A. DiSpezio  
Author and Global Educator

# Michael A. DiSpezio



# Goals

Explore Tenets of Motivation

Offer up ideas for online, F2F, and hybrid classes

Model effective and affective pedagogy

Profile FREE Resources

Challenge you

**Have Fun!**

# Pop Quiz

When chilled, which freezes first?


warm water

cool water

# Erasto B. Mpemba

## Tanzanian Scientist

### Mpemba Effect

 Scientific Research Publishing

Journal of Modern Physics, 2017, 8, 2013-2020  
<http://www.scirp.org/journal/jmp>  
ISSN Online: 2153-120X  
ISSN Print: 2153-1196

## Explanation for the Mpemba Effect

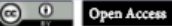
Ilias J. Tyrovolas

Nafplio Regional Quality Control Centre Laboratory, Nafplio, Greece  
Email: pkpfkpen@otenet.gr

How to cite this paper: Tyrovolas, I.J. (2017) Explanation for the Mpemba Effect. *Journal of Modern Physics*, 8, 2013-2020. <https://doi.org/10.4236/jmp.2017.812121>

Received: October 24, 2017  
Accepted: November 25, 2017  
Published: November 28, 2017

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 Open Access

### Abstract


Water molecules are oriented dipoles joined by hydrogen bonds. When water is heated, this structure collapses (*i.e.*, the entropy increases). When water is re-cooled to a lower temperature, the previous structure is not re-formed immediately. Sometimes, when the re-cooling is performed within a freezer, there is not enough time for the structure to re-form because of the high cooling rate. The entropy reduction curve as a function of the temperature,  $S = f(T)$ , shows retardation (a lag) relative to the entropy growth curve. Water that has been heated and re-cooled to the initial temperature shows greater entropy than that before it was heated. This means that, while its molecules now have the same kinetic energy, their thermal motion after heating is less oriented with respect to the structure mentioned above. After re-cooling, random collisions are more likely, owing to this the temperature decreases more quickly.

### Keywords

Entropy, Water, Specific Heat

### 1. Introduction

This case study proposes an explanation for the Mpemba effect, which is considered as the phenomenon wherein, under uncertain conditions, hot water freezes faster than cold water. The fact that the water has been warmed previously contributes to its rapid freezing. Hence many people, when they want to cool

 Proceedings of the National Academy of Sciences of the United States of America

Keyword, Author, or

Home Articles Front Matter News Podcasts Authors

NEW RESEARCH IN Physical Sciences Social Sciences

## RESEARCH ARTICLE

### Nonequilibrium thermodynamics of the Markovian Mpemba effect and its inverse

Zhiyue Lu and Oren Raz

PNAS May 16, 2017 114 (20) 5083-5088; first published May 1, 2017; <https://doi.org/10.1073/pnas.1701264114>

Edited by David A. Weitz, Harvard University, Cambridge, MA, and approved April 4, 2017 (received for review January 23, 2017)

Article Figures & SI Info & Metrics PDF

### Significance

It is commonly expected that cooling a hot system takes a longer time than cooling an identical system initiated at a lower temperature. Surprisingly, this is not always the case; in various systems, including water and magnetic alloys, it has been observed that a hot system can be cooled faster. These anomalous cooling effects are referred to as “the Mpemba effect”, and so far they lack a generic details-independent explanation. Based on recent developments in the theory of nonequilibrium thermodynamics, we propose a generic mechanism for similar effects, demonstrate it in various systems, and predict a similar anomalous behavior in heating.

# The Power of Discrepant Events

Occurrences that challenge our understandings by presenting unexpected outcomes

Well positioned as Lesson Openers

Engage critical and creative thinking

Many are everyday phenomena  
easily observed – inexpensive/readily available materials

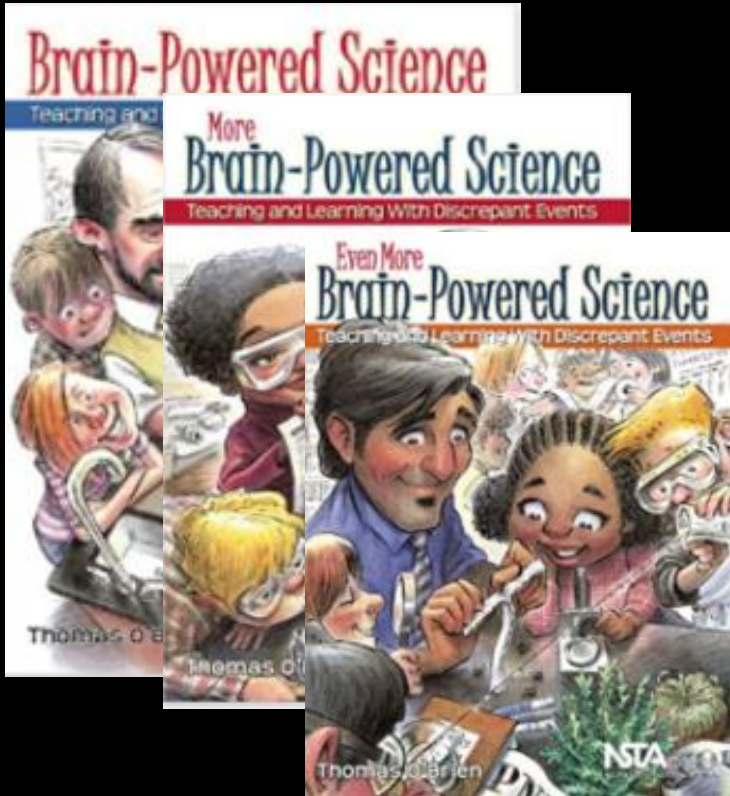
Revisited after construction of understanding

# Additional Discrepant Events

## Internet Searches

### Trade Books

Tom O'Brien  
NSTA Press



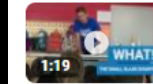
### Science Suppliers



### YouTube

www.youtube.com › watch

#### Discrepant Events: The Disappearing Cup - YouTube



A **Discrepant Event** is something you don't expect to happen and you have to ask yourself: "Why?" More ...

Oct 19, 2016 · Uploaded by Science World

You visited this page on 11/7/20.

www.youtube.com › watch

#### Discrepant Events: Walking Through Paper - YouTube

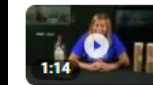


A **Discrepant Event** is something you don't expect to happen and you have to ask yourself: "Why?" More ...

Oct 27, 2016 · Uploaded by Science World

www.youtube.com › watch

#### Discrepant Events: The Marble Leap - YouTube

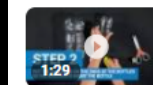


A **Discrepant Event** is something you don't expect to happen and you have to ask yourself: "Why?" More ...

Oct 14, 2016 · Uploaded by Science World

www.youtube.com › watch

#### Discrepant Events: Balloon in a Bottle - YouTube

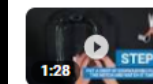


A **Discrepant Event** is something you don't expect to happen and you have to ask yourself: "Why?" More ...

Nov 10, 2016 · Uploaded by Science World

www.youtube.com › watch

#### Discrepant Events: The Soap Boat - YouTube



A **Discrepant Event** is something you don't expect to happen and you have to ask yourself: "Why?" More ...

Oct 7, 2016 · Uploaded by Science World



# Hierarchy of Discrepant Experience

**Engage students in a process-driven activity that offers an unexpected result.**

**Instructor demonstrates the discrepant experience**

**Live demo rather than recorded clip**

**Canned video from other sources**

**Too dangerous or too expensive**

**Impossible to duplicate the setting**

**Profile others performing the demonstrations**

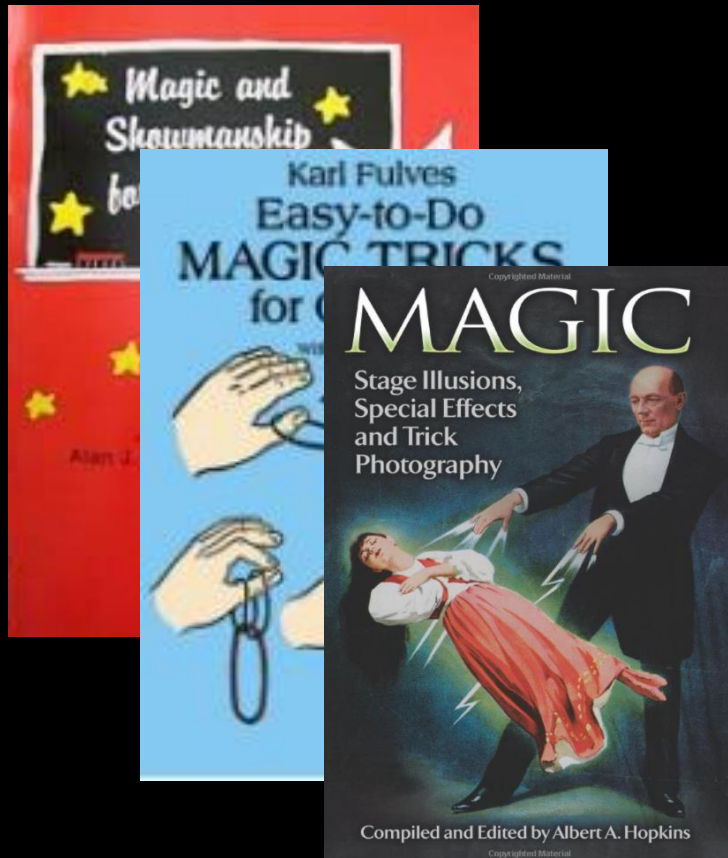


# Uncover Magic for the Classroom

## Trade Books

Alan McCormack

Idea Factory



## Magic Stores Online

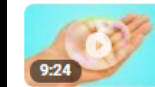
Suppliers



## YouTube

www.youtube.com › watch

20 COOL MAGIC TRICKS AND SCIENCE ... - YouTube



Science and magic tricks 1. Soft egg How to make a ball from an egg. You just have to put a raw egg inside a ...  
Jun 16, 2018 · Uploaded by 5-MINUTE MAGIC

www.youtube.com › watch

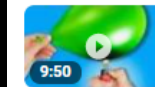
10 Amazing Science Magic Tricks! - YouTube



Easy science magic tricks and experiments for kids, beginners, and all ages! Family-friendly fun magic science ...  
Jun 25, 2017 · Uploaded by EvanEraTV

www.youtube.com › watch

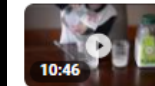
21 MIND-BLOWING MAGIC TRICKS AND SCIENCE ...



SCIENCE FOR KIDS THAT LOOKS MORE LIKE MAGIC Science can be such fun! ... You can do a lot of ...  
Oct 31, 2018 · Uploaded by 5-Minute Crafts PLAY

www.youtube.com › watch

10 Magic Tricks - That Are Really Just Science - YouTube



Checking out library books to learn new tricks and I'm almost sure he doesn't really understand the ...  
Oct 20, 2016 · Uploaded by Raising da Vinci

www.youtube.com › watch

18 EASY SCHOOL MAGIC TRICKS AND SCIENCE ... - YouTube



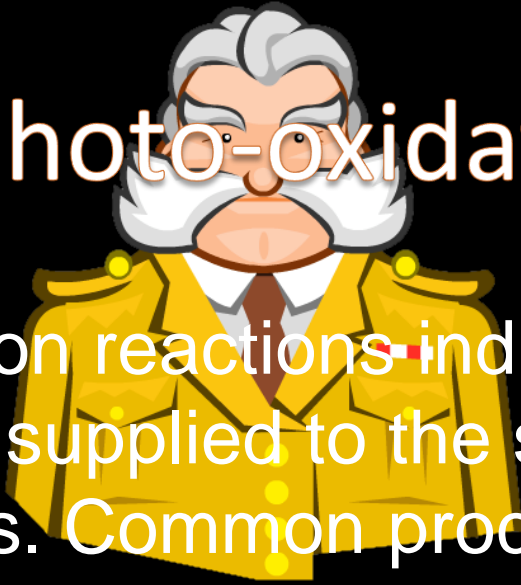
UNEXPECTED TRICKS AND IDEAS FOR KIDS There are so many science tricks that you can perform at ...  
Oct 23, 2018 · Uploaded by 5-Minute Crafts PLAY

# Phenomenon

## photo-oxidation

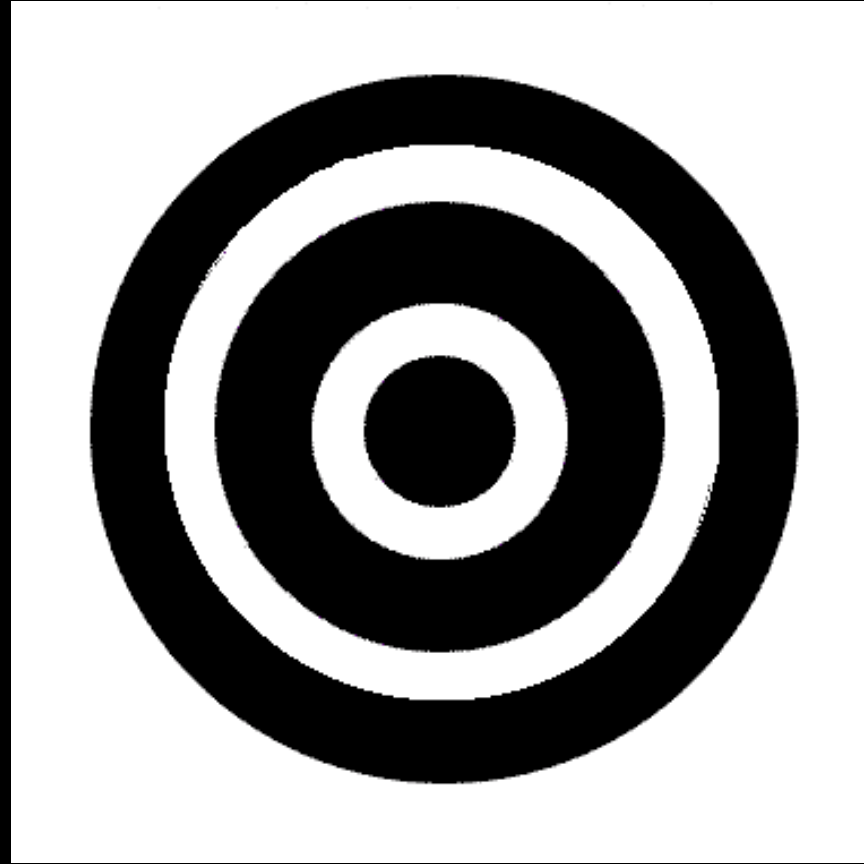
Oxidation reactions induced by the energy supplied to the system by photons. Common processes are:  
a. the reaction of a substance with oxygen activated by the energy transfer of photons. B. the loss of one or more electrons (oxidation) from a chemical species as a result of photoexcitation.

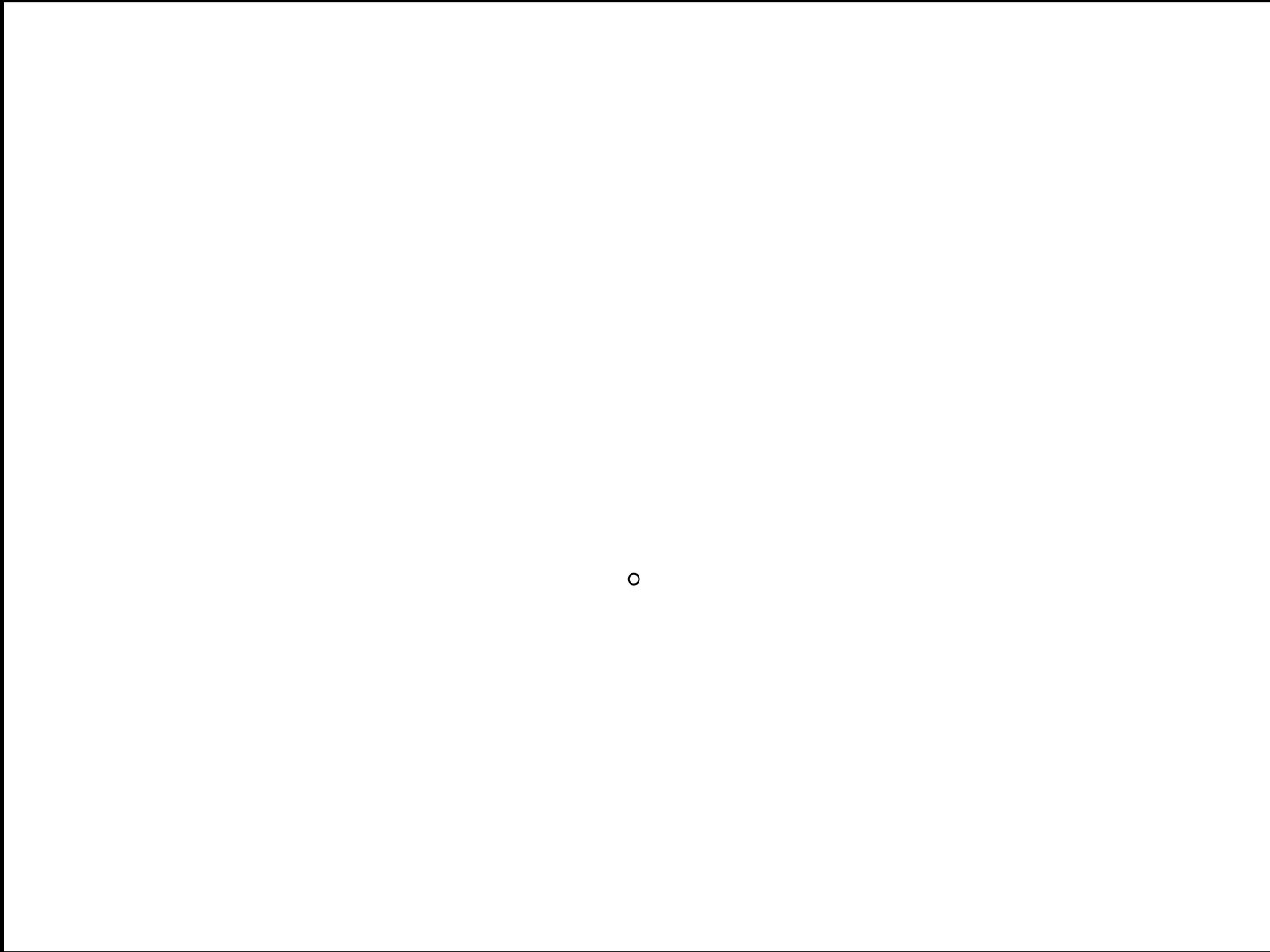
General  
Knowledge



Denim  
in the sun

# Chemistry Experiment





o



o

# Simulations

The screenshot shows the PhET Interactive Simulations website. At the top left is the PhET logo and the University of Colorado Boulder logo. The navigation menu includes SIMULATIONS, TEACHING, RESEARCH, ACCESSIBILITY, and a DONATE button. A search icon is also present. Below the navigation is a large banner image of two divers underwater with the word "Simulations" in the center. Underneath the banner are "Browse" and "Filter" buttons. The main content area is divided into two sections: "Physics" with 106 items and "Chemistry" with 53 items. Each section contains a grid of simulation thumbnails, each with a title and a small icon.

**Physics** [All Physics \(106\)](#)

- Curve Fitting
- Vector Addition
- Gravity Force Lab: Basics
- Waves Intro
- Gases Intro
- Diffusion

**Chemistry** [All Chemistry \(53\)](#)

- Build a Molecule
- Gases Intro
- Diffusion
- Gas Properties
- Blackbody Spectrum
- Energy Forms and Changes

This image displays a grid of 40 simulation thumbnails from the PhET website, arranged in 10 rows and 4 columns. Each thumbnail includes a title, a small image representing the simulation, and a brief description. A callout box points to the "Quantum Mechanics" thumbnail with the text: "A completely visual way to learn quantum mechanics."

Transistor	STM	Semiconductor	Plasma
Molecular Rover	Chemical Bonding	Chemical Resp.	Diffusion
Heat & Temperature	Electrostatics	Phase Change	DNA to Protein
Mission: Immunity	Lipids & Carbs	Tree of Life	Proteins & DNA
Harvest Light	Quantum Mechanics	Crystallography	ELISA



# Nighttime Sky

light pollution

Sky Atlas



Celestron  
Skyportal

ISS



ISS  
Detector



Google Earth on web



Google Earth on mobile



Google Earth Pro on desktop

# Google Earth Pro on Desktop



## Travel the world without leaving your seat

With Google Earth for Chrome, fly anywhere in seconds and explore hundreds of 3D cities right in your browser. Roll the dice to discover someplace new, take a guided tour with Voyager, and measure distances and areas. Coming soon to more browsers.

Launch Earth in Chrome

Search

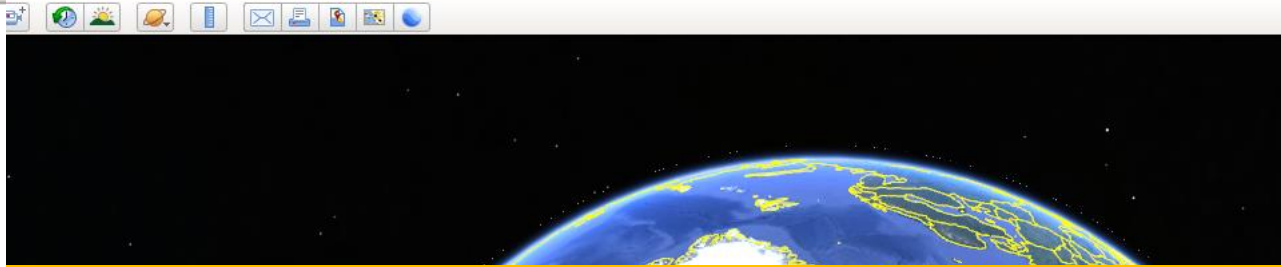
ex: 37 25.818°

Places

- My Places
- Victoria
- Victoria
- Re...
- Ve...
- Vi...
- auclan...
- aukland airport 2
- down on south island
- glacier
- mt. tasman
- mount cook
- topo tasman cook
- anartcia
- western hemisphe...
- grand canyon
- g c village
- bright angle trail
- phantom ranch
- us
- atlanta and stone mt
- stone mountain
- atlanta

Layers

- Primary Database
- Announcements
- Borders and Labels
- Places
- Photos
- Roads
- 3D Buildings
- Weather
- Gallery
- More
- Terrain



### Movie Maker

Record from

- Live mouse and keyboard navigation
- A saved tour: Bodo to Stavanger (My Places / Viking Northern Lights)

Save to

C:/Users/icari/Desktop/Tudda STEM Presentations/HD coney to SI building.asf Browse

Video parameters

XGA (1024x768 pixels, 30 frames/sec)

Picture size (pixels): 1024 x 768 Frames per second: 30.000

Output configuration

File type: Windows Media (.asf) Picture quality: High

Create Movie Cancel

# Google Cardboard



# My Blog

## michaeldispezio.com

### Welcome To My Universe

Virtual Reality, Science Education and More



#### Leveling the Playing Field Through Understanding



01

Jul

Michael DiSpezio

Google Expeditions, Part 2, Classroom Tools

Are you ready to lead a field trip through the International Space Station? Perhaps it's time to stretch...



28

Jun

Michael DiSpezio

Google Expeditions, Part 1, Virtual Field Trips

"Who wants to go on a field trip?" Stupid question. EVERYONE wants to go on a field trip...including the...

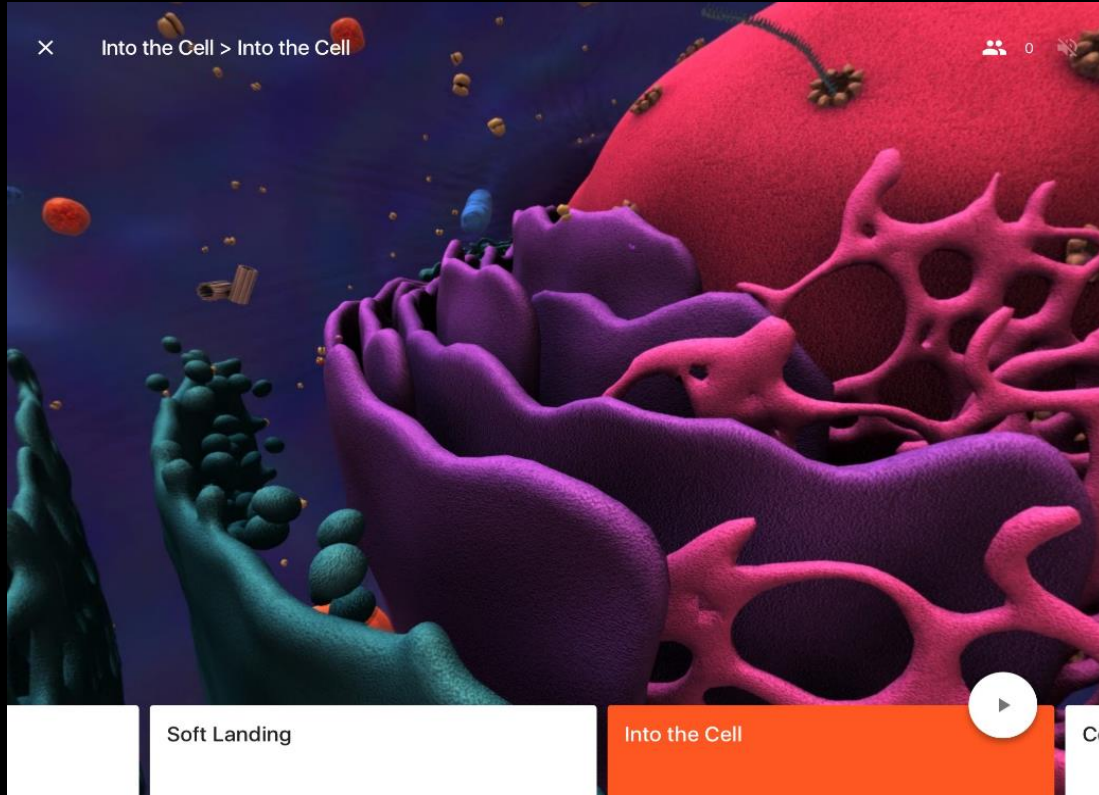
# Google Expeditions





# Expedition

# *Into the Cell*



# Expeditions AR Tours



The screenshot displays the main interface of the Expeditions AR Tours app. At the top, a grid of various AR tour cards is visible, each with a small preview image and a scene count (e.g., 'Farming AR' with 6 scenes, 'Tools AR' with 5 scenes, 'Creative Commons AR' with 4 scenes, 'Vida Systems AR' with 5 scenes, 'Vida Systems AR' with 6 scenes, 'Anim Relat' with 7 scenes, 'Anim the M' with 5 scenes, 'Audite' with 7 scenes, 'Bees' with 5 scenes, 'Geometry - types of triangles' with 5 scenes, and 'Greek Architecture' with 5 scenes). Three specific AR tour cards are highlighted with black borders and expanded into detailed view windows:

- Moon Landing:** Features an AR scene of the Apollo lunar module on the moon's surface. The text below reads: "The Moon is Earth's largest natural satellite. During the 1950's the great 'Space Race' occurred between the Soviet Union and the United States. Both countries poured money and man hours into trying to get humans to the Moon first. In 1969 the United States landed the Eagle and two humans walked on the surface of the Moon for the first time." It includes 'View in AR' and 'Guide' buttons.
- DNA and RNA:** Features an AR scene of a blue DNA double helix. The text below reads: "Present in most cells in all living things, DNA (deoxyribonucleic acid) is a molecule that carries all the information needed to create an organism. This information is a genetic inheritance—DNA is passed from parents to children in cell structures called chromosomes. RNA (ribonucleic acid) is DNA's helper. It carries instructions from DNA for the creation of proteins. Join this tour to learn more about the way in which DNA and RNA interact to build bodies." It includes 'View in AR' and 'Guide' buttons.
- Animals of the Cretaceous:** Features an AR scene of a red and blue dinosaur. The text below reads: "The Cretaceous Period, a geological time period that ended 66 million years ago, lasted 79 million years and began and ended with extinction events. The Earth's continents were in different positions than they are today and the Earth's climate was much warmer than the current climate." It includes 'View in AR' and 'Guide' buttons.

At the bottom of the app, there are navigation icons for 'Discover', 'Library', and 'Class' on both the left and right sides.

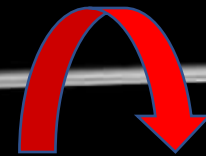
Michael DiSpezio @mdispezio



# Playfulness in the Presentation



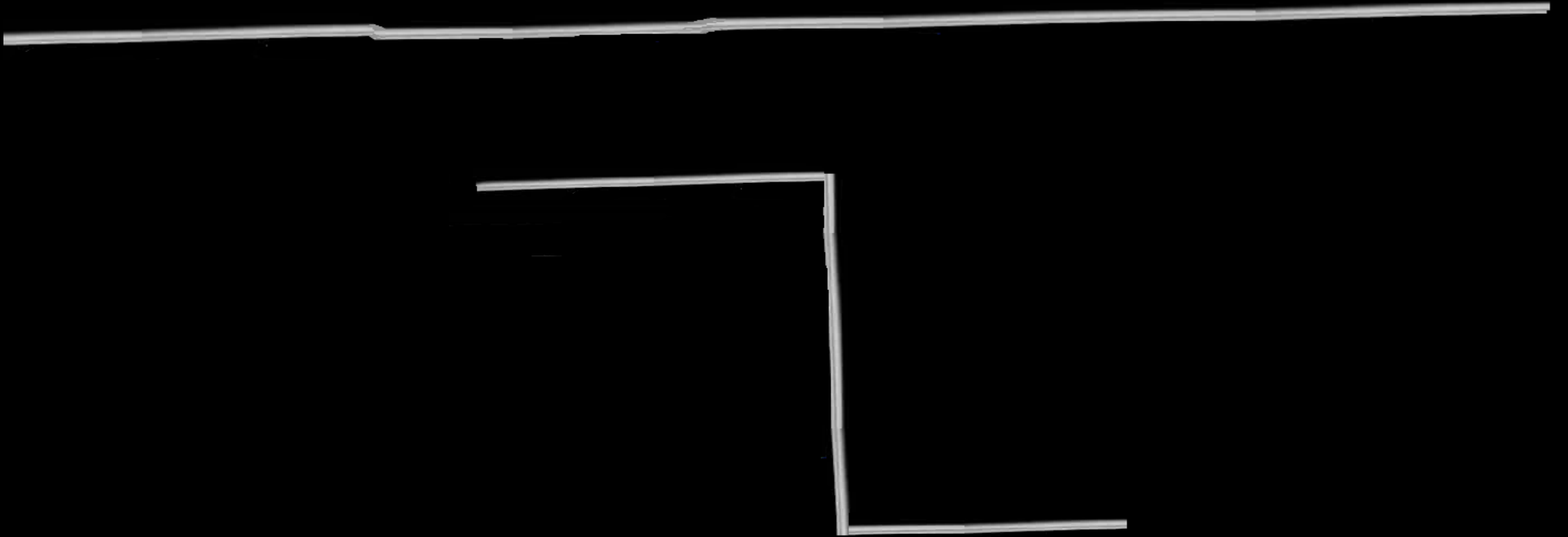
# Basic Engineering



Clamp down tightly!  
Don't let it spin.

Try to make the wire  
spin.

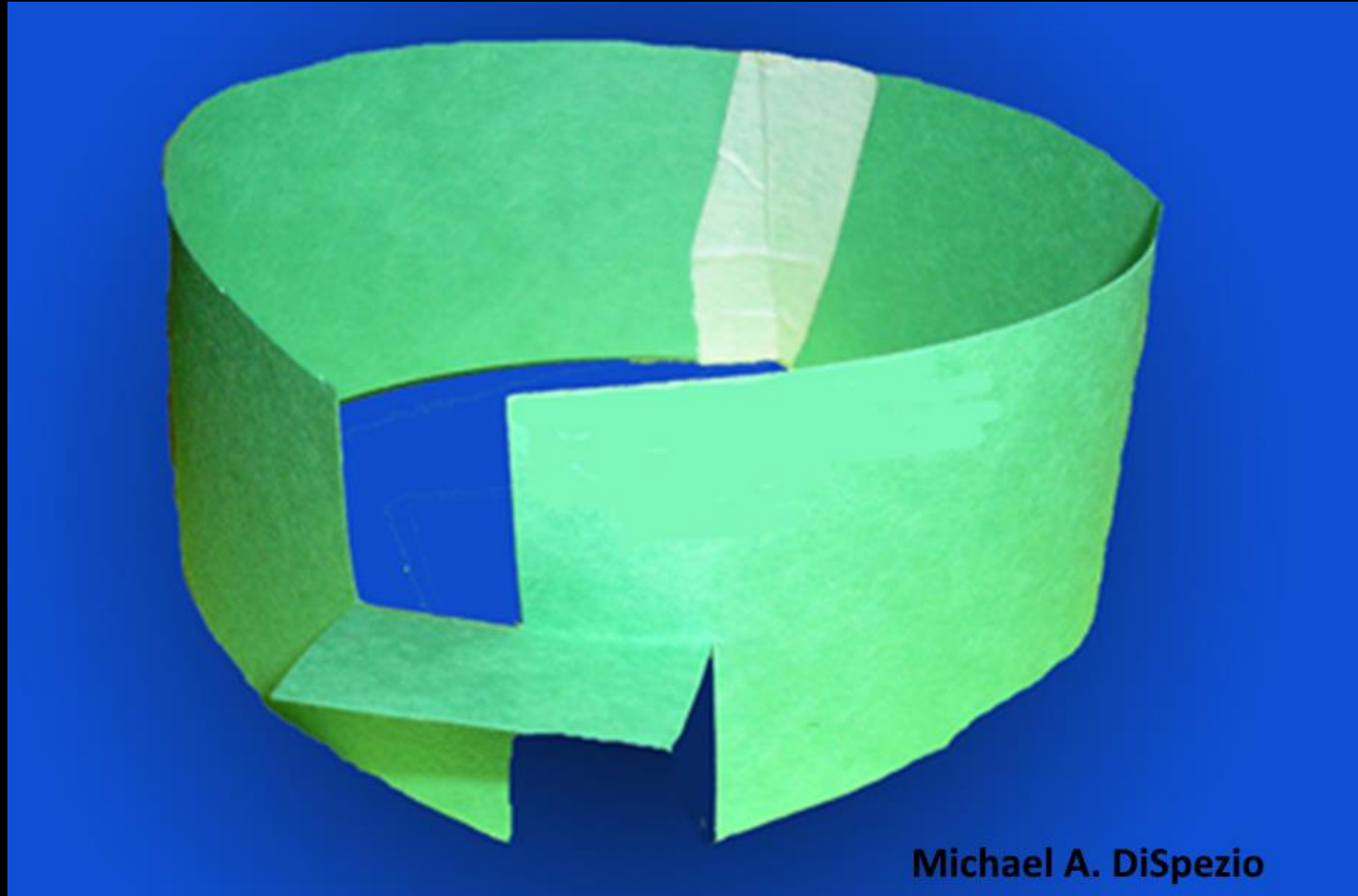
# Basic Engineering



I could tell you a science joke...  
but all the good ones Argon.

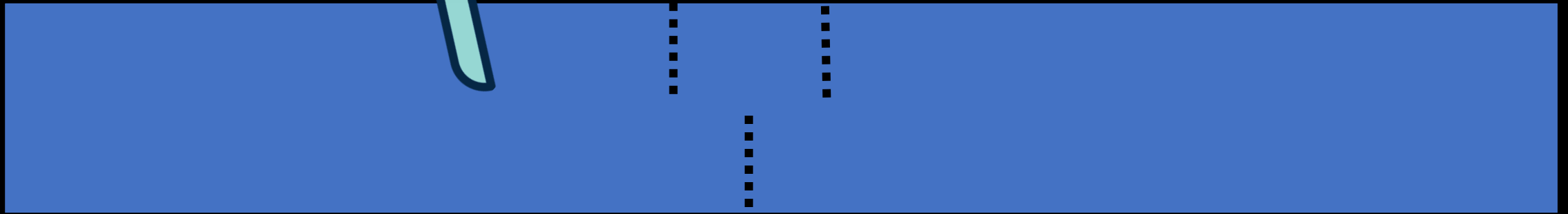
# Challenging Puzzles

# Challenge



Michael A. DiSpezio

# 3-cut Card





Michael A. DiSpezio





**Tweeter**  
**@mdispezio**

**Blog**  
**covid19.michaeldispezio.com**

**Thank You**

← **Michael DiSpezio**  
250 Tweets



**Michael DiSpezio**  
@mdispezio

Biologist, educator, and science author, driven to improving the human condition through education  
[en.wikipedia.org/wiki/Michael\\_A...](https://en.wikipedia.org/wiki/Michael_A...)

📍 Cape Cod 🌐 [covid19.michaeldispezio.com](https://covid19.michaeldispezio.com) 📅 Joined November 2010

18 Following 753 Followers

Tweets Tweets & replies Media Likes

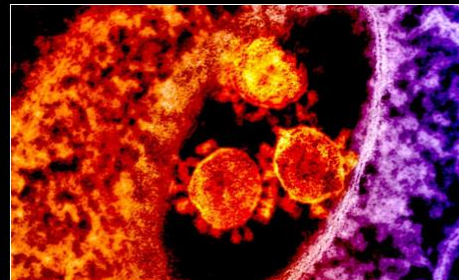
# Understanding COVID-19

## The Science, Spread and Therapies of Coronavirus Disease



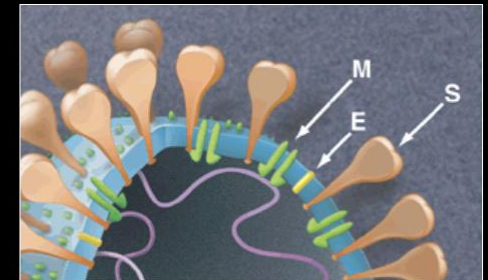
17  
Apr  
Michael DiSpezio  
**COVID-19 Testing Part I**

*Who has the virus? Who doesn't? At the beginning of the outbreak, there was no certain way to know. Although these...*



27  
Mar  
Michael DiSpezio  
**Coronaviruses**

*Coronaviruses compose a group, or family (Coronaviridae) of viruses that was discovered and first studied in the mid-1960s...*



26  
Mar  
Michael DiSpezio  
**COVID-19 Viral Envelope**

*Most viruses have two structural components; nucleic acid and a protective protein coat called a capsid. (see my March 22 blog...*

# The End

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icaris@aol.com