CSSA Workshop

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May 31st 2014

Learning Outcomes

Educators will

- 1) Learn modeling strategies that are easy to use, student friendly, and align with National Standards
- 2) Understand the relevance of scientific models in the scientific community
- 3) Develop skills in real world data extraction
- 4) Learn how use graphical models to develop conclusions
- 5) Discover new uses for data science in the classroom
- 6) Apply modeling strategies to develop scientific conclusions

Workshop Outcomes

- NGSS – Models and Common Core Alignment
- Recognize examples of models to use in the classroom in conjunction with NGSS
- Explain how astronomers use models to make predictions
- Extract astronomical data sets for classroom use
- Generate multiple plots for data analysis
- Learn how to use mathematical models in laboratory settings

Learning Outcomes

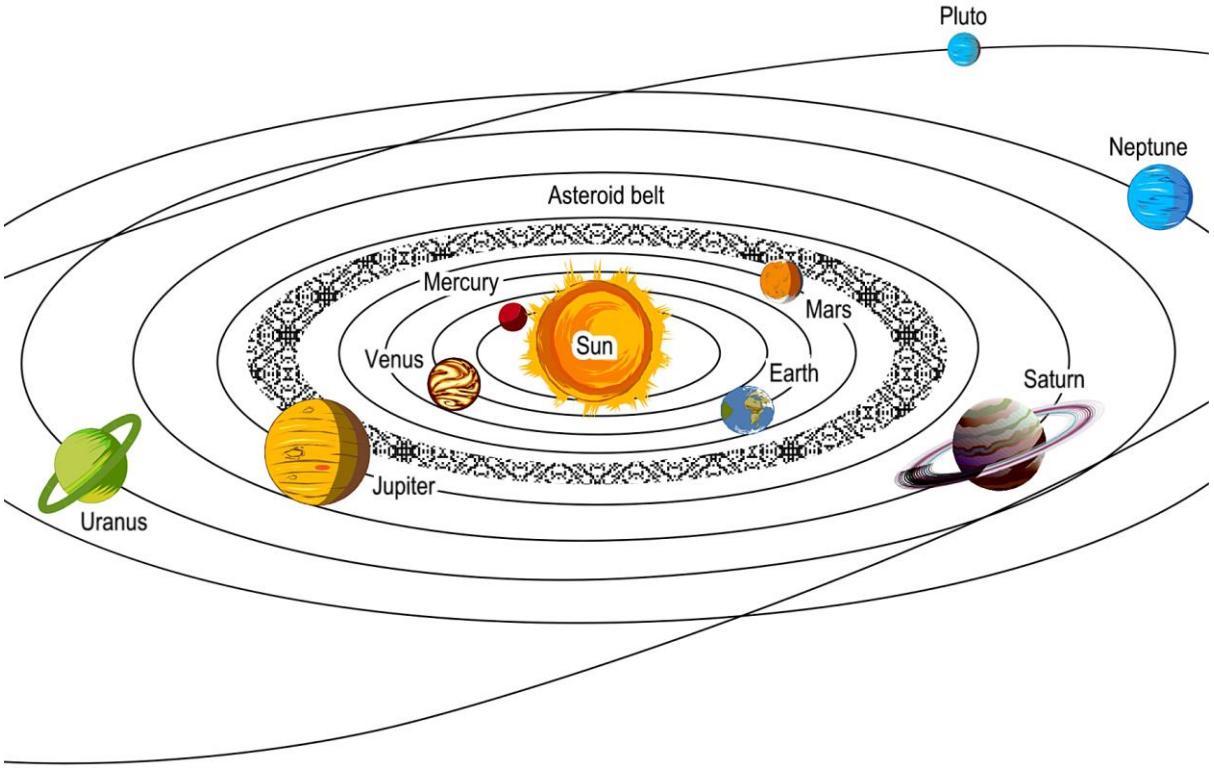
- Learn how to engage students in real world data explorations
- Find new ways to included data science concepts and strategies in CS courses including mobile technology
- Develop skills in data science that are applicable to the classroom
- Discover readily available, easy to use, student friendly, yet powerful data tools

Agenda

- NGSS Practices/Common Core
- NASA/IPAC Teacher Archieve Research Program – NITARP
- “Kit I” – Using HR Models to determine stellar characteristics
- “Kit II” – Using the Ohm’s Law model to determine characteristics of electronic devices
- Conclusion

Activity

- Draw a model of the solar system



What is a Model?

" …a system of objects, symbols, and relationships representing another system in a different medium"

Models-Based Science Teaching NSTA Press – Steven W. Gilbert

A method for displaying information to show understanding

Developing and using models

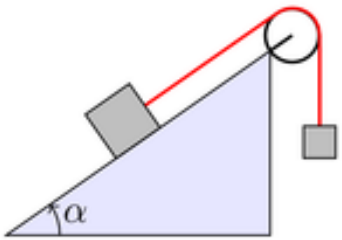
- Based on Evidence
- Represent a system/process through
- Evaluate & Refine Models
  - Models are simplified
  - Inaccuracies

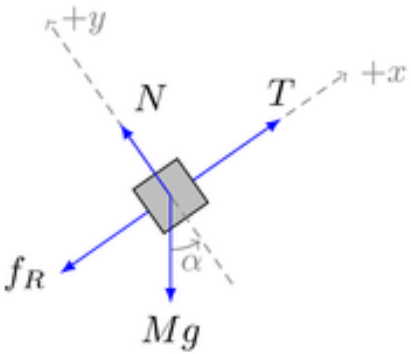
Examples of Models in Several Categories

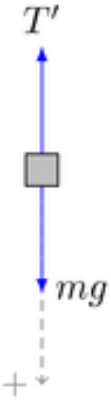
Class of Models	Examples
Concrete Models	Scale Models Mock-Ups Figurines Analogies
Pictorial/graphical	Blueprints Story Boards Infographics Photographs Diagrams
Mathematical Models	Formulae and Equations Graphs Topographic Maps
Verbal Models	Descriptions Scripts Directions
Simulation Models	Simulation Games Cockpit Simulations Crash Test Dummies
Symbolic Models (Semiotic Models)	Words, Numbers Mathematical Figures Stoplights, Traffic Signs

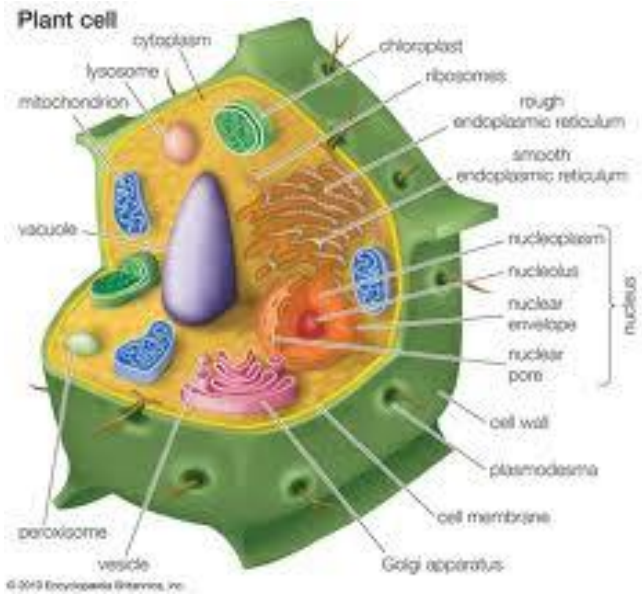
Models-Based Science Teaching – NSTA Table 1.1 pg 5

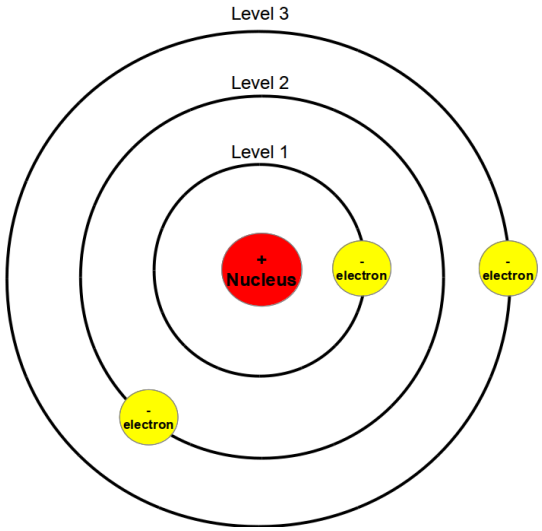
Model Examples - Diagrams





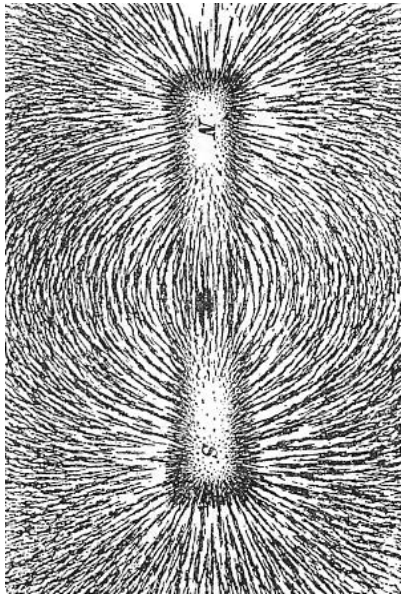


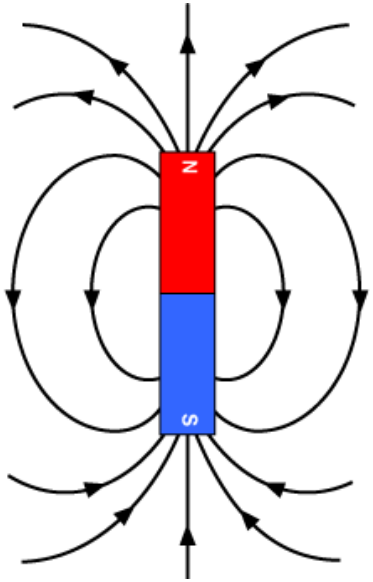




Model Examples - Diagrams

- **Magnetic Field** – a region of space around the magnet that generates an interaction between other magnets





Model Examples - Mathematical

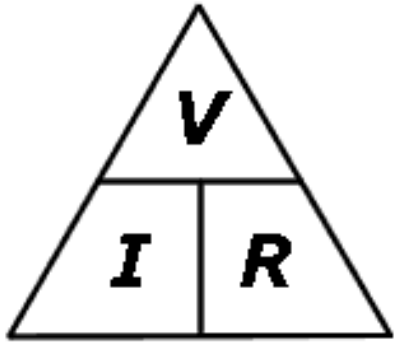
- Ohm's Law

Voltage in Circuit (V)

$$I = \frac{V}{R}$$

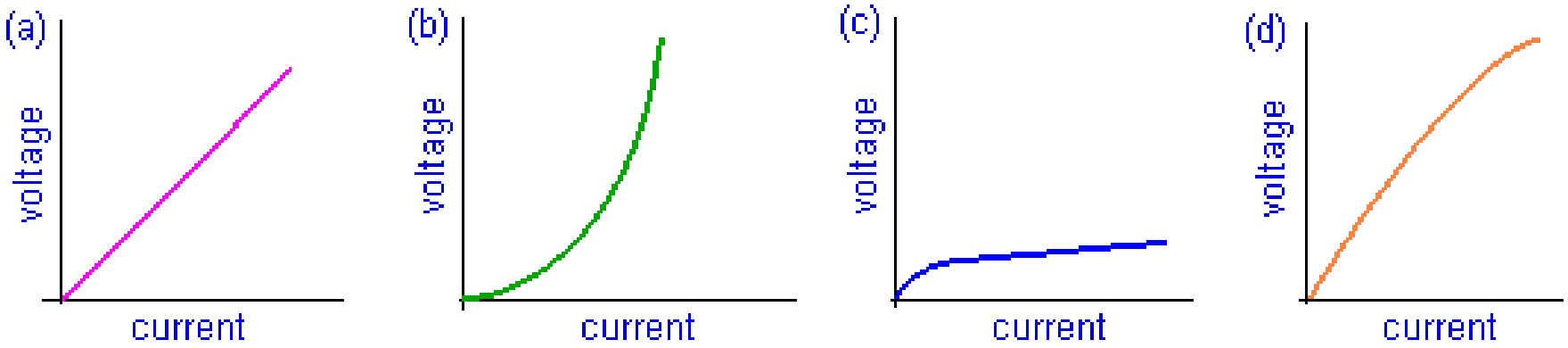
Current in a Circuit (A)

Total Resistance of the circuit (Ω)



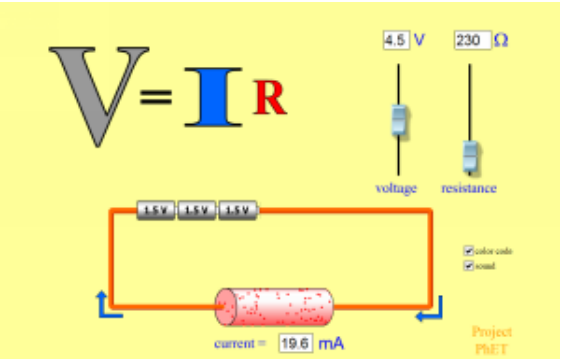
Model Examples - Graphical

- Graphical Representation of Ohm's Law



The relationship between voltage and current for some components
(a) an ohmic resistor, (b) a non-ohmic light bulb, (c) a diode, (d) a thermistor

http://physics.nayland.school.nz/VisualPhysics/NZ-physics%20HTML/14_Electronics/chapter14a.html



$$V = I\,R$$

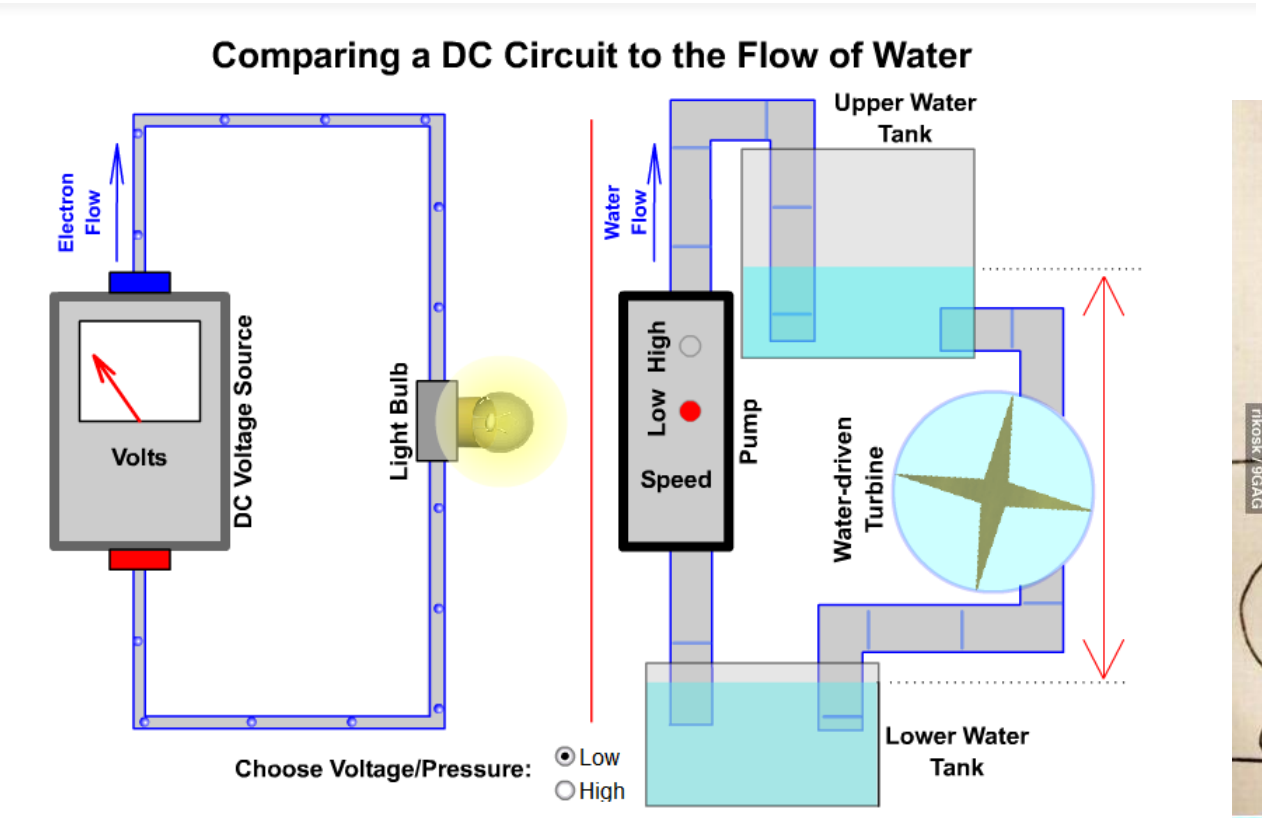
y = mx

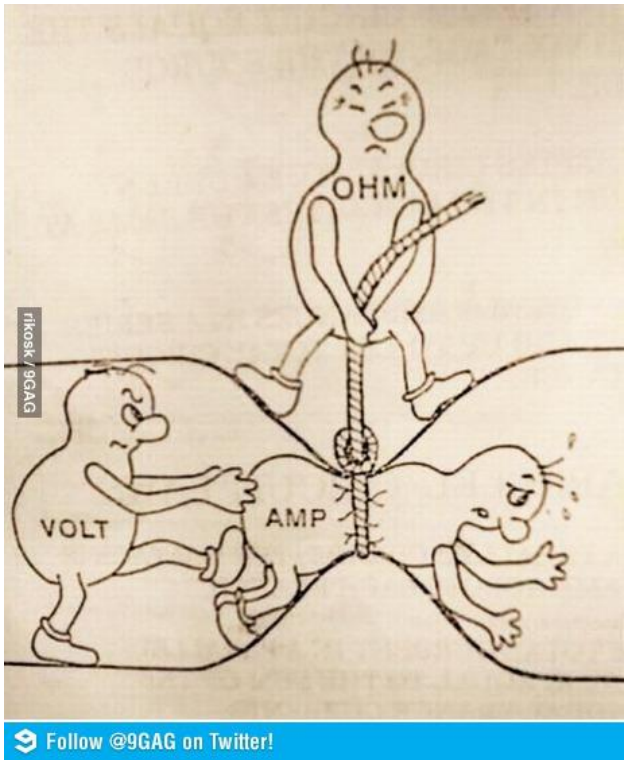
V= y I =x

m = R

Slope of Graph = R

Model Examples - Analogies





http://www.learnerstv.com/animation/animation.php?ani=85&cat=Physics

Model Examples – Concept Maps

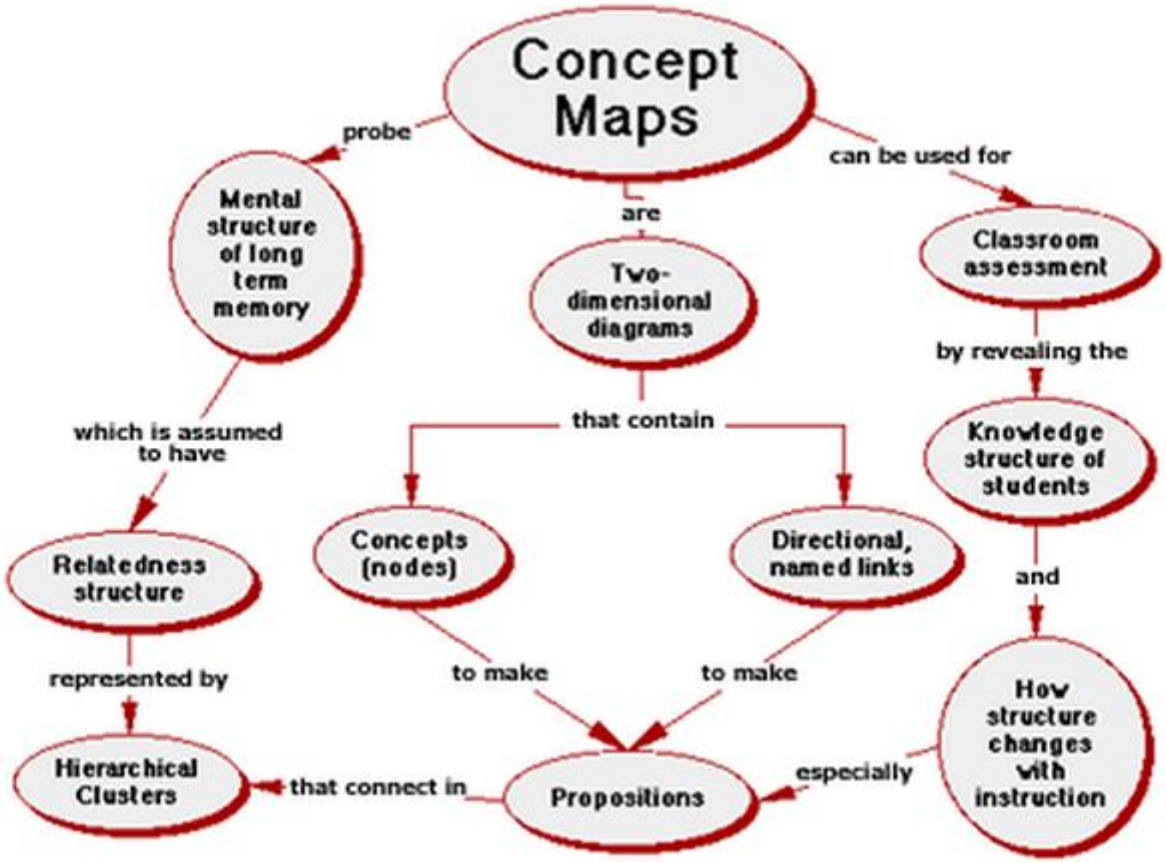


Figure 1: Concept Map Of Concept Maps

Model Examples - Simulations

- PHET Simulators

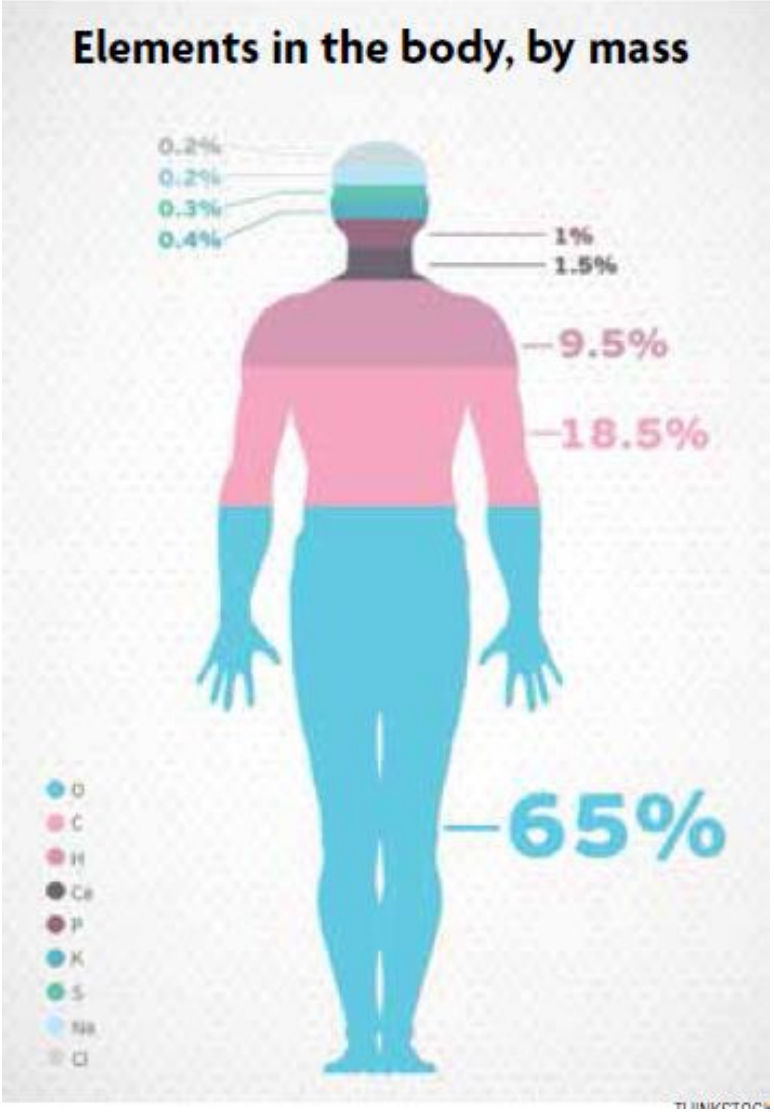
John Travoltage

http://phet.colorado.edu/en/simulation/travoltage

Generator

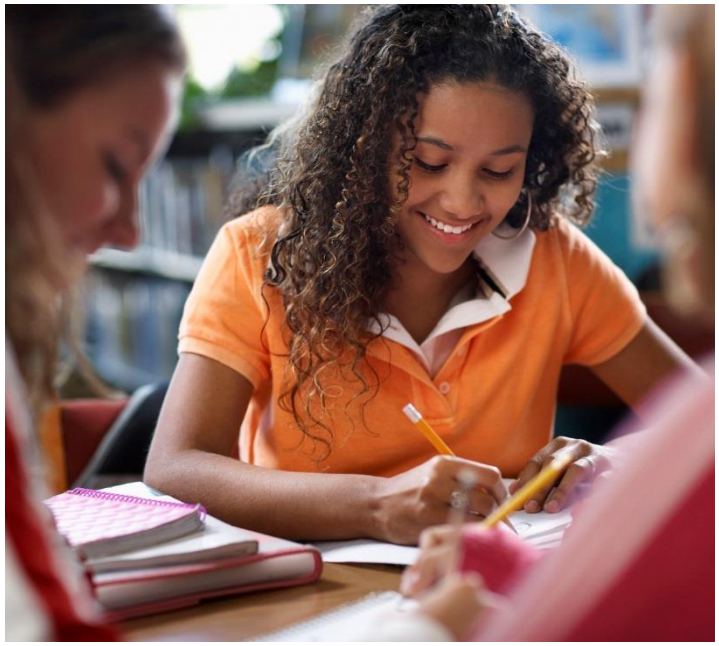
http://phet.colorado.edu/en/simulation/generator

Model Examples - Infographs



How do Models help student understanding?

- Promote Higher order **thinking**
  - Analyze
  - Synthesize
  - Evaluate
- **Communicates** science through a visual for understanding



NGSS Practices

1. Asking questions (for science) and defining problems (for engineering)
2. **Developing and using models**
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

http://www.nextgenscience.org/

Mathematics

High School - Linear Modeling

- CCSS.Math.Content.HSF-LE.A.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

- CCSS.Math.Content.HSS-ID.C.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.

- CCSS.Math.Content.HSF-LE.B.5 Interpret the parameters in a linear or exponential function in terms of a context.

- CCSS.Math.Content.HSS-ID.A.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

Writing for Science

High School - Developing a Model & Writing

- CCSS.ELA-LITERACY.W.9-10.7
  Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- CCSS.ELA-LITERACY.W.9-10.8
  Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
- CCSS.ELA-LITERACY.W.9-10.9
  Draw evidence from literary or informational texts to support analysis, reflection, and research.

NGSS – CC Alignment

Practice 2 Developing and Using Models	CC WLS - 7, 8, 9
Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • **Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism or system in order to select or revise a model that best fits the evidence or design criteria.** • **Design a test of a model to ascertain its reliability.** • **Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.** • **Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations.** • **Develop a complex model that allows for manipulation and testing of a proposed process or system.** • **Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.**	7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. 8. Gather relevant information from multiple authoritative print and digital resources, using advanced searches effectively; access the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. 9. Draw evidence from informational texts to support analysis, reflection and research.

Sue Blozzon – Oxford High School Science Chair

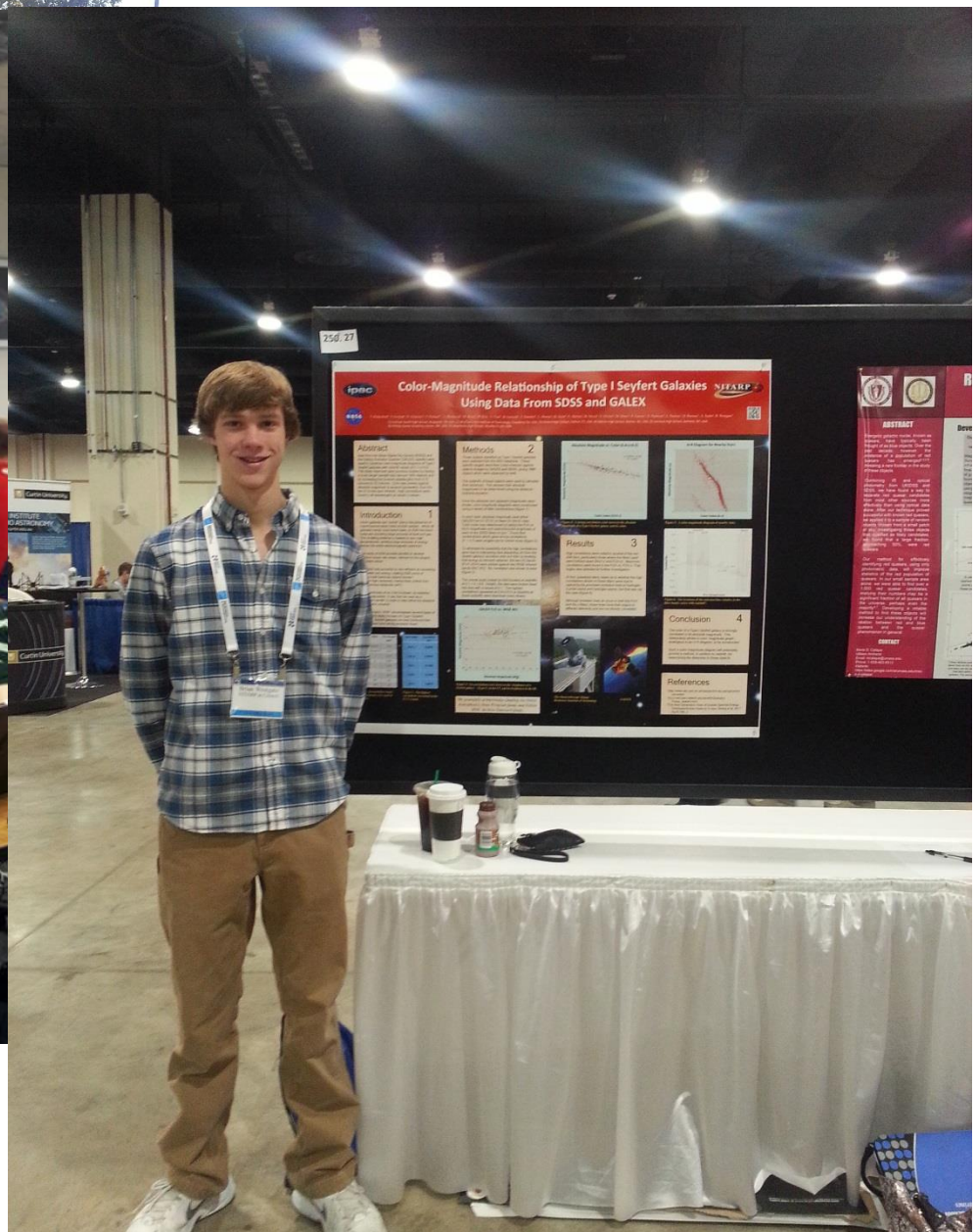
How do scientist use Models?

NITARP Research Project

http://nitarp.ipac.caltech.edu/

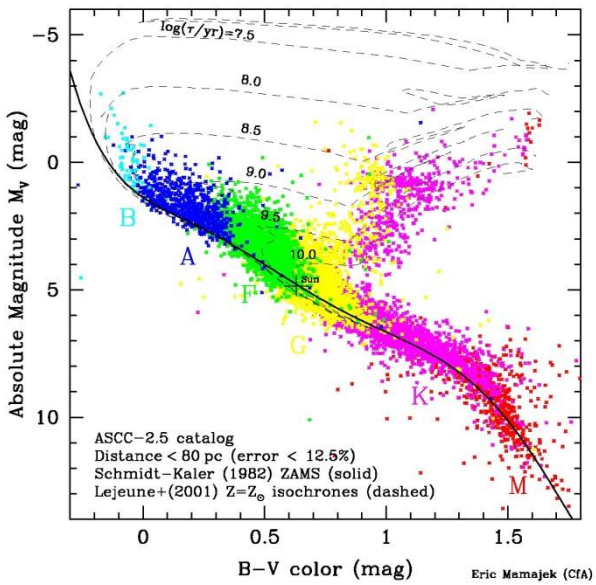
- NASA/IPAC Teacher Achieve Research Program
- Research collaboration with teachers around the country and NASA/IPAC Astronomers.

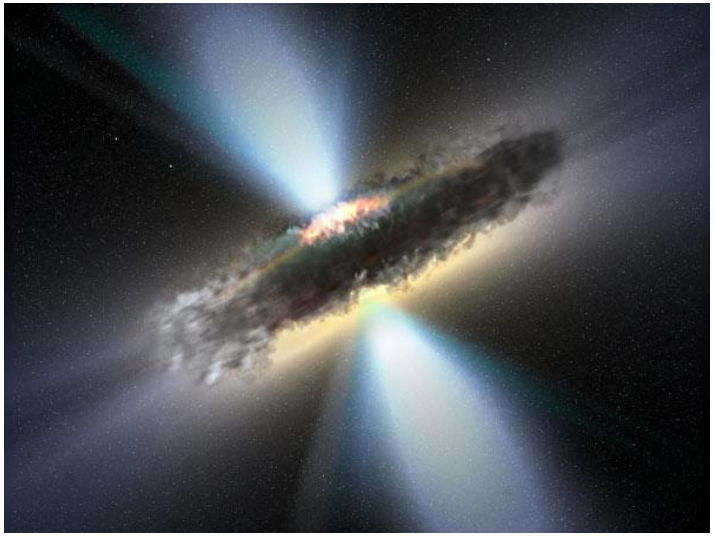
Caltech


Color-Magnitude Relationship of Type I Seyfert Galaxies
Using Data From SDSS and GALEX
Abstract
Methods
Introduction
Results
Conclusion
References

Research Project:

- Generate a color-magnitude diagram (CMD) for active galactic nuclei (AGN)





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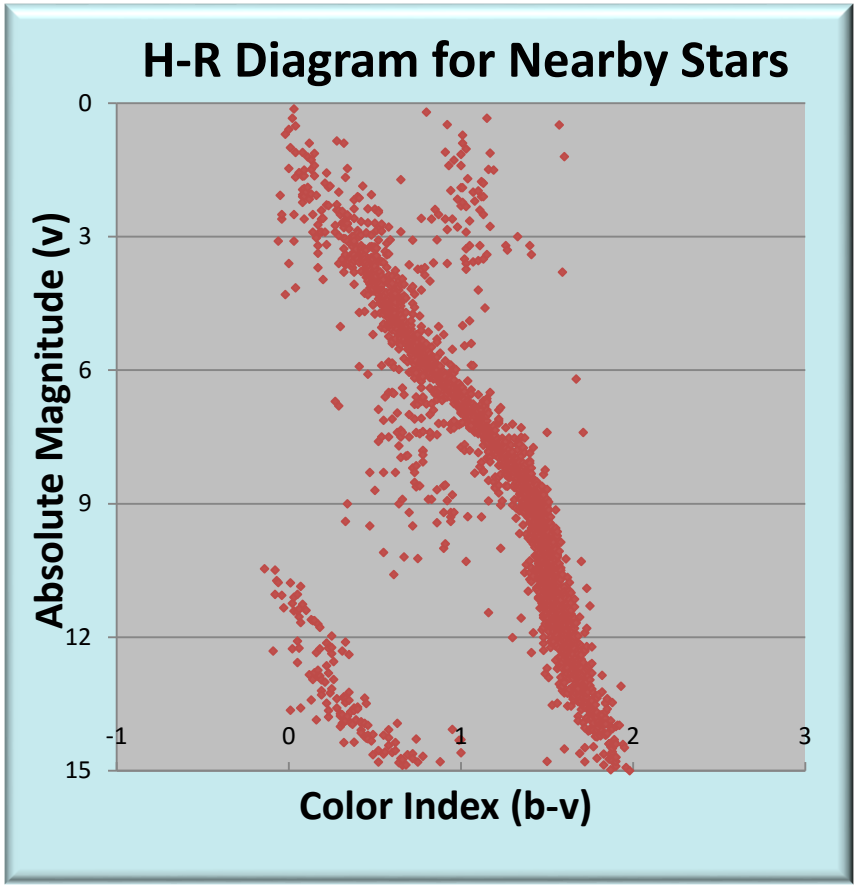
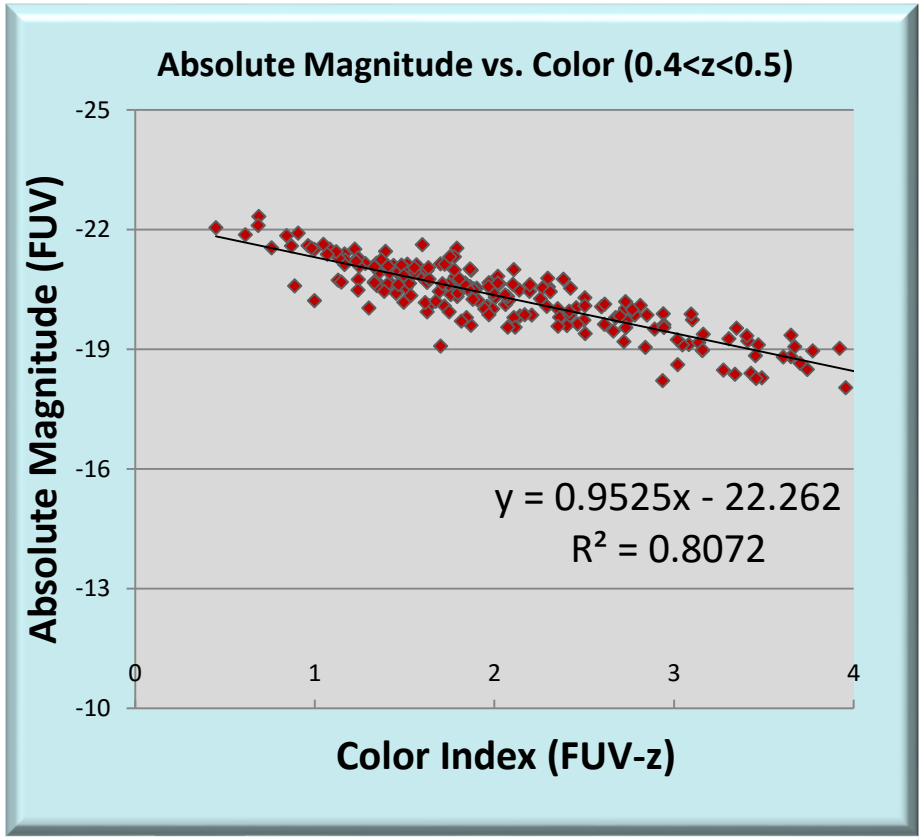
Research Results



Model HR Diagram



Results - AGN Model HR

Activity I

- Determine the types of stars present in a cluster using the HR-Diagram Model

- Activity Extension – Does the model for stars apply for galaxies

Activity II

- Develop a model for different electronic devices
- Use your model to determine an unknown voltage source

- Extension

Generate a Model

- Resistors
- Diodes
- Lightbulbs
- LEDs

Share document on Google Docs