

# Operation Fabric of the Cosmos

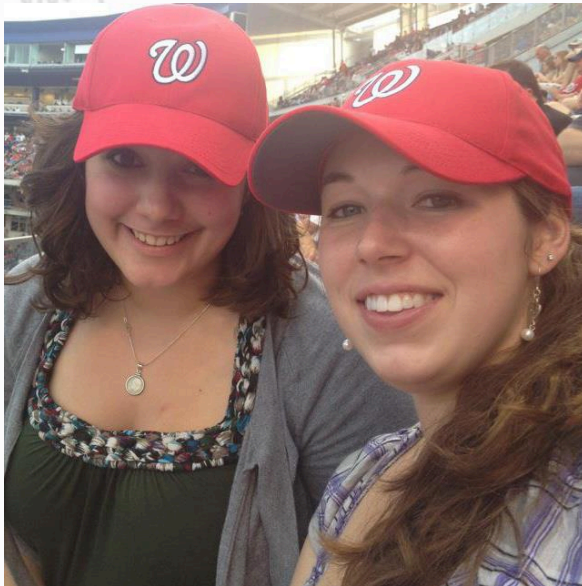
2012 SOCK: The Fabric of the Cosmos  
Meredith Woy & Melissa Hoffman



Melissa Hoffman  
Drew University



tidal bulges



Meredith Woy  
Bloomsburg University





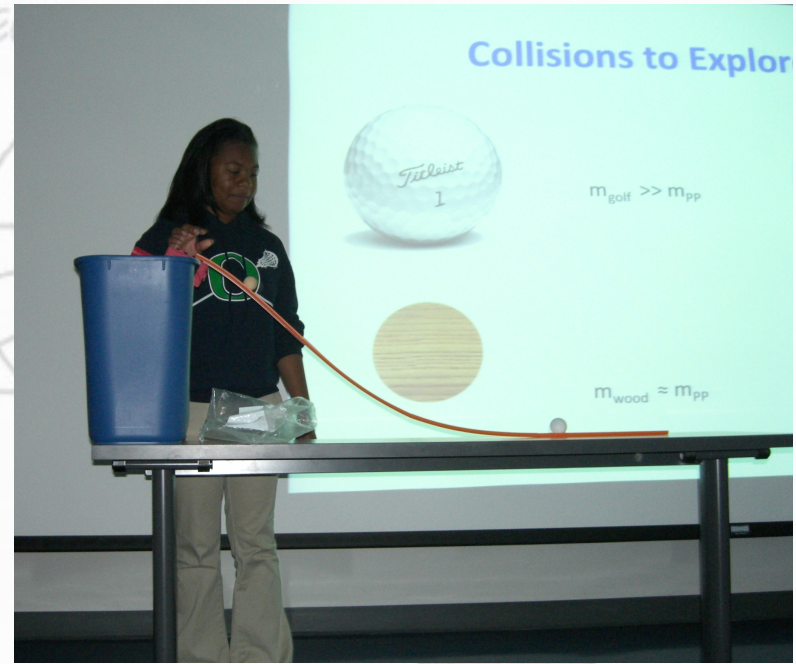
# What is a SOCK, anyway?

- Science Outreach Catalyst Kit
- Sent to SPS chapters each year
- Used for outreach



# Types of Outreach Events

- Last year
  - Outreach event for elementary, middle, and high school students
  - Middle school open house
  - After school science program for girls, 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> grade
  - Presentation at AAPT meeting
  - Science night at an elementary school
  - Science fair at an elementary school





# What's the Theme, Brian Greene?

- This year's theme – “Fabric of the Cosmos”
  - Funded by NOVA
- Our focus is “Invisible Fields of the Cosmos”
  - Gravity, Magnetism



# Gravity

- Visualize spacetime using spandex
- Model a gravitational field



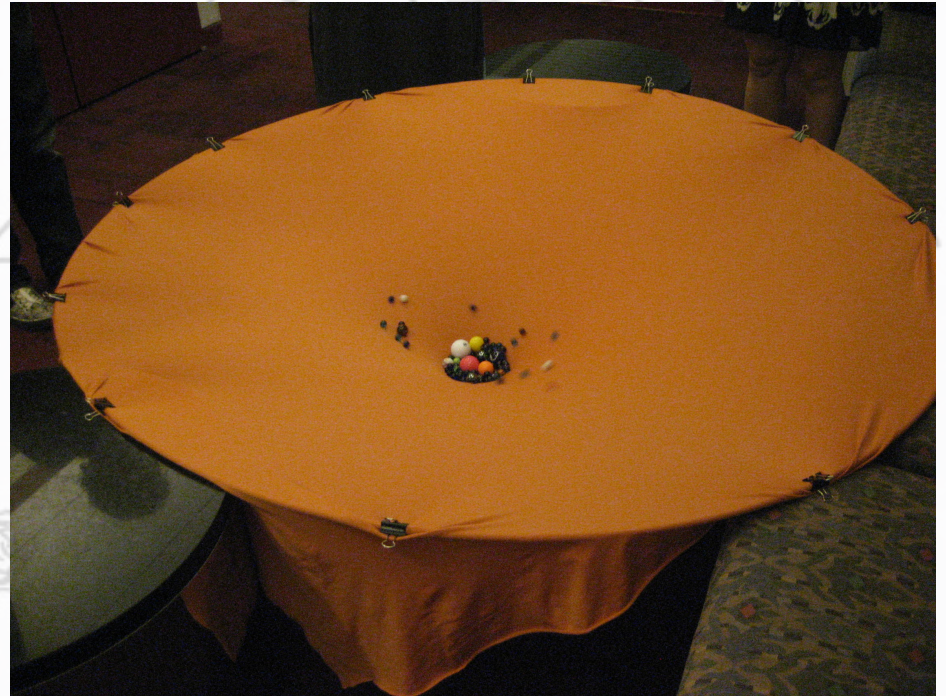
Background diagrams and text:

- Magnet diagram: A bar magnet with 'S' and 'N' poles, with magnetic field lines curving around it.
- Newton's thought experiment: A globe with a bearded man (Newton) and the text "Apple = Earth".
- Force diagram: A small blue sphere labeled "marble = Moon" and a larger red sphere labeled  $m_2$ , with a force vector  $F_{21}$  pointing from the marble towards the larger sphere.
- Tidal bulges: A diagram of a globe with arrows pointing to the top and bottom, labeled "tidal bulges".
- Spacetime diagram: A grid of lines representing spacetime curvature.
- Ballerina diagram: A ballerina in a tutu with a red arrow pointing to her feet, illustrating the concept of spacetime curvature.
- Box diagram: A 3D box with a red arrow pointing to it, possibly representing a volume of spacetime.



# Demonstrations

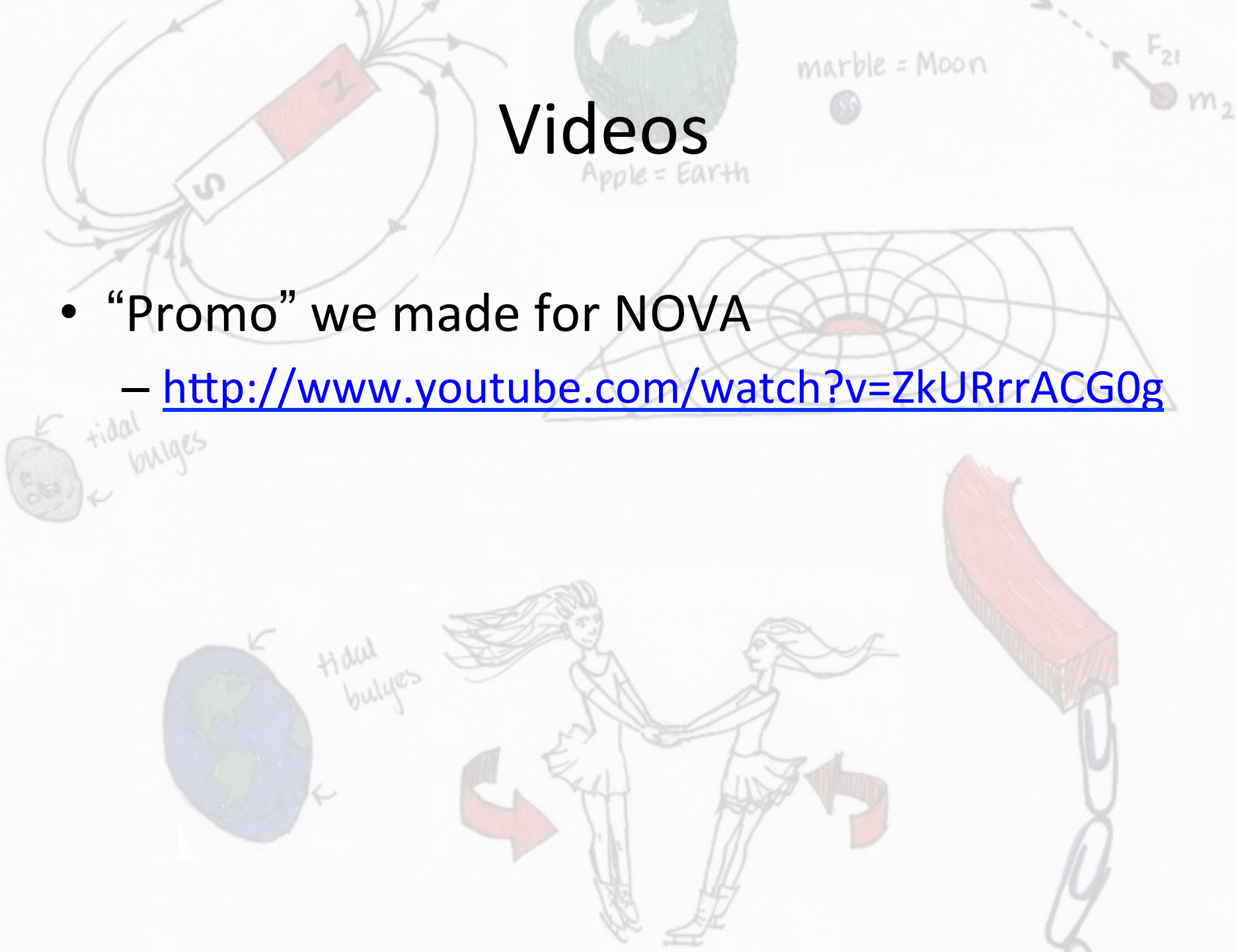
- Understanding spacetime
- Single point mass
- Binary system
- Roche limit
- Tides
- Density gradient
- Value of  $G$
- Creation of the solar system



# Videos

- “Promo” we made for NOVA

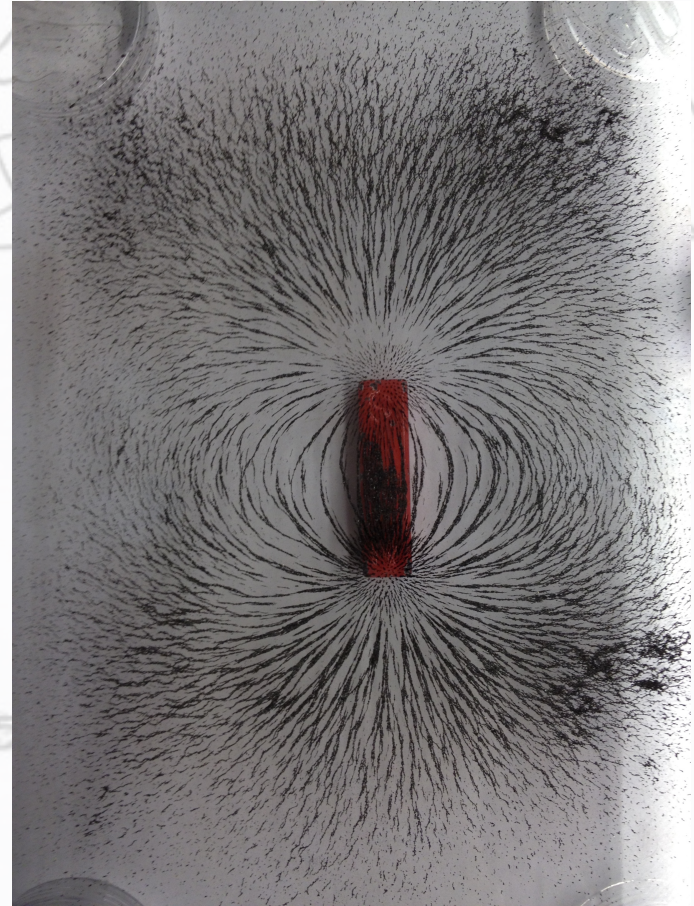
– <http://www.youtube.com/watch?v=ZkURrrACG0g>





# Magnetism

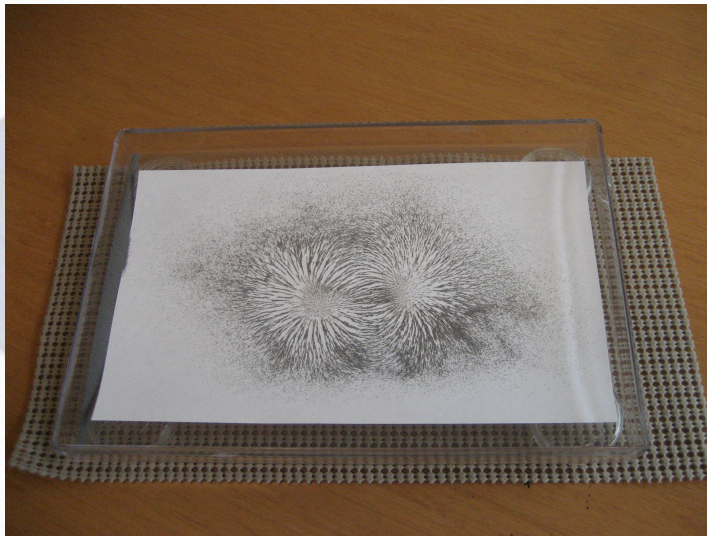
- Visualize magnetic fields
- Understand how magnets affect other materials and other magnets
- Quantitative Experiments





# Experiments & Activities

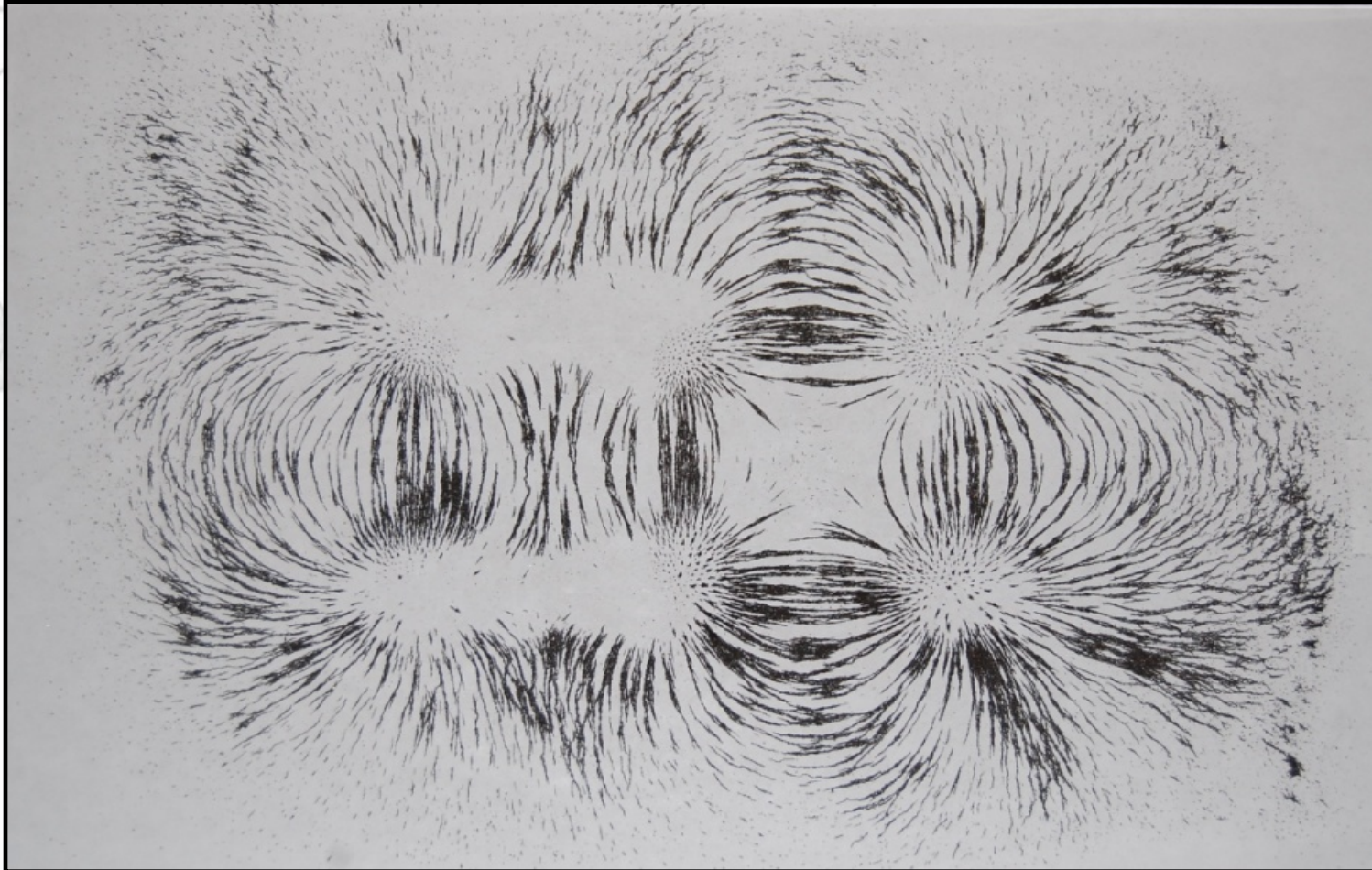
- What's Magnetic?
- Exploring Two Magnets
- Mapping Magnetic Field
- Magnetic Fields
- Magnetic Field Game (Older/Younger)





# Magnetic Field Game

How are the three bar magnets arranged?





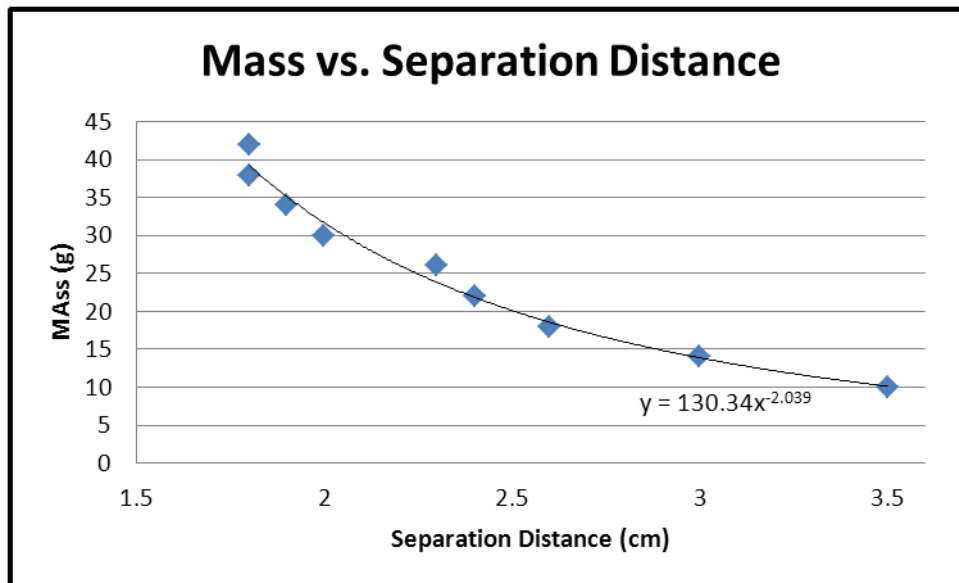
marble = Moon

$F_{21}$   
 $m_2$



# Quantitative Experiments

- Levitating Ring Magnets
- Compass and Bar Magnet



# Ferrofluid

- Ferrofluid as a tool of viewing 3D magnetic field
- Ferrofluid as a practical application of magnetic fields

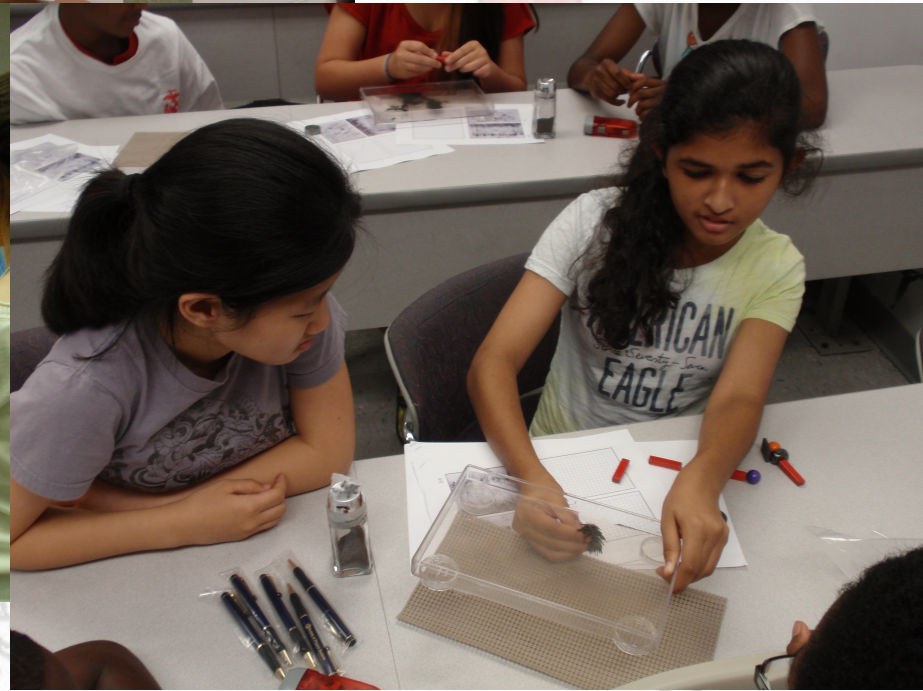




- 3<sup>rd</sup> grade Tuckahoe Elementary
- Yorktown High School physics classes
- University of Maryland science camps
  - 9<sup>th</sup> graders
  - 11<sup>th</sup>, 12<sup>th</sup> graders









# Our Outreach



# Changes and Additions

- Spandex
  - Added density gradient
- Magnetism
  - Added worksheets
  - Alterations to magnetic field game

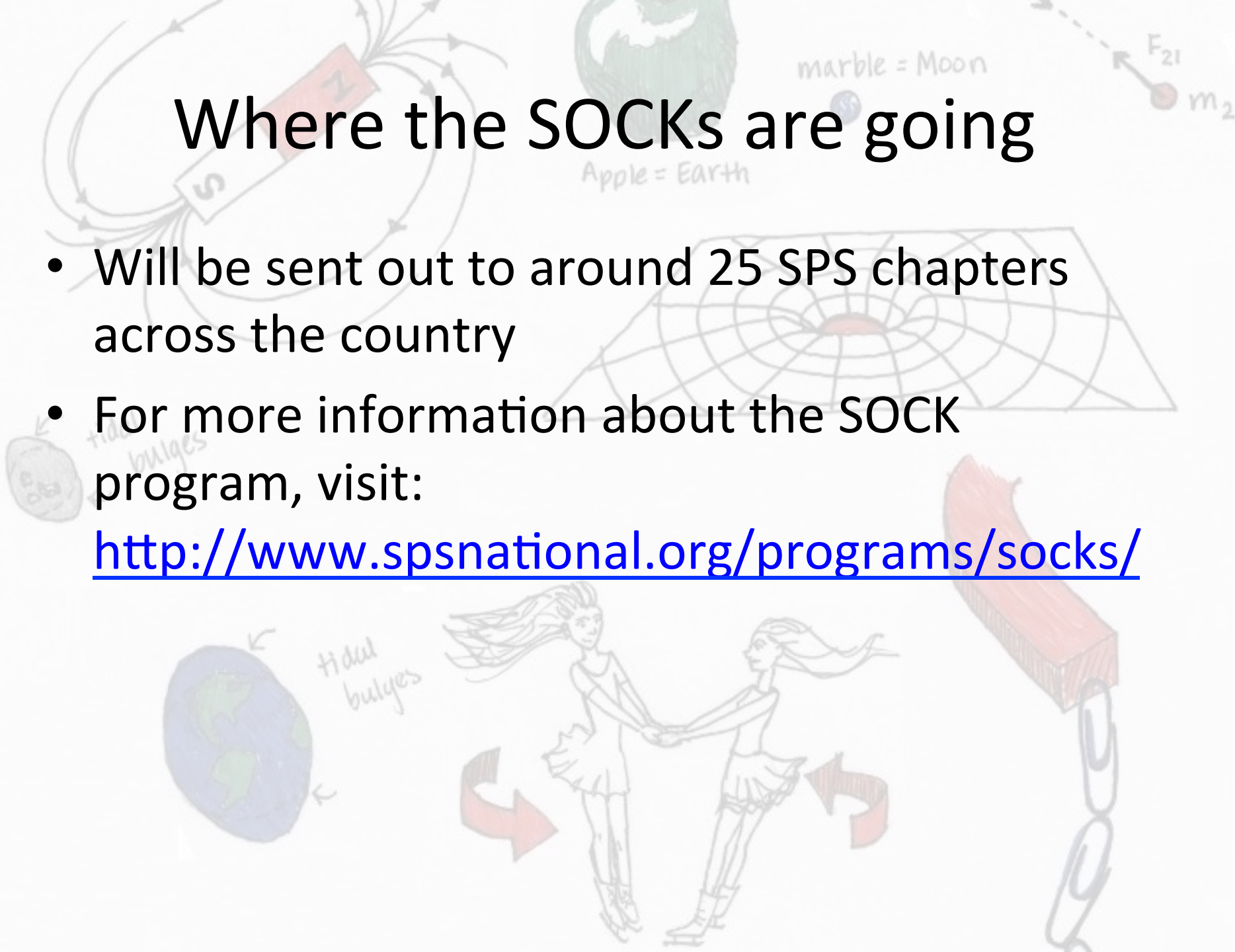
Magnet	Predicted Field	Observed Field
Bar		
SN-NS Like Poles Facing		
SN-SN Opposite Poles Facing		

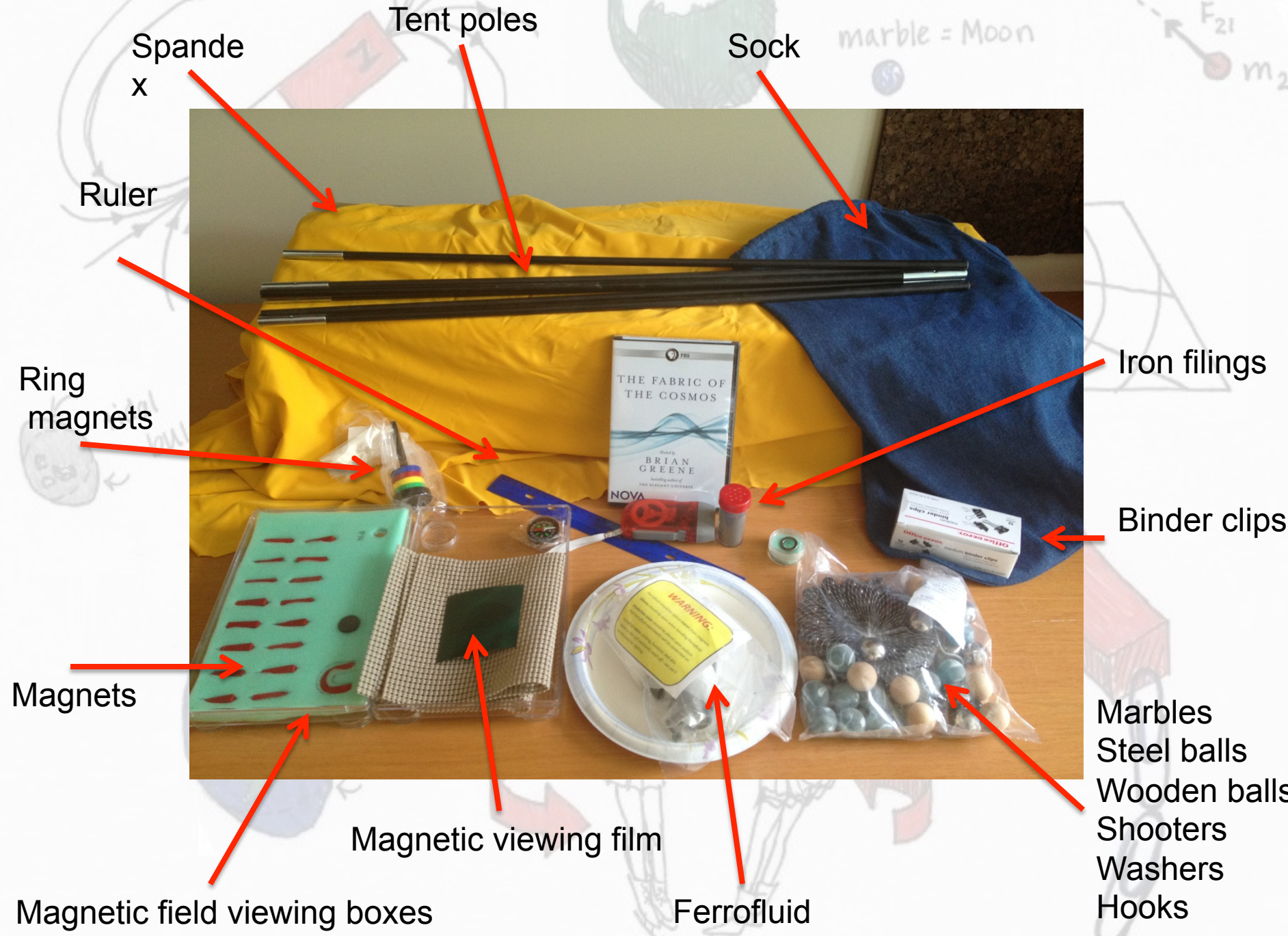


# Where the SOCKs are going

- Will be sent out to around 25 SPS chapters across the country
- For more information about the SOCK program, visit:

<http://www.spsnational.org/programs/socks/>





Spande  
x

Tent poles

Sock

marble = Moon

$F_{21}$   
 $m_2$

Ruler

Ring  
magnets

Iron filings

Binder clips

Magnets

Marbles  
Steel balls  
Wooden balls  
Shooters  
Washers  
Hooks

Magnetic viewing film

Ferrofluid

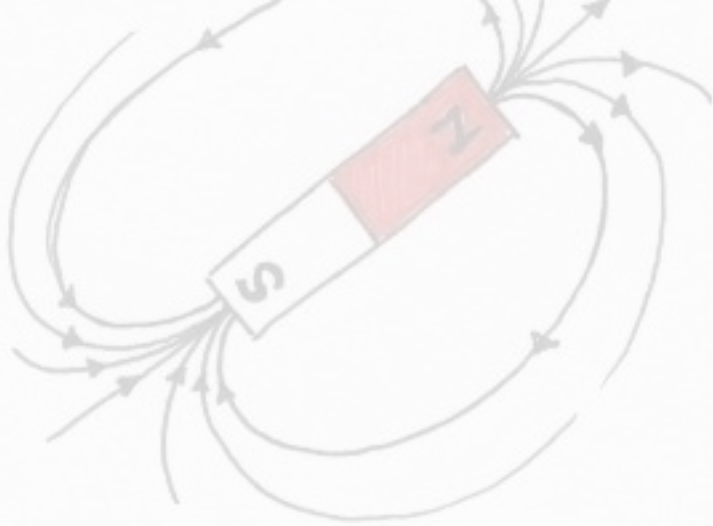
Magnetic field viewing boxes



# Special Thanks to...

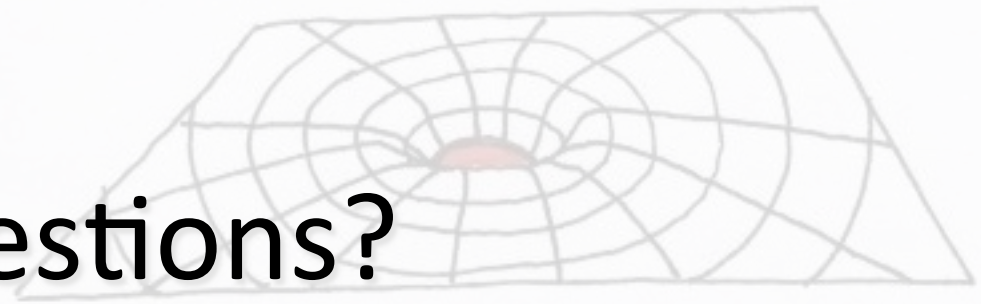
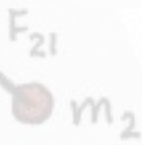
- Elizabeth Hook
- Aaron Schuetz
- Doug Dalton
- Jenny Lee
- Kendra Redmond
- Gary White
- Matt Goszewski
- Ryan Barley
- Shouvik  
Bhattacharya





Apple = Earth

marble = Moon



# Questions?

