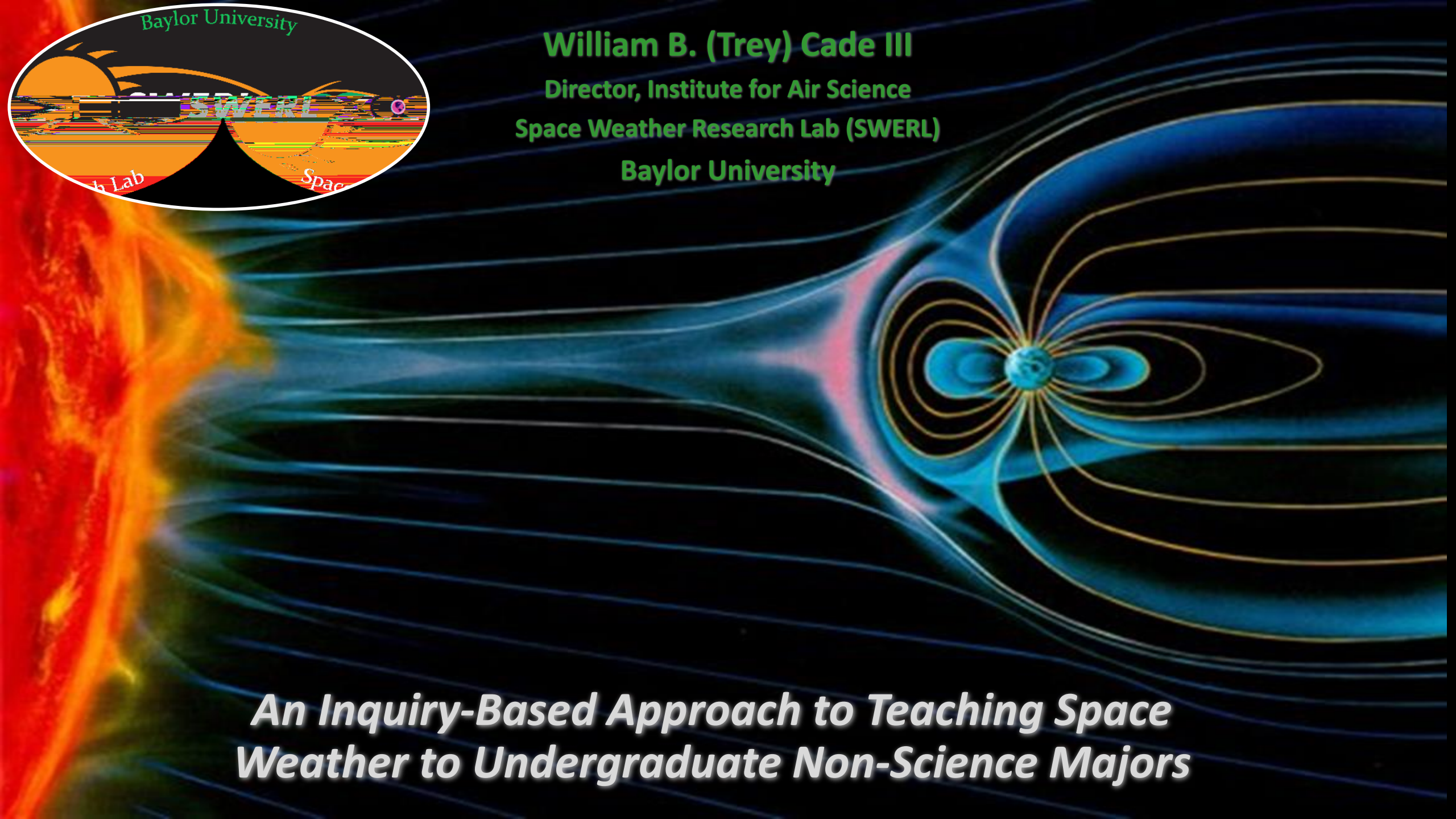
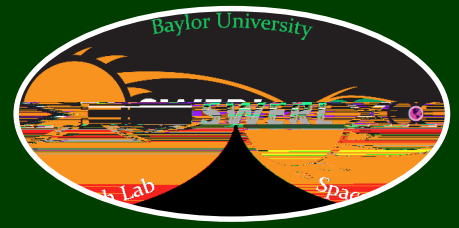


William B. (Trey) Cade III
Director, Institute for Air Science
Space Weather Research Lab (SWERL)
Baylor University

An Inquiry-Based Approach to Teaching Space Weather to Undergraduate Non-Science Majors

AVS 3350 – Introduction to Space Weather



Purpose:

- *Expand Space Weather exposure beyond the typical physics and engineering students*
- *Teach fundamental physics concepts to non-science students*

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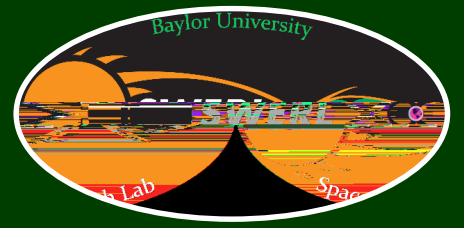
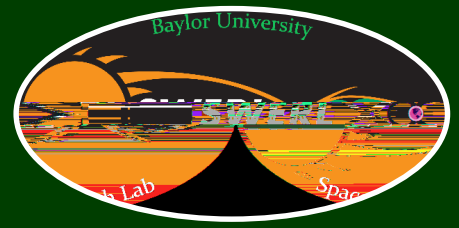
Enrollment by Major



- 41 Aviation Science
- 1 Chemistry
- 1 Mechanical Engineering
- 1 Astronomy
- 1 Geology
- 1 Environmental Studies
- 1 Computer Science
- 2 Journalism
- 1 Psychology
- 1 Literature
- 1 History
- 1 University Scholar
- 1 Education
- 1 International Studies
- 1 Medical Humanities
- 4 Business
- 1 Business Fellow
- 2 Accounting
- 1 Marketing
- 1 Entrepreneurship



Philosophy:

- *Use a historical/storytelling approach*
- *Use Inquiry-Based Learning Techniques*

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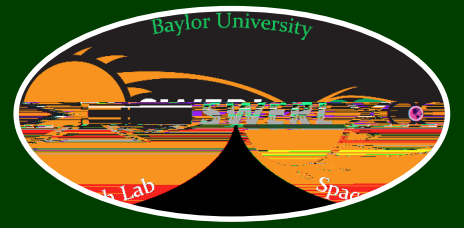
Advantages of Historical/Storytelling



- Scaffolding builds basic foundation for the rest of the course
- First 1/3 of the course unfolds like a mystery novel

“The class was engaging because he made it exciting, and I came into class every day anxious to know what would come next.”

“How the material was presented piqued my interest. I really enjoyed how the class read like a novel, and each lesson built on the last one, with some cliff hangers.”

“I wish you would just skip to the end and tell us the answers. I have to come to class so I can find out what happens next!”

“Structural design of the course was actually what made this class so interesting. To me it was like showing up for a tv episode because I felt like every time I was getting closer to more answers I had even more questions until the end of the course and I realized I learned stuff all along the way.”

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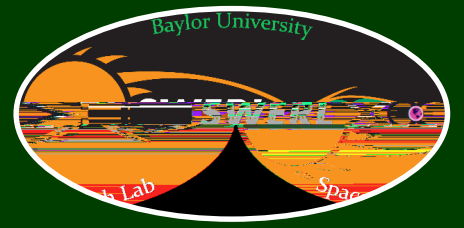
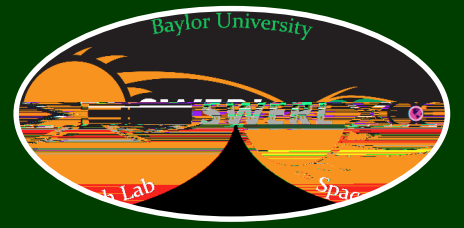
Research on Inquiry-Based Learning



- Teaching by telling is not effective for most students
- Students who are part of an interactive community are more likely to be successful
- Knowledge is *personal* – students develop greater ownership of material when they construct their own understanding

Inquiry-Based Learning



- Involve students in constructing new knowledge
- Use in-class investigations, linked to historical development, to make connections and reinforce lecture

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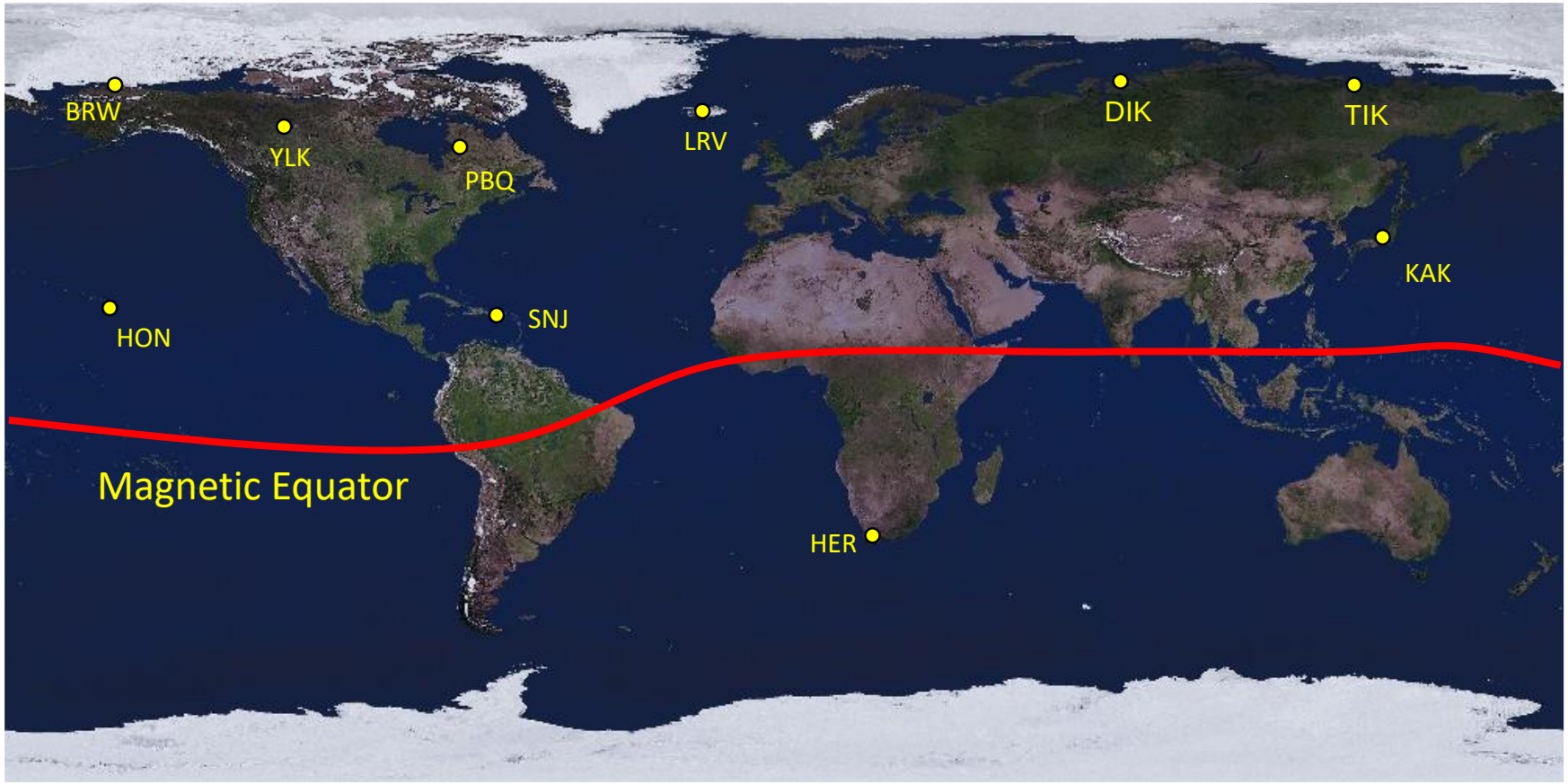
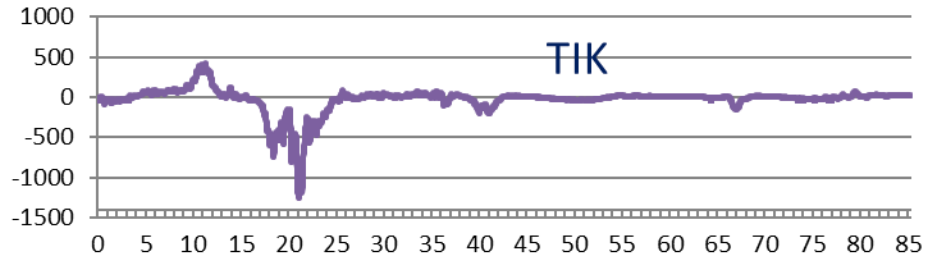
Example

Exploration, Concept Formation, Discussion, Interaction



Magnetic Storm Measurements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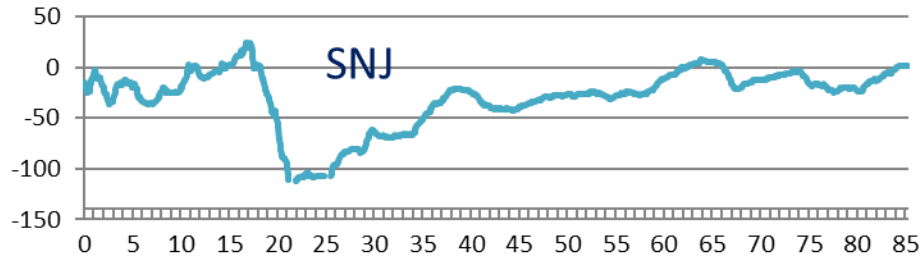
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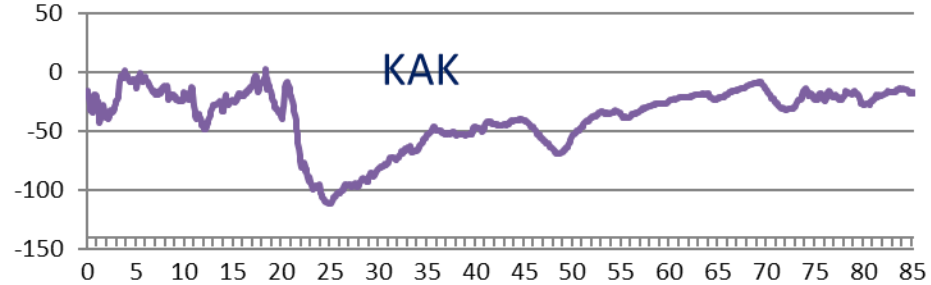
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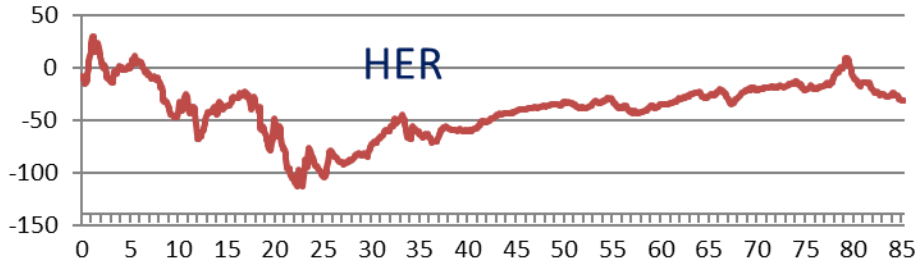
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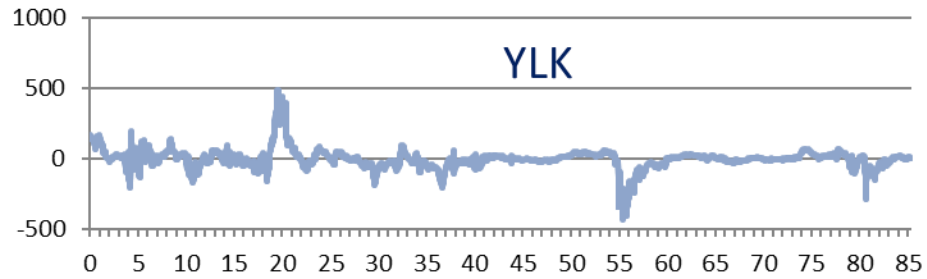
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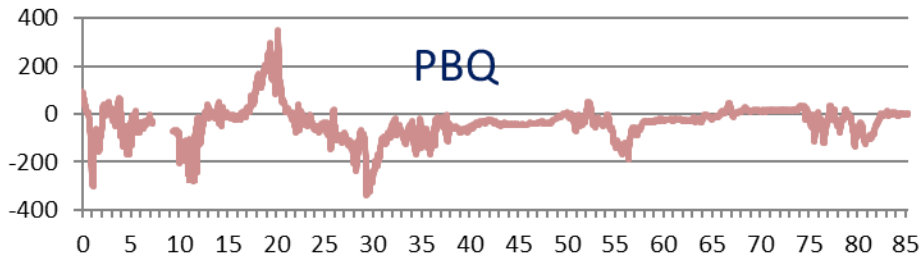
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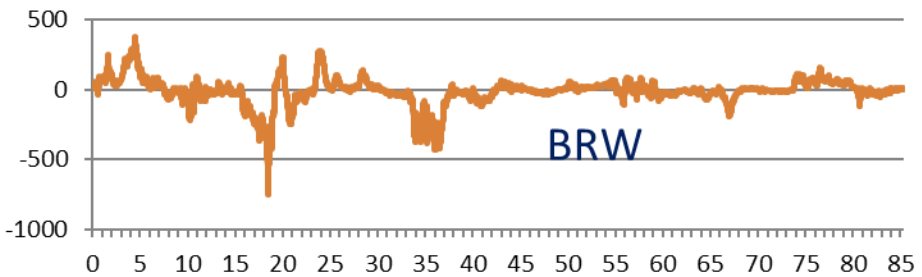
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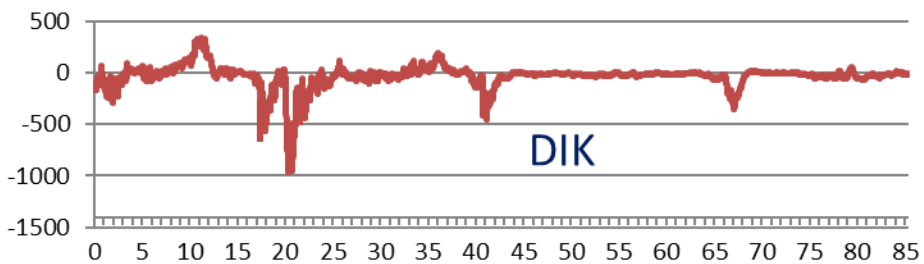
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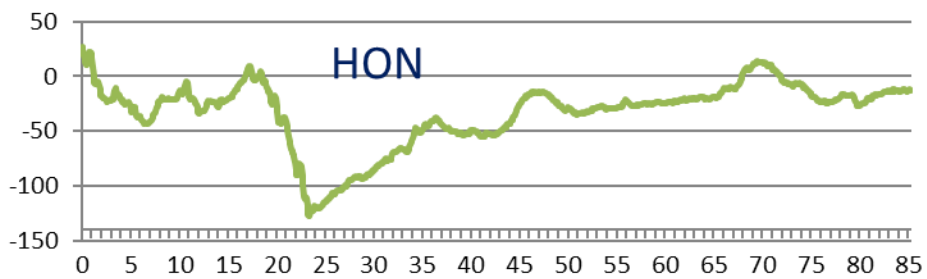
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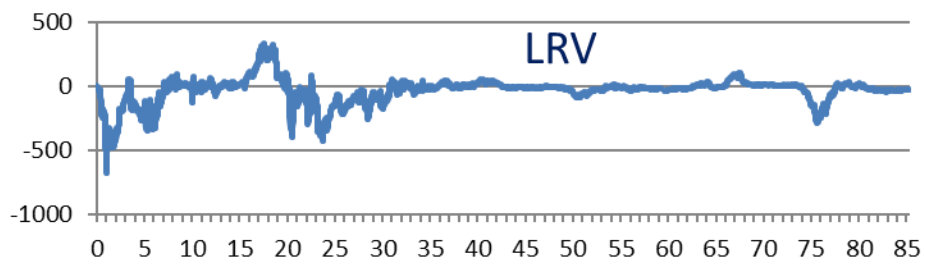
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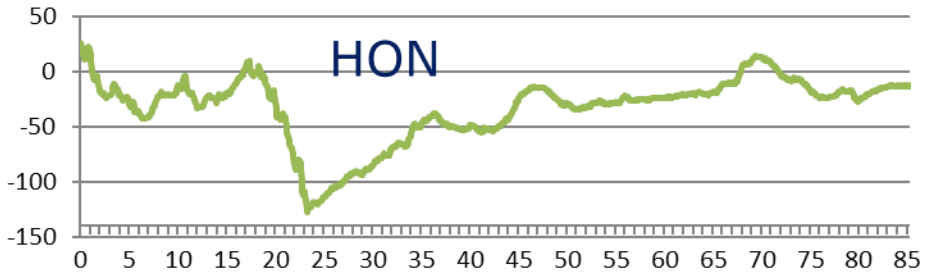
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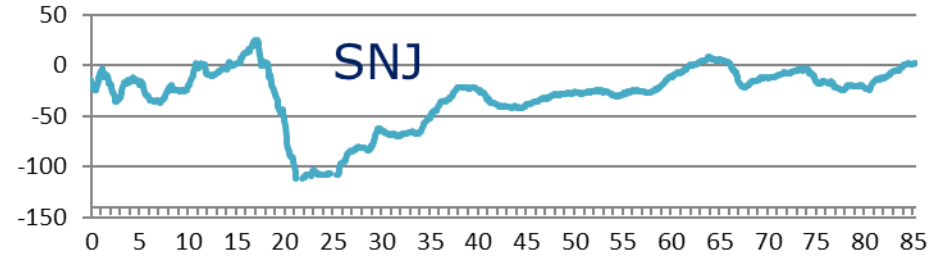
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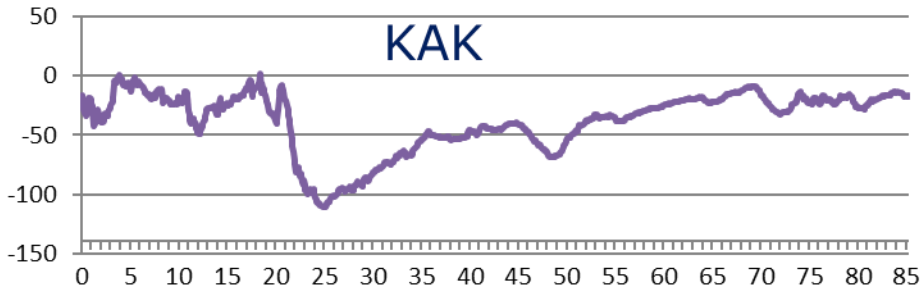
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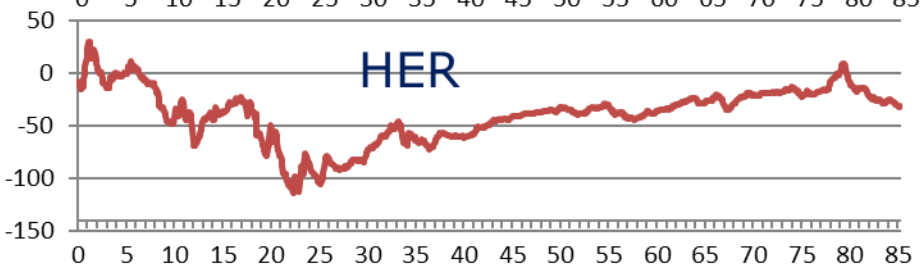
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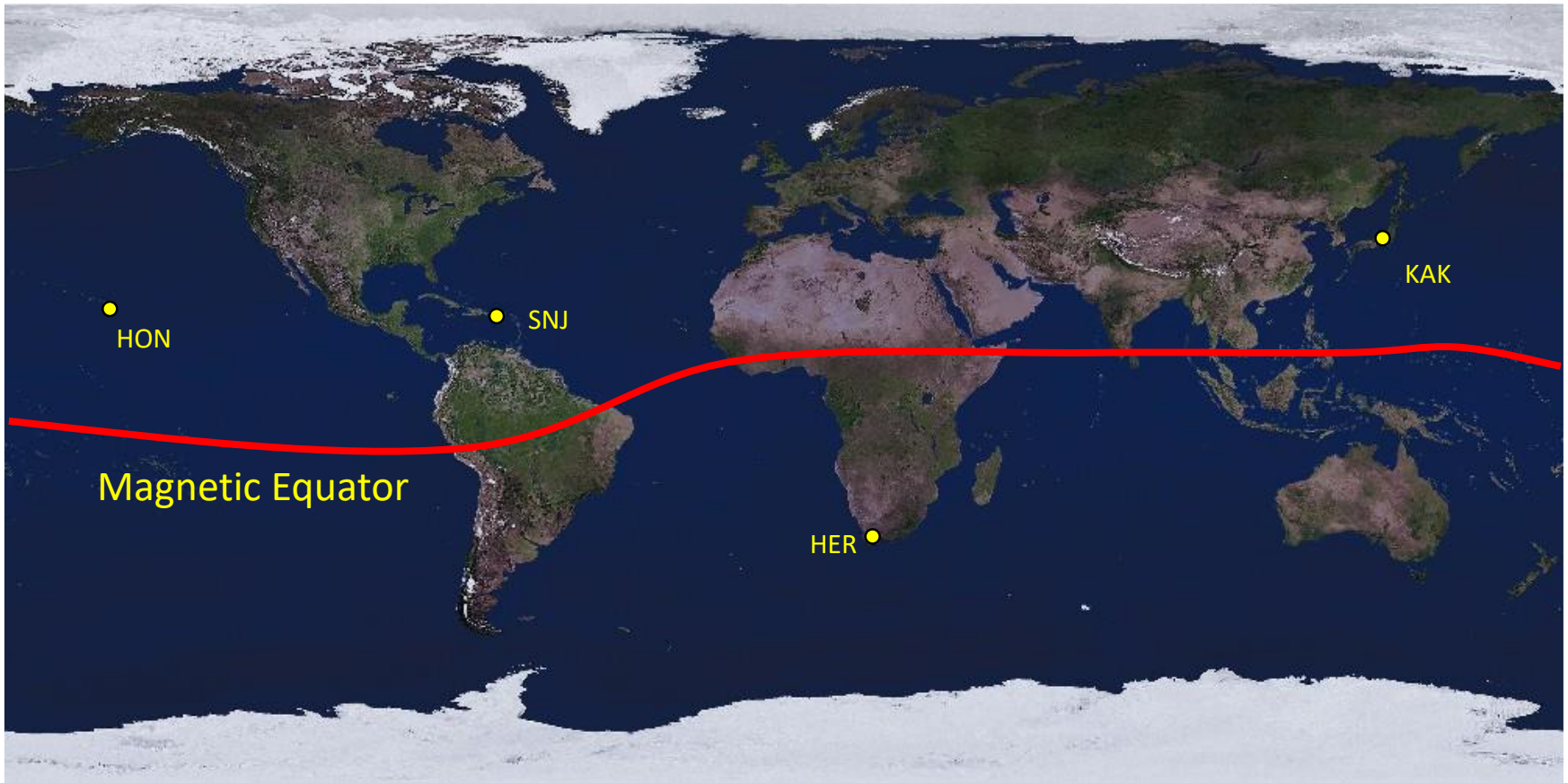
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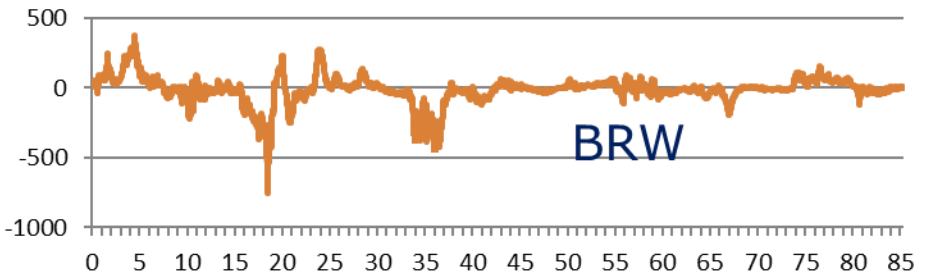
Magnetic Equator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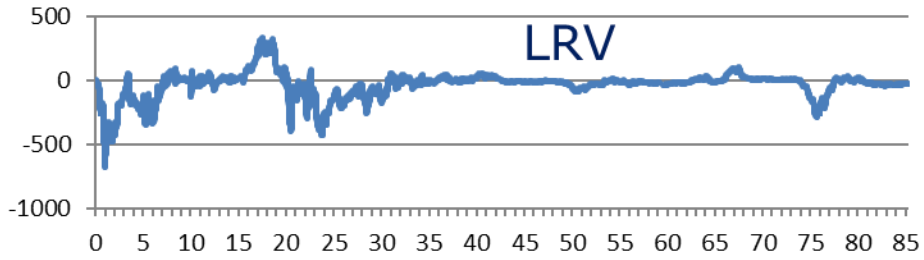
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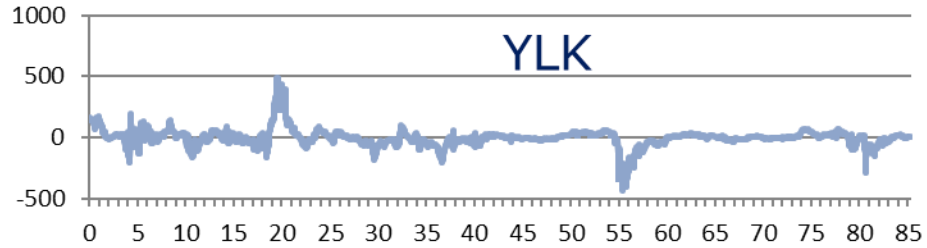
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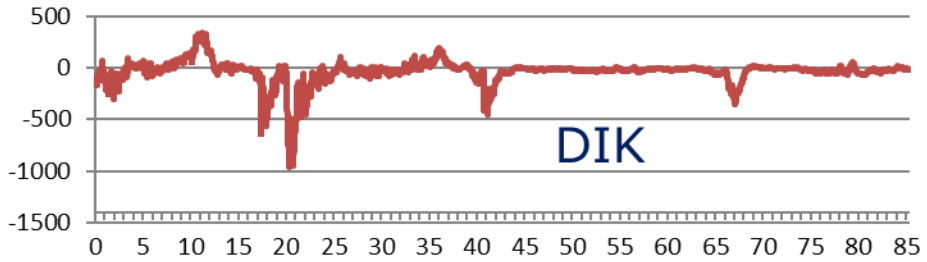
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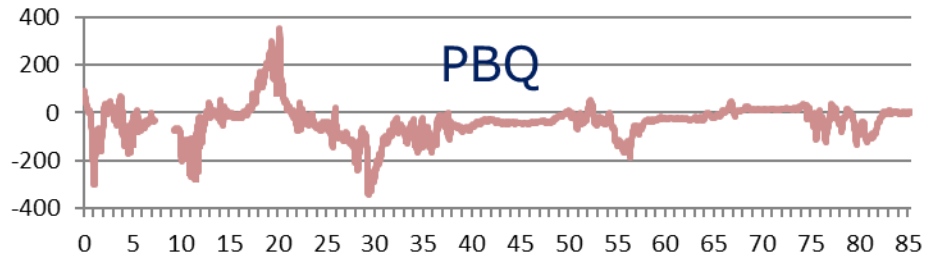
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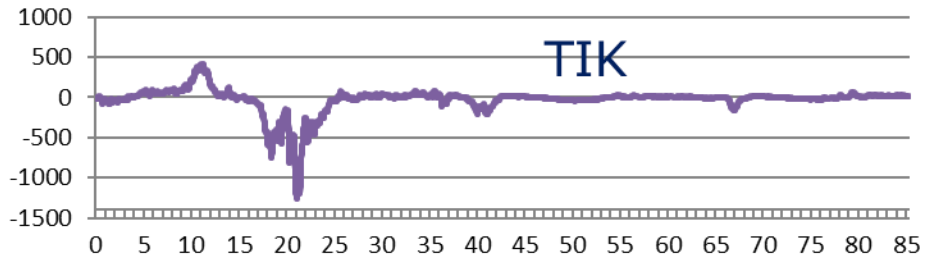
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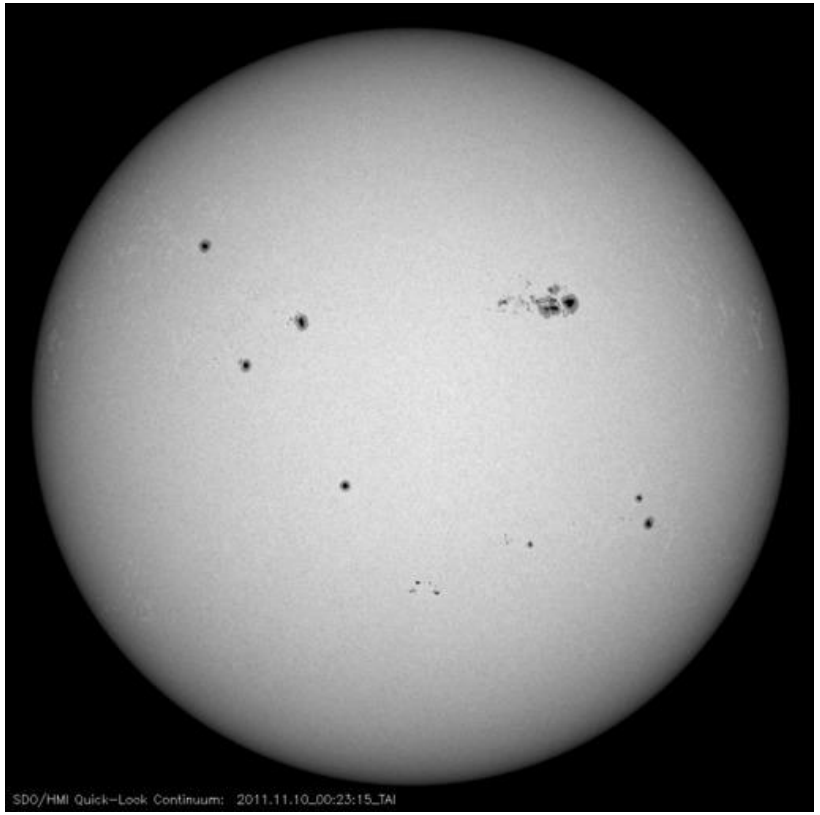
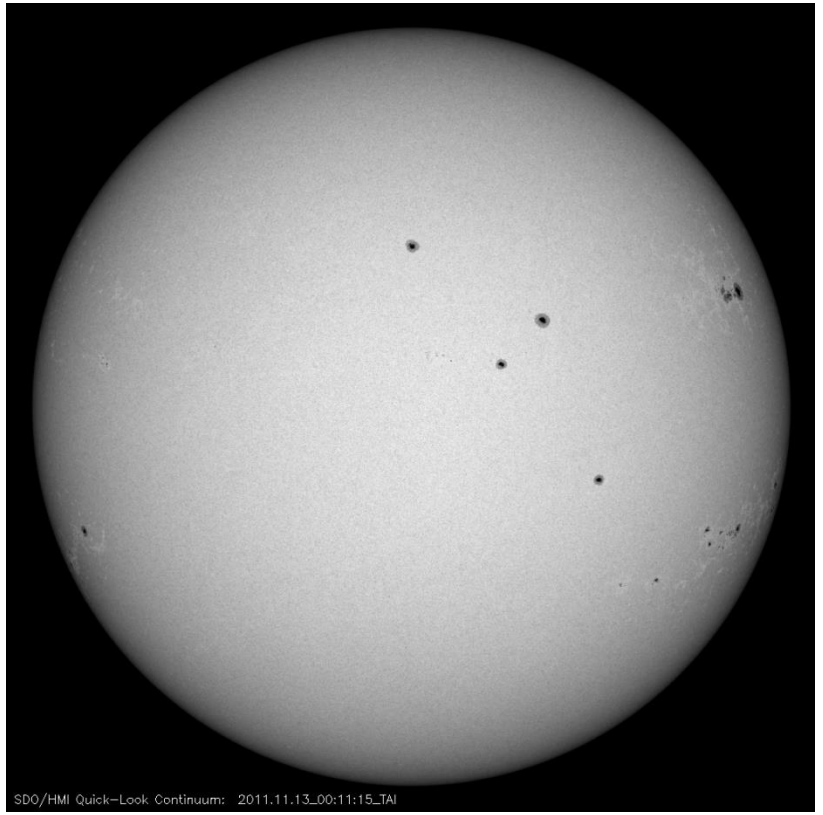
How Fast Does the Sun Rotate?





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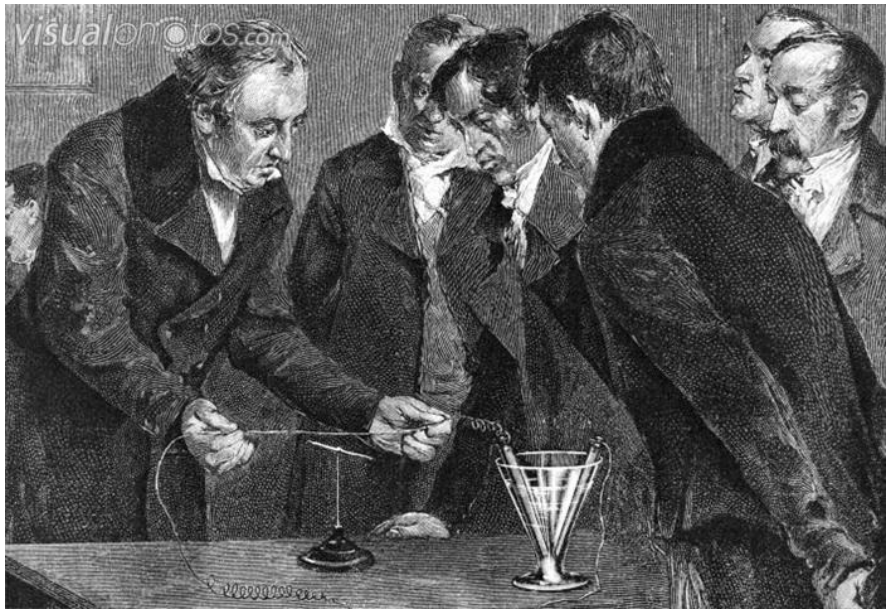
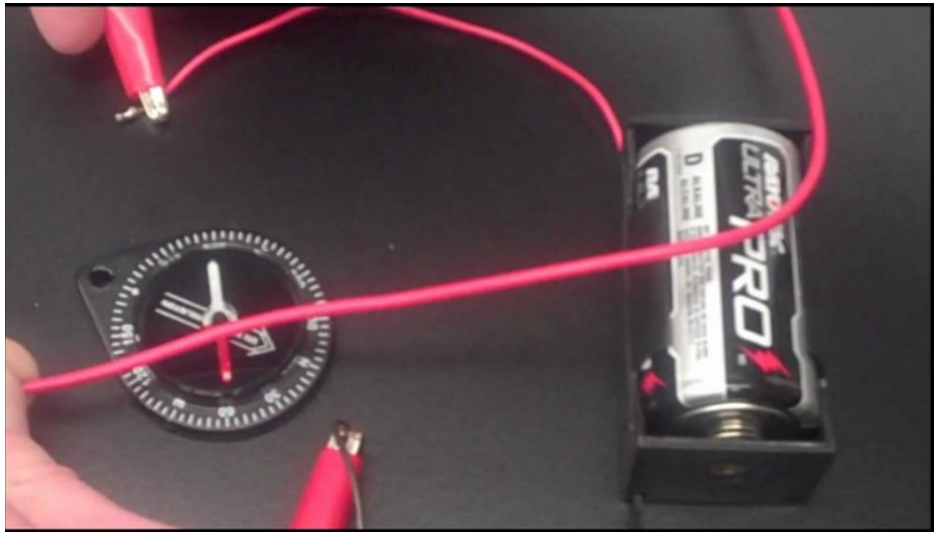
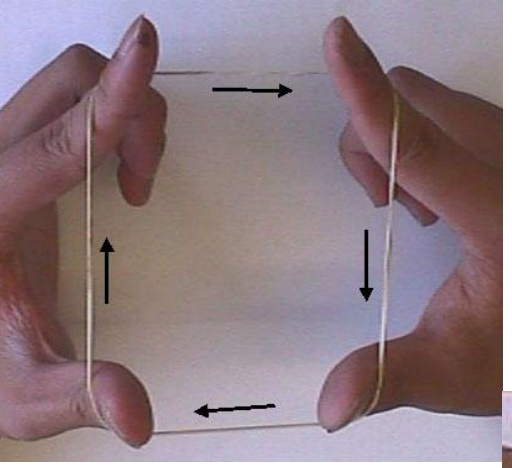
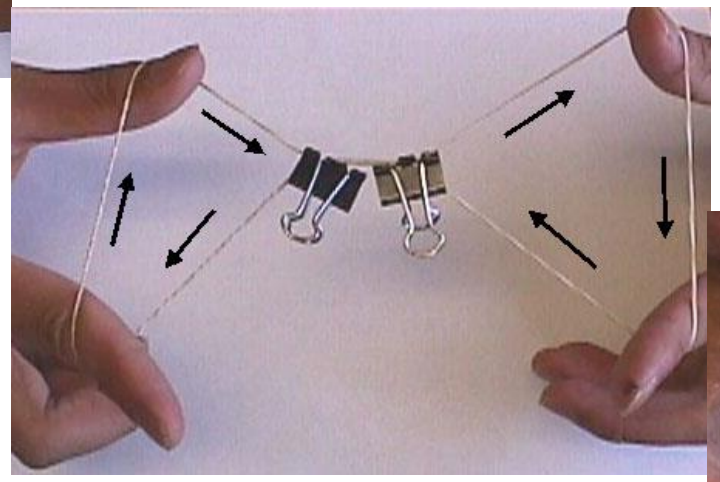
Oersted Experiment
1820

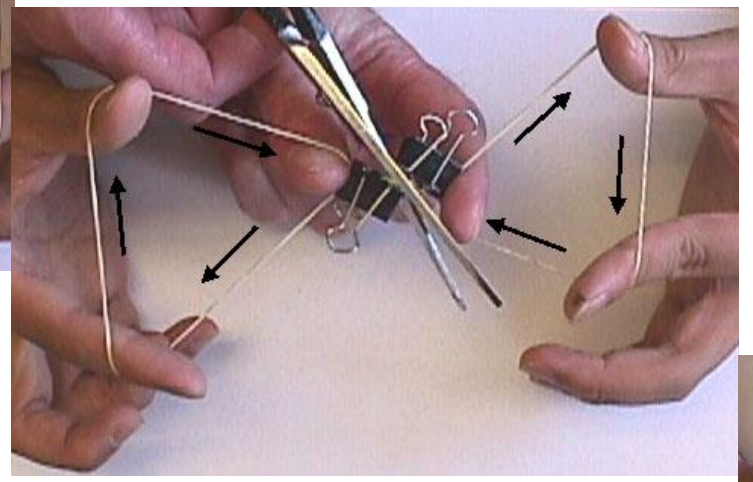


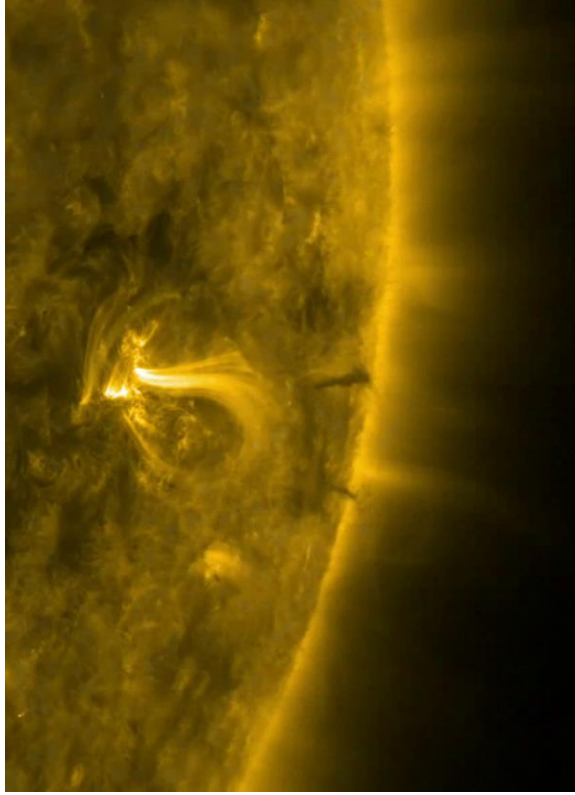


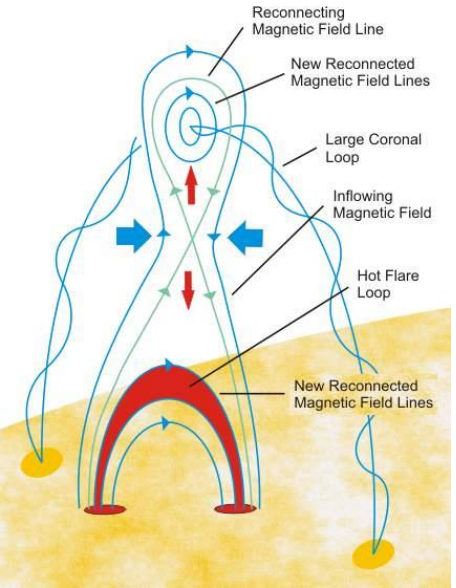
Where Does a Solar Flare's Energy Come From?

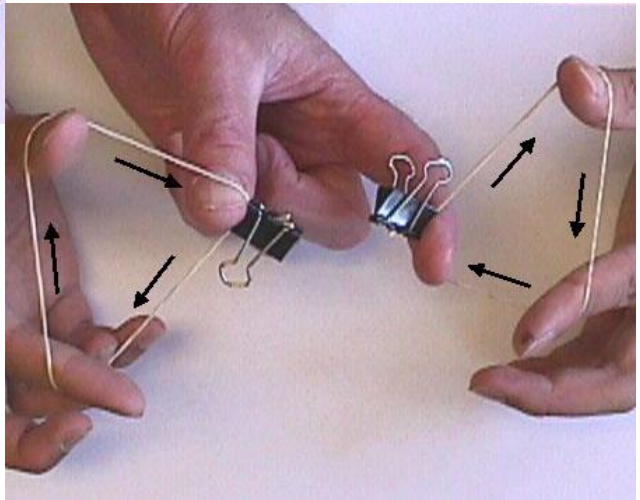












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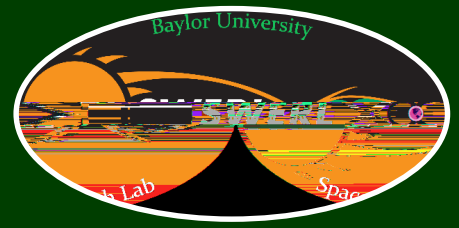
Course Evaluation Comments



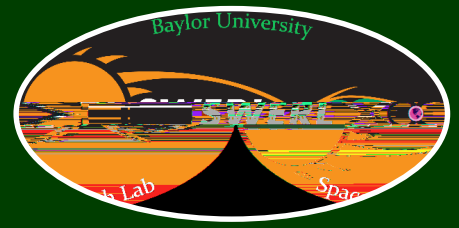
"The hands-on work really helped solidify the topics in the lectures."

"Liked the use of groups and working on what we learned in class. Always kept you interested in the next lesson to come."

"The in-class group work was incredibly useful."

"It was taught in a very interesting way and it was so different than the rest of my classes."

Course Evaluation Comments



"The group work where we did experiments such as the rubber band and clip demonstrate and the battery/compass experiment were a very cool way to learn the concepts explored in class."

"it would've been nice to do more hands on projects like the magnetic reconnection theory project."

"Experiments with the compass, and the rubber band with the clips caught my attention and helped me learn much more."

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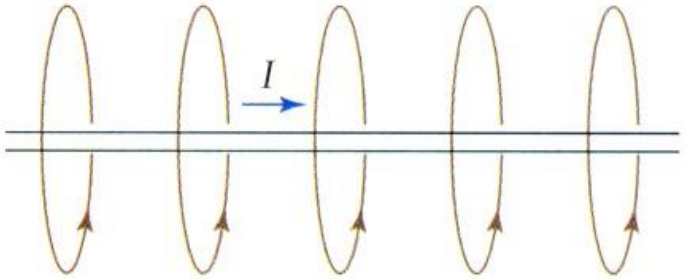
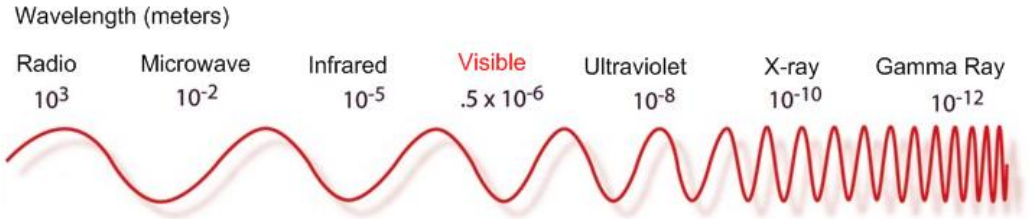
Physics Concepts

Electricity & Magnetism



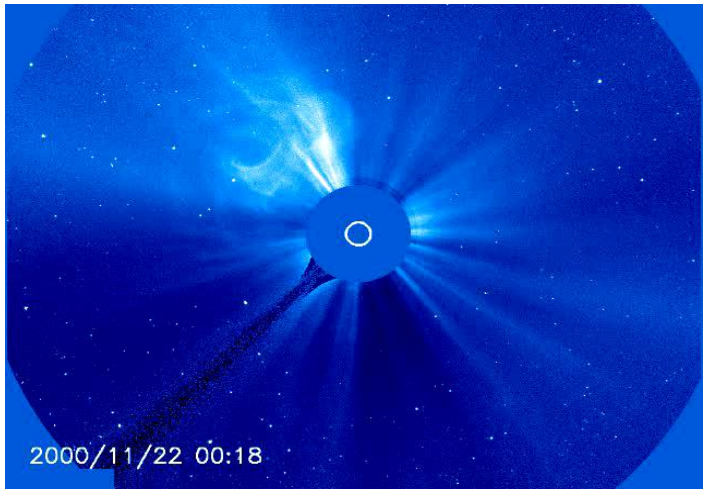
Electromagnetic Radiation



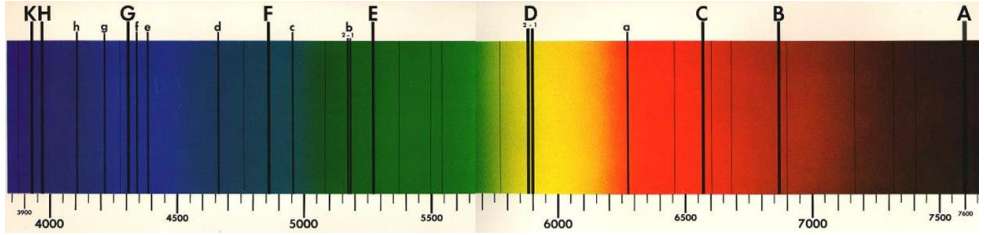
Relativity

$$v^2 = \left(1 - \frac{1}{\gamma^2}\right)c^2$$

Charged Particle & Plasma Physics



Spectroscopy



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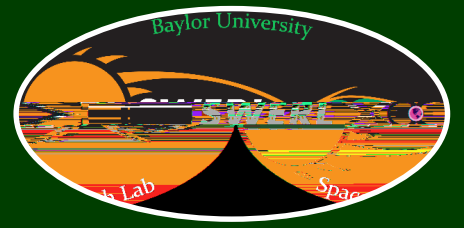
Final Exam Scenario



- **You are members of OsoSpace, a Space Weather Consulting Company. You have been called to testify before Congress regarding potential budget cuts to NOAA's Space Weather Prediction Center.**

Synthesis & Application

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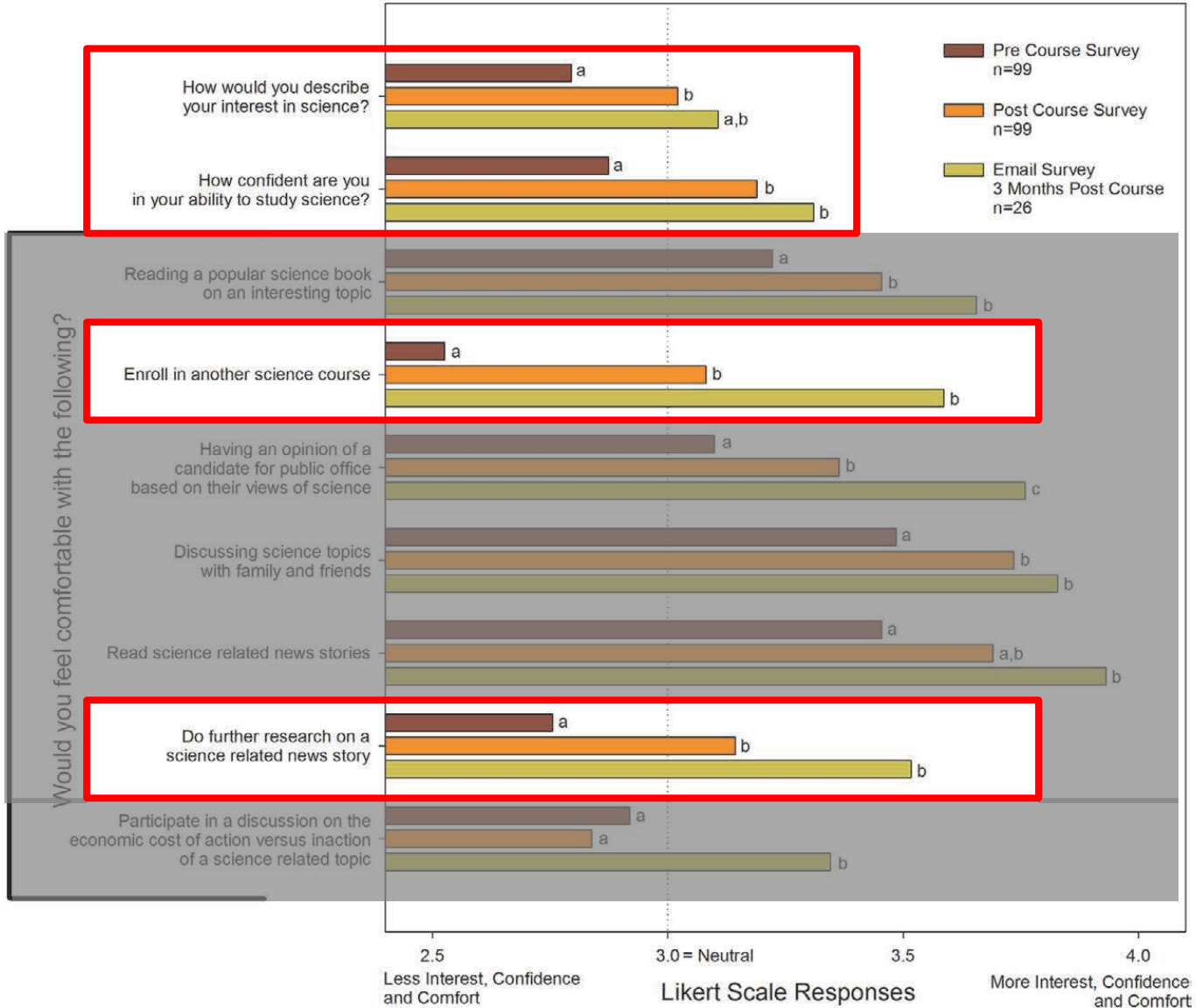
Science Courses for NonScience Majors

Reed & Lyford 2014, *Bulletin of the American Meteorological Society*



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