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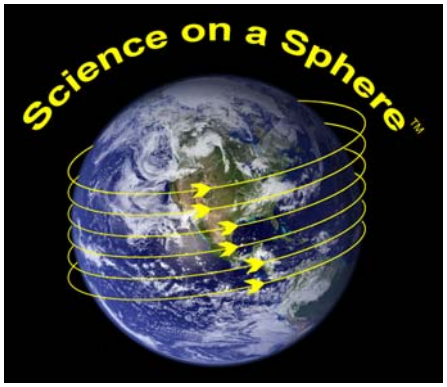
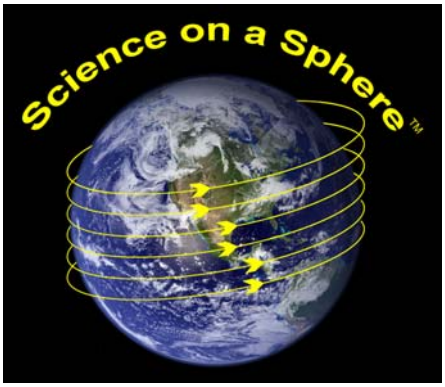


INTRODUCTION



Science on a Sphere™ uses a unique concept that helps a viewer to visualize complex science processes in a simple format. It uses satellite data that have been transformed into visual images and, then, projected onto a sphere. The result is the illusion that the observer is watching Earth as it rotates on its axis from thousands of miles in space.

This exceptional system provides a perfect teaching tool – for public education as well as for student use in schools across the country. The lessons and activities that are included in this document are designed for use in conjunction with the Science on a Sphere™.

This document is divided into two main sections, preliminary information, and extra activities. The first main section is a series of interactive structured lessons for the teacher or presenter to use in the presence of Science on a Sphere™. Although originally intended for middle school students, these lessons may be adapted for general public use by simply eliminating the "game" technique for teaching the lesson. For example, the lesson called "Geography and Relative Humidity" can be taught to a general audience by omitting the map coloring exercise. Questions to ask the audience are provided, including an answer key. The presenter should adapt the information and questions with answers to his or her personal style.

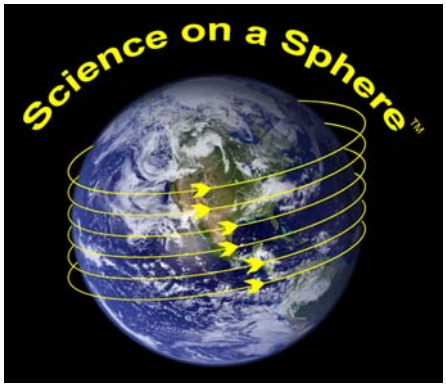
The second main section is intended for classroom use. It provides follow-up activities for teachers to use, after the Science on a Sphere™ presentation, when the students return to the classroom. There is an extended lesson for each data set. For example, after the lesson called "Topographic Maps in Three Dimensions", the follow-up activity provides an opportunity for students to graph the altitude of Mt. Everest and depth of the Mariana Trench, and then compare their elevations.

Teachers, please note that a grid is included which shows how Science on a Sphere™ interactive structured lessons for teachers and classroom activities for students conform to national science, math, and geography standards.

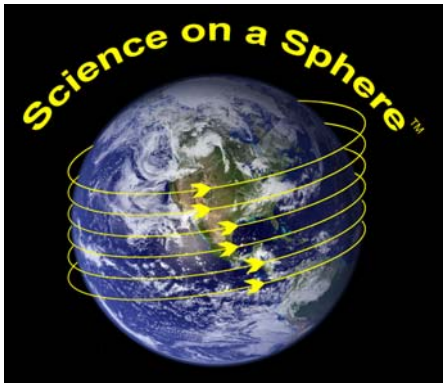
Whether you are a teacher of school age students or a presenter to the public, I hope that you find the accompanying lessons and activities helpful in your educational effort.

Beverly L. Meier

Beverly L. Meier
Science Teacher - Boulder Valley School District
Educational Consultant to the Forecast Systems Laboratory



DESCRIPTION



Imagine gazing upon Earth as you are suspended in orbit 22,000 miles above its surface. You can watch a hurricane form, as a small storm slowly gathers strength, traveling westward from Africa, across the Atlantic Ocean, toward the Gulf of Mexico. You can see the colorful infrared images of cloud tops meet, join, grow, collapse and disperse. The prevailing westerly winds and the easterly trade winds materialize before your eyes. You can see the Earth's scorching desert expanses in contrast to the below-zero temperature of cloud tops. Our dynamic atmosphere roils as you watch with the help of infrared satellite imagery projected onto a movie screen-like, white sphere.

Called Science on a Sphere™, this spectacular vision of our Earth is the brainchild of Dr. Alexander (Sandy) McDonald, Director of the National Oceanic and Atmospheric Administration's (NOAA) Forecast Systems Laboratory in Boulder, Colorado. Four projectors cast rotating images onto a sphere, approximately six feet in diameter to create the effect of Earth in space. Because the images originate from data collected by satellites, researchers refer to the projected images as "data sets".

The possible data sets that can be projected using Science on a Sphere™ seem limited only by imagination. Already, there are data sets where you can see the dry, brown deserts of Australia, Asia, Africa as well as both North and South America in contrast to the adjacent verdant plains and forests. You can trace Earth's continuous plates from ocean depths to mountain chains. You can watch dust blow across the surface of Mars. You can observe our Sun erupting in violent solar storms sending streams of deadly particles Earthward.

Imagine future data sets where you can see Pangaea, the super-continent that included all the landmasses of Earth, breaking up and carried by Earth's crustal plates to form the continents that we recognize today...and, even more fantastically, be able to project into the future, where the Earth's landmasses might be. Imagine data sets where you can see the climate of the past and present...and then, be able to project into the future, what the climate would be like.

Imagine...we could plan for the future...Imagine…the many possibilities.

Science on a Sphere™ provides a dramatic visualization of complex information in an understandable form for the public; a unique instrument for teaching students science, math, and geography ; and a handy scientific tool to translate numerical information into visual images. Science on a Sphere™! A spectacular look, not just of our world, but also of the universe.

Beverly L. Meier

Hints for Presenters

Dear Teachers and Presenters,

The objective of Science on a Sphere™ lessons or presentations is to expose the audience to ideas, principles, and concepts related to science, math, and geography in a visual, easy to understand format. The scripts are in the form of interactive structured lessons for teachers or presenters, and are designed for general audiences. Be serious about your presentation, but show your enjoyment and enthusiasm for learning.

Safety

- *Caution the audience to avoid shining the laser pointer toward another person in order to prevent direct eye exposure. Laser light is harmful if used improperly.*
- *Caution the audience to avoid bumping the projectors.*
- *Tell the audience not to touch the sphere.*

Pedagogy

- *Do not talk unless the audience is quiet and attentive.*
- *Hand out supplies only as needed; otherwise, supplies may become distracting "toys".*
- *Use a flashlight to point to members of the audience to call on them since you do not know their names.*
- *For middle school, call on students even if they do not raise their hands. Alternate girl-boy.*
- *Show enthusiasm, but do not over-excite middle school students. Once they are on a high, it is difficult to "bring them down".*
- *Encourage questions from the audience. One way to do this is to use "wait time". That means, ask for questions, then, silently and slowly count to ten before going on. Frequently, students and adults need time to formulate a question.*
- *Help the audience to answer questions correctly. Give hints as necessary; "add-on" to correct, but incomplete, responses.*

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Hints for Presenters (continued)

SOS™ Lessons

- *Begin the lesson or series of lessons with "Map vs. Globe" to help students better understand the reasons for using a globe.*
- *There are "Extra" lessons, if you need time fillers.*

As we gain experience with Science on a Sphere lessons and presentations, I hope to use your suggestions to add to this list of hints. So, please keep track of your ideas. Email suggestions to me at **t.meier@att.net**.

Thank you!

Beverly L. Meier

Education Content Standards

Science	1 - Map vs. Globe	2 - Topo. Map - Night View	3 - Topo. Maps 3D	4 - Earth's Atm. From Space	5 - Geography & Rel. Hum.	6 - Topo. & Bathy.	7 - Sat. Hurricane	8 - Sat. Image & Epid.
Inquiry								
- Identify questions that can be answered through scientific investigations.	✓	✓	✓	✓	✓	✓	✓	✓
- Design and conduct a scientific investigation.								
- Use appropriate tools and techniques to gather, analyze, and interpret data.	✓	✓	✓	✓	✓	✓	✓	✓
- Develop descriptions, explanations, predictions, and models using evidence.	✓	✓	✓	✓	✓	✓	✓	✓
- Think critically and logically to make the relationships between evidence and explanations.	✓	✓	✓	✓	✓	✓	✓	✓
- Recognize and analyze alternative explanations and predictions.								✓
Physical Science								
- Properties and changes of properties in matter					✓		✓	✓
- Motions and forces			✓	✓	✓		✓	
- Transfer of energy				✓			✓	
- Communicate scientific procedures and explanations	✓	✓	✓	✓	✓	✓	✓	✓
- Use mathematics in all aspects of scientific inquiry	✓	✓	✓	✓	✓	✓	✓	✓
Life Science								
- Structure and function in living systems								
- Reproduction and heredity								
- Regulation and behavior								✓
- Populations and ecosystems					✓			✓
- Diversity and adaptations of organisms		✓			✓			

Pre-6

Education Content Standards (continued)

Science	1 - Map vs. Globe	2 - Topo. Map - Night View	3 - Topo. Maps 3D	4 - Earth's Atm. From Space	5 - Geography & Rel. Hum.	6 - Topo. & Bathy.	7 - Sat. Hurricane	8 - Sat. Image & Epid.
Earth Science								
- Structure of the earth system	✓	✓	✓	✓	✓	✓	✓	✓
- Earth's history			✓					
- Earth in the solar system								
Science and Technology								
- Abilities of technological design								
- Understandings about science and technology	✓	✓	✓	✓	✓	✓	✓	✓
Science in Personal and Social Perspectives								
- Personal health								
- Populations, resources, and environments		✓		✓	✓			✓
- Natural hazards			✓	✓		✓	✓	✓
- Risks and benefits								✓
- Science and technology in society	✓	✓	✓	✓	✓			✓
History and Nature of Science								
- Science as a human endeavor	✓					✓	✓	✓
- Nature of science						✓	✓	✓
- History of science								
Math								
- Number and Operations				✓	✓	✓	✓	✓
- Algebra								
- Geometry	✓	✓	✓	✓	✓	✓	✓	
- Measurement	✓			✓	✓	✓	✓	
- Data Analysis and Probability		✓						✓
- Problem Solving								

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EDUCATION CONTENT STANDARDS (CONTINUED)

	1 - Map vs. Globe	2 - Topo. Map - Night View	3 - Topo. Maps 3D	4 - Earth's Atm. From Space	5 - Geography & Rel. Hum.	6 - Topo. & Bathy.	7 - Sat. Hurricane	8 - Sat. Image & Epid.
Math								
- Reasoning and Proof - Communication - Representation	✓	✓	✓	✓	✓	✓	✓	✓
Geography								
- How to use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective.	✓	✓	✓	✓	✓		✓	✓
- How to use mental maps to organize information about people, places and environments in a spatial context.		✓	✓	✓	✓	✓	✓	
- How to analyze the spatial organization of people, places and environments on Earth's surface.	✓	✓	✓	✓	✓	✓	✓	✓
- The physical and human characteristics of places.		✓						✓
- That people create regions to interpret Earth's complexity.	✓	✓	✓	✓	✓	✓	✓	✓
- How culture and experience influence people's perceptions of places and regions.								
- The physical processes that shape the patterns of Earth's surface.			✓	✓	✓		✓	
- The characteristics and spatial distribution of ecosystems on Earth's surface.			✓		✓			✓
- The characteristics, distribution, and migration of human populations on Earth's surface.		✓						
- The characteristics, distribution, and complexity of Earth's cultural mosaics.								
- The patterns and networks of economic interdependence on Earth's surface.		✓						

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Education Content Standards (continued)

Geography	1 - Map vs. Globe	2 - Topo. Map - Night View	3 - Topo. Maps 3D	4 - Earth's Atm. From Space	5 - Geography & Rel. Hum.	6 - Topo. & Bathy.	7 - Sat. Hurricane	8 - Sat. Image & Epid.
- The process, patterns, and functions of human settlement.		✓			✓			
- How the forces of cooperation and conflict among people influence the division and control of Earth's surface.								
- How human actions modify the physical environment.		✓						
- How physical systems affect human systems.				✓	✓			✓
- The changes that occur in the meaning, use, distribution, and importance of resources.								
- How to apply geography to interpret the past.								
- How to apply geography to interpret the present and plan for the future.	✓		✓					✓