AIAA AEROSPACE MICRO-LESSON

Easily digestible Aerospace Principles revealed for K-12 Students and Educators. These lessons will be sent on a bi-weekly basis and allow grade-level focused learning. - AIAA STEM K-12 Committee.

THE INTERNATIONAL GEOPHYSICAL YEAR

Sixty years ago, scientists and technicians from 67 nations around the world worked together in a research program called the International Geophysical Year. Although it was called a "year," it actually lasted for eighteen months and was renewed for another year (officially called "International Geophysical Cooperation"), finally ending at the end of December 1959.

Next Generation Science Standards (NGSS):

- Discipline: Earth and Space Sciences.
- Crosscutting Concept: Scale, proportion, and quantity.
- Science & Engineering Practice: Obtaining, evaluating, and communicating information.

GRADES K-2

NGSS: Earth's Systems: Develop a model to represent the shapes and kinds of land and bodies of water in an area.

What do you do when a job is too big just for you alone? You get help.

This is what scientists did sixty years ago when they set about studying the Earth as a whole. Look at a globe. Even the largest nations cover just a small part of it and much of the Earth—notably the poles and oceans—do not belong to any one nation. To get an idea of how the Earth as a whole behaves, scientists needed to observe things and carry out experiments all over the Earth, not just in one place. The Earth was too big for scientists from any one country to study in full, so scientists from all over the world got together.

In all, scientists from 67 different countries took part in the International Geophysical Year. These included countries that were not very friendly toward each other, such as the United States and the Soviet Union (now named Russia) or India and Pakistan, and nations that were actually at war with each other, such as Egypt and Israel. Scientists from all of the countries realized that learning how the Earth's systems work was more important than fighting among each other.

Suggested Activity: On a world map or a globe, find some of the countries that took part in the International Geophysical Year. Some of them, like the United States, Cuba, Mongolia, and Great Britain, are still there. Others, like the Soviet Union (now Russia),

GRADES K-2 (CONTINUED)

East and West Germany (now Germany), North and South Vietnam (now Vietnam), and Czechoslovakia (now the Czech Republic and Slovakia), have changed.

GRADES 3-5

NGSS: Earth's Systems: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

What is there to study about the Earth? Plenty. Starting from the inside, the iron core of the Earth rotates as the rest of the Earth does, creating the Earth's magnetic field. This magnetic field is what makes compasses point north and south. The magnetic field also shields the Earth's atmosphere from harmful particles coming from the Sun. Before the International Geophysical Year, nobody knew about those particles from the Sun or the magnetic field's effects in protecting the atmosphere.

During the International Geophysical Year, scientists also mapped out parts of the ocean floors. You cannot see through the oceans and so making a map of the ocean's floor is quite difficult. Scientists had to go out in ships and use sonar to tell how deep the ocean is in any one place. (With sonar, a piece of equipment makes a loud "ping" sound and another piece of equipment measures how long it takes for the "ping" to bounce off of something and come back. If you know how fast the sound travels, you can tell how far away the thing is that the "ping" bounced off.) To make a map of the ocean floor, scientists in the ships had to criss-cross the oceans, taking sonar readings everywhere they went.

When they mapped the ocean floors, the scientists—called "oceanographers"—discovered the longest mountain chain in the world. This mountain chain is entirely underneath the oceans. Its discovery gave solid evidence for the theory of plate tectonics, which explains how many of the Earth's natural features were made. Before the International Geophysical Year, scientists did not know what caused mountains to form.

Scientists also studied the atmosphere during the International Geophysical Year. In addition to working on better weather forecasting, they sent balloons and rockets up into the upper atmosphere to see what sorts of gases there were up there. Near the North and South Poles, they also studied the auroras.

GRADES 3-5 (CONTINUED)

The first satellites were also placed into orbit during the International Geophysical Year. The Soviets launched Sputnik 1 in October 1957 and the Americans launched Explorer 1 four months later.

Suggested Activity: NOAA has an online activity on mapping the ocean floor.

GRADES 6-8

NGSS: Earth's Systems: Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.

During the International Geophysical Year, scientists were able to take advantage of some natural phenomena which they were ready to observe even though they could not predict when they would happen. For example, the Sun has an eleven-year cycle in which the number of sunspots and solar flares waxes and wanes. The International Geophysical Year was timed to coincide with the "solar maximum," which is the point in the solar cycle at which there are the most sunspots and flares. (By happy coincidence, 1957-58 was also the twenty-fifth anniversary of the second International Polar Year of 1932-33.) This timing paid off handsomely on February 9, 1958 when a "Class 2+" flare erupted on the surface of the Sun. (Solar flares are now classified using a different system, so it is not possible to say just how strong the February 1958 flare was. It is safe to say, however, that it was unusually strong.) The solar wind caused by the flare interacted with the Earth's magnetic field to cause a major geomagnetic storm. This geomagnetic storm disrupted radio communications, caused the "Northern Lights" as far south as Cuba, and caused an electrical blackout in Toronto. While solar flares had been observed for hundreds of years, though, and while scientists knew a little about geomagnetic storms, thanks to the International Geophysical Year they were able to study this solar flare and the resulting storm in great detail. Scientists had set up magnetic "listening posts" all over the world and thus were able to measure the Earth's magnetic field, the transmission of radio waves, and all sorts of related phenomena. In addition, since the International Geophysical Year had been advertised widely to the general public, ordinary people were aware of such physical phenomena for the first time.

GRADES 9-12

NGSS: Earth's Systems: Develop a model to illustrate how Earth’s internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.

International relations have always been a strange mix of cooperation and competition. Science has, for the most part, leaned toward the side of cooperation; scientists realize that better knowledge helps everybody. (An earlier example of this cooperation can be seen in Sir Arthur Eddington’s expedition to view the solar eclipse of May 29, 1919 in order to confirm Albert Einstein’s Theory of General Relativity published four years earlier. Eddington was English and Einstein was German. At the time that Einstein published his theory, their two nations were in the heat of the First World War.) During the International Geophysical Year, this cooperation reached new heights as scientists from 67 nations not only built upon each other’s work, but actively worked together toward a common goal.

This was not the first example of organized international cooperation among scientists. Indeed, as early as the mid-1800s, scientists from the different countries across Europe saw the need to measure the precise size and shape of the Earth; this was clearly too big a job for any single nation to carry out by itself. With the increased exploration of the Arctic and Antarctic regions, eleven countries in Europe and North America cooperated in the first International Polar Year from 1881 to 1884. (NOAA has a web page dedicated to International Polar Years.) A second International Polar Year fifty years later saw participation from forty countries. The International Geophysical Year itself was first considered a third International Polar Year but the name was changed as the objects to be studied broadened beyond the polar regions. A fourth International Polar Year took place in 2007-2008, fifty years after the International Geophysical Year. Scientists have also organized the International Year of the Quiet Sun, the International Hydrological Decade, and the International Decade of Ocean Exploration.

All was not positive and cooperative during these years of scientific research, though. Activities during the second International Polar Year in 1932-33 were scaled back as the participating countries dealt with the effects of the Great Depression. Political difficulties showed themselves during the fourth International Polar Year, when Russian authorities almost prevented one of the research ships from leaving port. During the International Geophysical Year itself, the Soviet Union launched the first artificial satellite, Sputnik 1. While this in itself was not a sign of non-cooperation, it happened at the height of the Cold War and the immediate reaction in the United States was that the next satellite could have a

GRADES 9-12 (CONTINUED)

nuclear warhead aimed at the United States. In addition, the United States government had announced at the beginning of the IGY that the centerpiece of its contributions to the research would be the launching of a satellite; that the Soviets had "stolen a march" on the United States was a serious blow to national pride.

One point on which the organizers of the International Geophysical Year learned from the past had to do with the storage of the scientific data which was gathered. Many scientific measurements that had been made during the second International Polar Year of 1932-33 had been lost during the chaos of the Second World War of the next decade. To prevent such a loss from happening again, the organizers set up World Data Centers in different places around the world. These World Data Centers duplicate the scientific measurements made during the IGY so that if one is destroyed, the data will still be safe at the others.

Some results from the International Geophysical Year are still with us. Certainly the scientific discoveries made are still current—the fact that the Earth is shaped more like a pear than an ellipsoid, the existence of the Van Allen Belts, and the theory of plate tectonics. In addition to these discoveries, though, are organizations and international treaties. Before the IGY, several nations had claimed swathes of Antarctic territory as their own; thanks to the IGY, the Antarctic is now preserved as an international territory independent of any nation. The Global Earth Observation System, or GEOSS, is another fruit of the IGY.

Suggested Activity: Stanford University has a project in which citizen scientists—which can include high school students—match solar flares with disturbances in the Earth's ionosphere. Teachers and students, either individually or as a classroom activity, are invited to take part in this program.

Sixty Years Ago in the Space Race:

July 12, 1957: The Soviets attempted a third R-7 rocket test launch but the rocket veered off course after 33 seconds and disintegrated.