Activity 10 - Universal Time

Teacher's Guide

Scientists use the Universal Time reference to talk about data that is taken around the globe. Universal Time is the time kept in the time zone centered on Greenwich, England (longitude zero). Universal Time does not participate in daylight savings time, so there is no springing forward or falling back one hour during the year. UT times are given in terms of a 24-hour clock. Thus, 14:42 is 2:42 p.m., and 21:17 is 9:17 p.m. As an example of how to compare times in different time zones to universal time, in the winter when it is 6:00 am in Oregon, it is 7:00 am in Montana, 9:00 am in Pennsylvania, and 14:00 Universal Time.

Goals

1. Students will translate their local time to times in other zones around the world.
2. Students will work with the concept of Universal Time.

Materials

Either

- Globe
- Ping-pong ball
- Class reading
- Two worksheet handouts

One of the most common tasks that astronomers have to perform involves calculating times in different *time zones*. When one astronomer observes a phenomenon from a particular place on Earth, it is often important to be able to communicate when exactly that phenomenon occurred to another astronomer located somewhere else on Earth. To make this as easy as possible, we adopt the time of the phenomenon as it would have been observed in Greenwich England – called Greenwich Mean Time (GMT) or Universal Time (UT). This requires converting the astronomer's local time to UT.

Note to Teachers: Time zone math is a challenge for most people, including seasoned travelers, because intuitively it makes no sense why times are earlier or later than what the clock on your wall indicate, depending on which direction east to west you travel.

Procedure

Review with your students that Earth rotates from west to east. Show them a globe, and then have a student hold a small ball (ping pong ball) a few meters from the globe. Explore the relationship between sun angle and local time by exploring the following questions:

1. Where on Earth is the sun-ball directly overhead?
2. What time it would be on Earth from where the sun-ball is directly overhead? (12 noon).
3. Without moving the ball, ask the students where in the sky the sun-ball would be when viewed from countries located to the east of the above "noon" longitude. **Answer**: The ball would be lower in the western sky. That means that the sun is setting and that local times are LATER than noon as you travel eastward. The reverse is true for a traveler moving westward from the 'noon' longitude of the sun-ball.

Make sure your students have done **Activity 11** before continuing with the following activity.

Working with the Concept of Universal Time

Next have your students imagine that a Coronal Mass Ejection (CME) has launched from the Sun today at 12:00pm Noon Local Time (LT). The CME is heading toward Earth and is predicted to hit Earth's magnetosphere 2 days and 3 hours after it left the Sun. Have the students work in teams to come up with developing a general way of communicating the time of this solar storm's departure from the Sun and its arrival at Earth's magnetosphere with other students around the world. Have them think about these questions as they approach this problem:

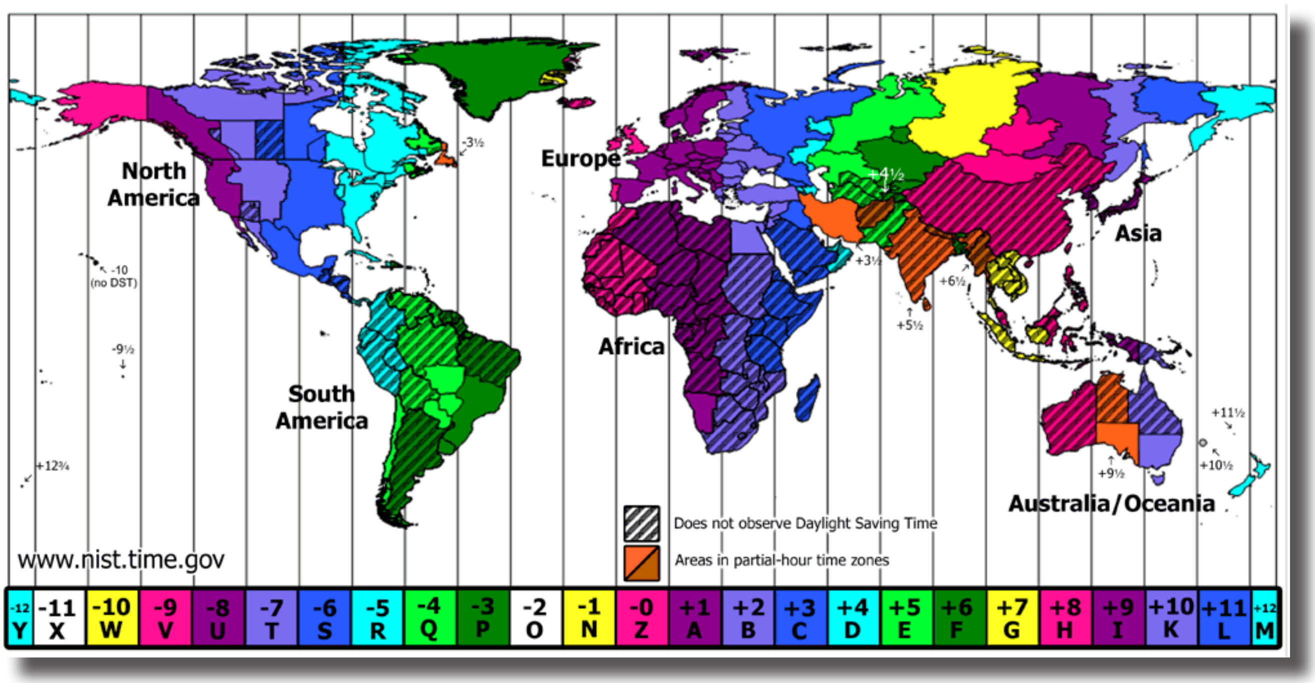
- What time would you use to tell someone in China about this event?
- Who would be awake when the CME arrived and does this matter in terms of what time to use?
- If many more CMEs were launched over the course of weeks, what general time would you use with other students around the world to communicate the timing of these CMEs?

Have the students share their ideas with each other in a class discussion. Then introduce the idea of Universal Time using the information at the beginning of this activity. Work a couple examples of converting local time to UT during daylight savings time and during standard time. Then have the students fill out the student worksheet to determine if they have understood how Universal Time works.

1. Students will read the material provided on their work sheet and note the local times for the solar flare, and the geographic locations of the observers.
2. They will identify in which time zone each observer is located.
3. They will read the diagram to determine the number of hours to add (+) or subtract (-) to determine the Universal Time (UT) of the solar flare.
4. They will answer questions about another event and whether it was observed by a scientist who was on a break from working.

Student Name ______________________________ ***Date*** ________

Universal Time



The above diagram shows the 24 time zones around the world. If you live in New York and want to call someone in San Francisco, you have to remember that the local time in San Francisco (Pacific Standard Time) is three hours BEHIND New York Time (Eastern Standard Time). By counting the time zones between the locations and keeping track of "ahead" or "behind" you, you can figure out the correct local times anywhere on the planet. Suppose an astronomer in Texas is viewing the Sun—with a special solar filter to protect her eyes—and notices a bright flash coming from a spot on the Sun (a solar flare) at 6:00 AM Central Standard Time near sunrise. Meanwhile, an astronomer in India spots the same solar flare at 17:00 India Time near sunset. Answer the following questions:

1) How can exactly the same event be seen at two different times on Earth?

2) What time would an astronomer with a solar telescope in West Africa (in the "z" time zone) have seen the same solar flare according to his local time?

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3) What time in Universal Time (UT) did the solar flare occur?

4) Would an astronomer with a solar telescope in Central Australia have seen the flare? How about an astronomer in Alaska?

5) Suppose a solar flare happened at 10:31 UT. What time would the event have happened in California according to Pacific Standard Time?

6) A satellite registers a major solar explosion that lasts from 15:15 to 16:26 UT. A solar scientist monitoring the satellite data decided to go grab a cup of coffee between 7:00 AM and 7:45 AM Pacific Standard Time.
   a) How long did the explosion last?
   b) Did the scientist know about the flare before he left for coffee?
   c) How much of the flare event did the scientist get to see in the satellite data as it happened?
   d) Should the scientist have gone for coffee?

Teacher Answer Key

1) How can exactly the same event be seen at two different times on Earth?
Answer: Because the surface of Earth has different time zones.

2) What time would an astronomer with a solar telescope in West Africa have seen the same solar flare according to his local time?
Answer: From the diagram and the location of West Africa, the local time would be 11:00 AM.

3) What time in Universal time did the solar flare occur? **Answer:** Knowing that Universal Time is Greenwich Mean Time at the "Prime Meridian," the flare occurred at 12:00 UT.

4) Would an astronomer with a solar telescope in Central Australia have seen the flare? How about an astronomer in Alaska? **Answer:** Neither would have seen it because the sun had already set (Australia) or had not yet risen (Alaska).

5) Suppose a solar flare happened at 10:31 UT. What time would the event have happened in California according to Pacific Standard Time? **Answer:** By the diagram, PST is 8 hours behind UT so 10:31 UT – 8hrs = 2:31 AM PST. This is well before sunrise, so it wouldn't have been seen.

6) A satellite registers a major solar explosion that lasts from 15:15 to 16:26 UT. A solar scientist monitoring the satellite data decided to go for a coffee between 7:00 AM and 7:45 AM Pacific Standard Time.

a) How long did the explosion last? **Answer**: 16:26 – 15:15 UT = 1hour and 11 minutes.

b) Did the scientist know about the flare before he left for coffee? **Answer:** He left for coffee at 7:00 AM PST which is 7:00 + 8hrs = 15:00 UT so he didn't know about the solar explosion, which happened 15 minutes after he left.

c) How much of the flare event did the scientist get to see in the satellite data as it happened? **Answer:** When he returned to the satellite station, the time was 7:45 AM PST + 8hrs = 15:45 UT. The explosion ended at 16:26 UT, so the scientist got to see 16:26 PM – 15:45 PM = 41 minutes of the last part of the explosion.

d) Should the scientist have gone for coffee? **Answer:** Yes, of course! Because if he had been smart, he would have made sure that his data was being recorded for playback, just the way you program your VHS or DVD-recorder to record favorite programs you have to miss at regular broadcast time. Also, no scientist using satellite data ever relies on on-the-spot analysis. Scientists always record the satellite data so they can study it in detail later. Still, we can guess that after a long night at the satellite terminal, this scientist would have loved to have been there to see it happen in "real-time"!!