LINKS
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LEAP YEARS

Areas of interaction:
Human ingenuity, Environments

The most common calendar in use around the world is the **Gregorian calendar** which was created in 1582. In this calendar, February usually has 28 days, but every four years it has 29 days instead. These years are called **leap years**, and in this investigation we explore why we have them.

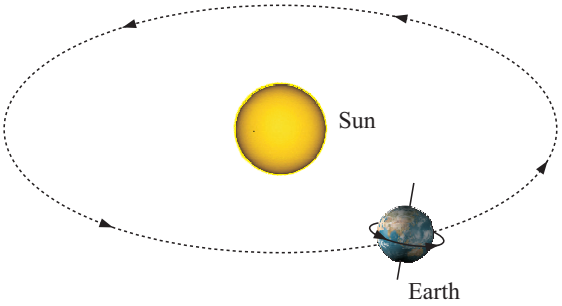
ROTATIONS AND REVOLUTIONS OF THE EARTH

As you know, the Earth **revolves** around the Sun.

A **year** is the length of time it takes for the Earth to complete one revolution of the Sun.

While the Earth revolves around the Sun, it also **rotates** about its axis. A **day** is the length of time it takes for the earth to complete one rotation about its axis.

The Earth rotates approximately **365.242 374** times in the same time that it takes to revolve once around the Sun. We therefore say that the **astronomical year** has approximately 365.242 374 days.



So, in a calendar year with only 365 days, the Earth will not quite revolve completely around the sun. The difference is quite small, but if **every** calendar was only 365 days, the inaccuracy would grow larger and larger over time. In time, the calendar year would drift out of line with the astronomical year, and the seasons would shift their places in the year.

To try to keep the calendar year in line with the astronomical year, an extra day is added once every 4 years, when the year number is divisible by 4.

DISCUSSION

What problems would arise if the calendar year were to drift out of line with the astronomical year?

What to do:

1. If there is a leap year when the year number is divisible by 4, explain why there are 1461 days in a 4 year period.
2. Show that the average number of days per year in this case is 365.25 .

You can see that the calendar year is now much closer to the astronomical year, but now our calendar year of 365.25 days is slightly too long.

To correct this we need to reduce the number of leap years. It was decided that if a year number is divisible by 100, it is **not** a leap year. For example, the years 1800 and 1900 were not leap years.

What to do:

3. If there is a leap year when the year number is divisible by 4 but not by 100, calculate the number of days in a 100 year period.
4. Calculate the average number of days per year in this case.

You should have found that the calendar year is even closer to the astronomical year, but now our calendar year is slightly too short.

To correct this we need to increase the number of leap years. So, it was decided that if a year number is divisible by 400, it **is** a leap year, even thought it is also divisible by 100. For example, the year 2000 was a leap year.

What to do:

5. If there is a leap year when the year number is divisible by 4, but not by 100, *unless* it is also divisible by 400, calculate the number of days in a 400 year period.

6 Calculate the average number of days per year in this case.

7 Find the difference between the average number of days in the calendar year in **6**, and the number of days in the astronomical year.

8 How many years will it take for this calendar year to drift one day out of line with the astronomical year?

RESEARCH

1 Why is there little point in trying to improve the accuracy of the calendar year any further than this?

2 In Greece, it is considered bad luck to hold what kind of event during leap year?

CHALLENGE

Mars rotates about its axis approximately 669.59 times in the time it takes to revolve around the Sun.

Construct a set of rules like those described for Earth, so the average number of days in a Mars calendar year is 669.59.

Hint: Since this figure is closer to 670 than 669, a standard year should have 670 days, while others should have 669 days.