Name: _____ Date: _____

A Clock That Could Ride the Waves

Circle group

Long ago, sailors had a hard problem. They could use the sun or stars to tell how far north or south they were. But they could not tell how far east or west they had sailed. That distance is called longitude. Without it, a ship could get lost.

The answer was time. The Earth turns once a day, so noon comes at different times in different places. A crew could use the time at their home port and the time where the ship was. They could compare the two to find their longitude. But the home time had to be exact. Pendulum clocks did not work well on a ship. The ship rolled on the waves.

In the 1700s, an English clockmaker named John Harrison tried to build a better clock. He worked for many years. He made several clocks, and each one was better. His small clocks used tiny springs instead of a pendulum. The rocking of a ship did not bother them. On test trips, they kept very good time.

Clocks like these are called marine chronometers. They helped sailors find their place at sea.

Questions

1. What could sailors learn from the sun or the stars?

_____

_____

2. What is longitude?

_____

_____

3. Which two times did a crew compare?

_____

_____

4. Why did pendulum clocks fail on ships?

_____

_____

5. What did Harrison use instead of a pendulum?

_____

_____

6. Why could a crew with a clock that was not exact not find longitude?

_____

_____

Words to know

longitude: how far east or west a place is on the Earth
pendulum: a weight that swings back and forth to keep a clock's time
chronometers: very exact clocks used to find a place at sea

Talk together (every group has these)

1. Find one fact that every group read. How did your sheet say it?
2. What did your sheet tell you that you think another group's did not? Ask them.
3. What is one question about this topic that none of the sheets answered?

Name: _____ Date: _____

A Clock That Could Ride the Waves

Triangle group

Long ago, sailors on the open ocean faced a puzzling problem. By measuring the sun or the stars, they could tell how far north or south they were. But they could not tell how far east or west they had sailed. That east-west distance is called longitude, and without it a ship could easily lose its way or miss a small island.

The answer lay in time. The Earth turns once every day, so noon arrives at different moments in different places. If a crew knew the exact time back at its home port, and also the local time where the ship was, they could compare the two and work out their longitude. The hard part was keeping the home time accurate. Pendulum clocks, the best clocks of the day, did not work well on a ship that rolled and pitched on the waves.

In the 1700s, an English clockmaker named John Harrison set out to build a clock that could. He worked for many years and made several versions, each better than the one before. His smaller timekeepers used tiny springs and moving parts in place of a swinging pendulum, so the rocking of the ship did not upset them. On test voyages, they kept very good time.

Thanks to clocks like these, called marine chronometers, sailors could at last find their place on the sea with confidence.

Questions

1. What could sailors learn by measuring the sun or the stars?

_____

_____

2. What is longitude?

_____

_____

3. Which two times did a crew compare to find longitude?

_____

_____

4. Why did pendulum clocks fail at sea?

_____

_____

5. What did Harrison use in place of a swinging pendulum?

_____

_____

6. Why could a crew with an inaccurate clock not find its longitude?

_____

_____

Words to know

longitude: how far east or west a place is on the Earth
accurate: correct and without mistakes
pendulum: a weight that swings back and forth to keep a clock's time
voyages: long trips over the sea
chronometers: very exact clocks used to find a place at sea

Talk together (every group has these)

1. Find one fact that every group read. How did your sheet say it?
2. What did your sheet tell you that you think another group's did not? Ask them.
3. What is one question about this topic that none of the sheets answered?

Name: _____ Date: _____

A Clock That Could Ride the Waves

Square group

In earlier centuries, sailors crossing the open ocean confronted a baffling difficulty. By measuring the position of the sun or the stars, they could determine how far north or south they had traveled. Yet they had no means of telling how far east or west they had sailed. That east-west distance is called longitude, and without knowing it, a ship could easily lose its course or sail past a tiny island without ever seeing it.

The solution depended on time. Because the Earth rotates once every day, noon arrives at different moments in different places. If a crew knew the exact time back at its home port, and also the local time at the ship's position, they could compare the two and calculate their longitude. The challenge was keeping the home time accurate. Pendulum clocks, the finest timepieces of the age, performed poorly aboard a vessel that rolled and pitched on the waves.

During the 1700s, an English clockmaker named John Harrison resolved to build a clock that could handle such conditions. He labored for many years and produced several versions, each an improvement on the one before. His smaller timekeepers relied on tiny springs and carefully balanced moving parts in place of a swinging pendulum, so the rocking of the ship did not disturb them. On test voyages, they kept remarkably good time.

Thanks to instruments like these, known as marine chronometers, sailors were at last able to determine their position on the sea with real confidence.

Questions

1. What could sailors determine by measuring the sun or the stars?

_____

_____

2. What does the word longitude mean?

_____

_____

3. Which two times did a crew compare to calculate longitude?

_____

_____

4. Why did pendulum clocks perform poorly aboard ships?

_____

_____

5. What did Harrison's smaller timekeepers use in place of a swinging pendulum?

_____

_____

6. Why would an inaccurate clock make it impossible to find longitude?

_____

_____

Words to know

longitude: how far east or west a place is on the Earth
accurate: correct and without mistakes
pendulum: a weight that swings back and forth to keep a clock's time
voyages: long trips over the sea
chronometers: very exact clocks used to find a place at sea

Talk together (every group has these)

1. Find one fact that every group read. How did your sheet say it?
2. What did your sheet tell you that you think another group's did not? Ask them.
3. What is one question about this topic that none of the sheets answered?

For the teacher: A Clock That Could Ride the Waves

Each student sheet carries a shape, not a level. The same topic and facts, written three ways.

Circle: A Clock That Could Ride the Waves

Easier · 187 words · Flesch-Kincaid grade 2.4

1. How far north or south they were.
2. How far east or west a ship is.
3. The time at home port and the time where the ship was.
4. The ship rolled on the waves.
5. Tiny springs.
6. The two times only help if the home time is exact, so the answer would be wrong.

Triangle: A Clock That Could Ride the Waves

This passage · 230 words · Flesch-Kincaid grade 6

1. How far north or south they were.
2. The distance east or west.
3. The time at the home port and the local time where the ship was.
4. The ship rolled and pitched on the waves.
5. Tiny springs and moving parts.
6. Comparing the two times only works if the home time is exact, so the answer would be wrong.

Square: A Clock That Could Ride the Waves

Harder · 249 words · Flesch-Kincaid grade 9.1

1. How far north or south they had traveled.
2. The distance east or west.
3. The exact time at the home port and the local time at the ship's position.
4. The ship rolled and pitched on the waves.
5. Tiny springs and carefully balanced moving parts.
6. The method depends on knowing the home time exactly, so any error would give a wrong position.