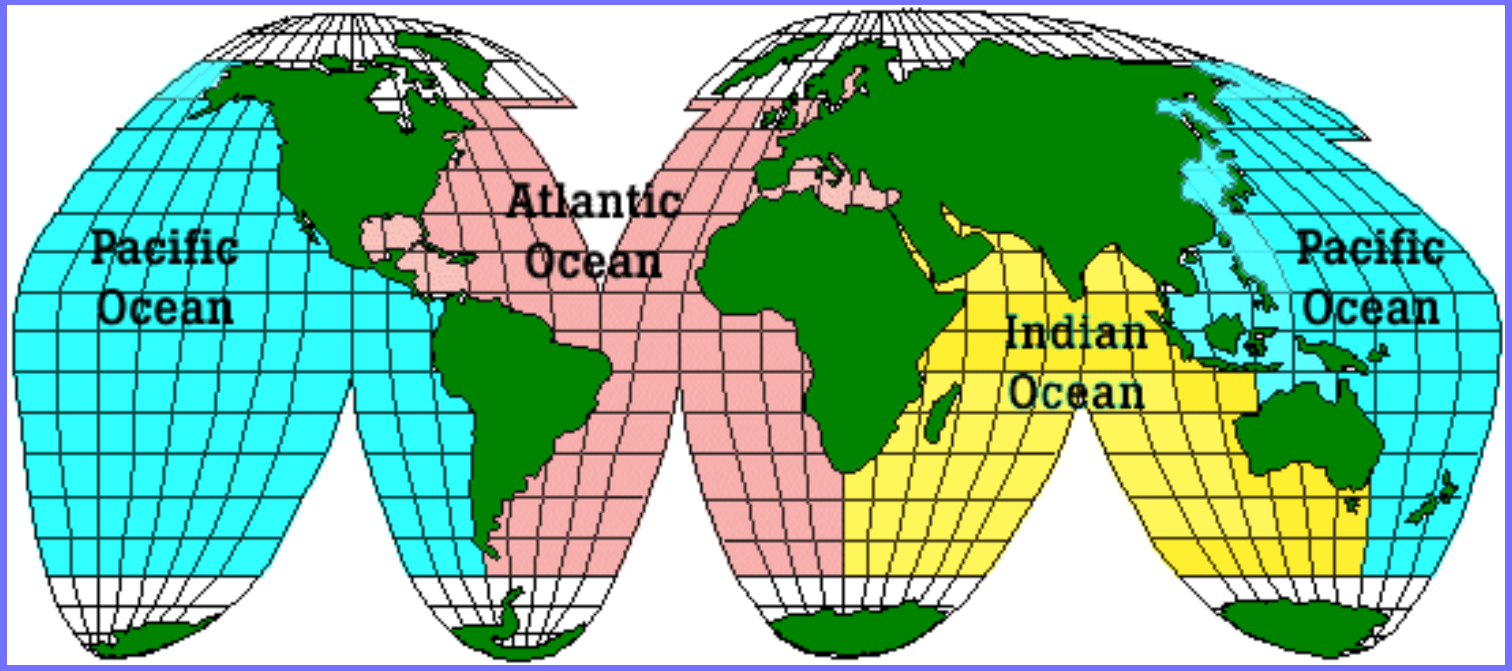
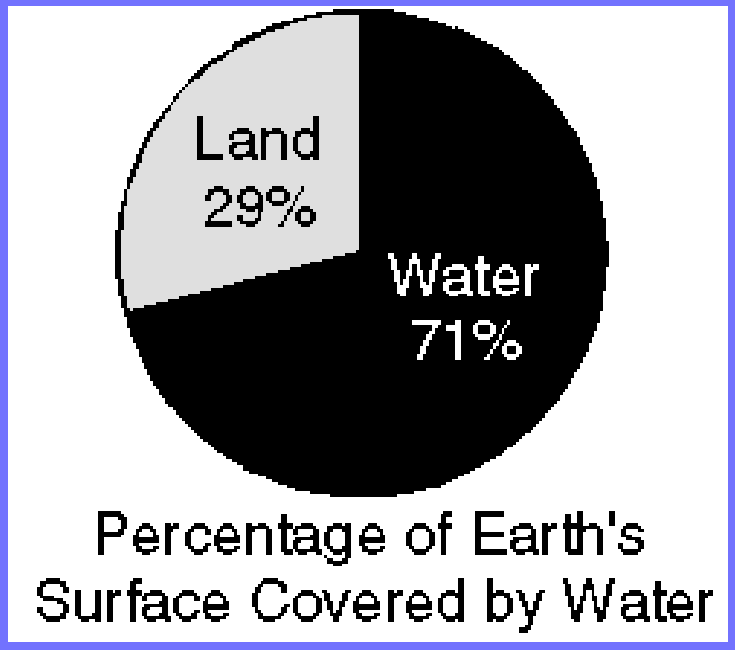
WAVES, TIDES, AND TSUNAMI

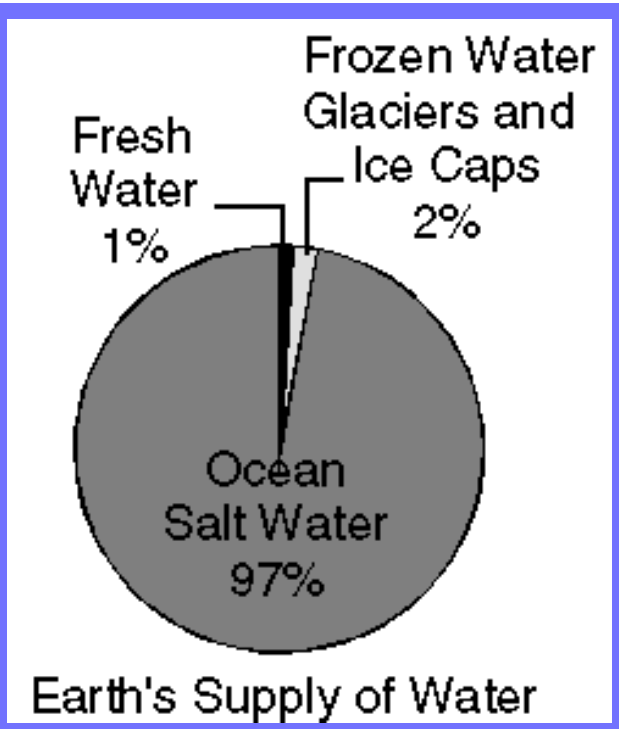

Arctic
Ocean
North
Pacific
Ocean
North
Atlantic
Ocean
South
Pacific
Ocean
South
Atlantic
Ocean


Arctic Ocean
North
Pacific
Ocean
South Pacific
Ocean
Indian
Ocean
Antarctic Ocean





Percentage of Earth's Surface Covered by Water



Earth's Supply of Water

Ocean

Tides

Waves

Ocean Storms

The Ocean Floor

Waves

Waves

A wave is a rhythmic movement that carries energy through matter or space.

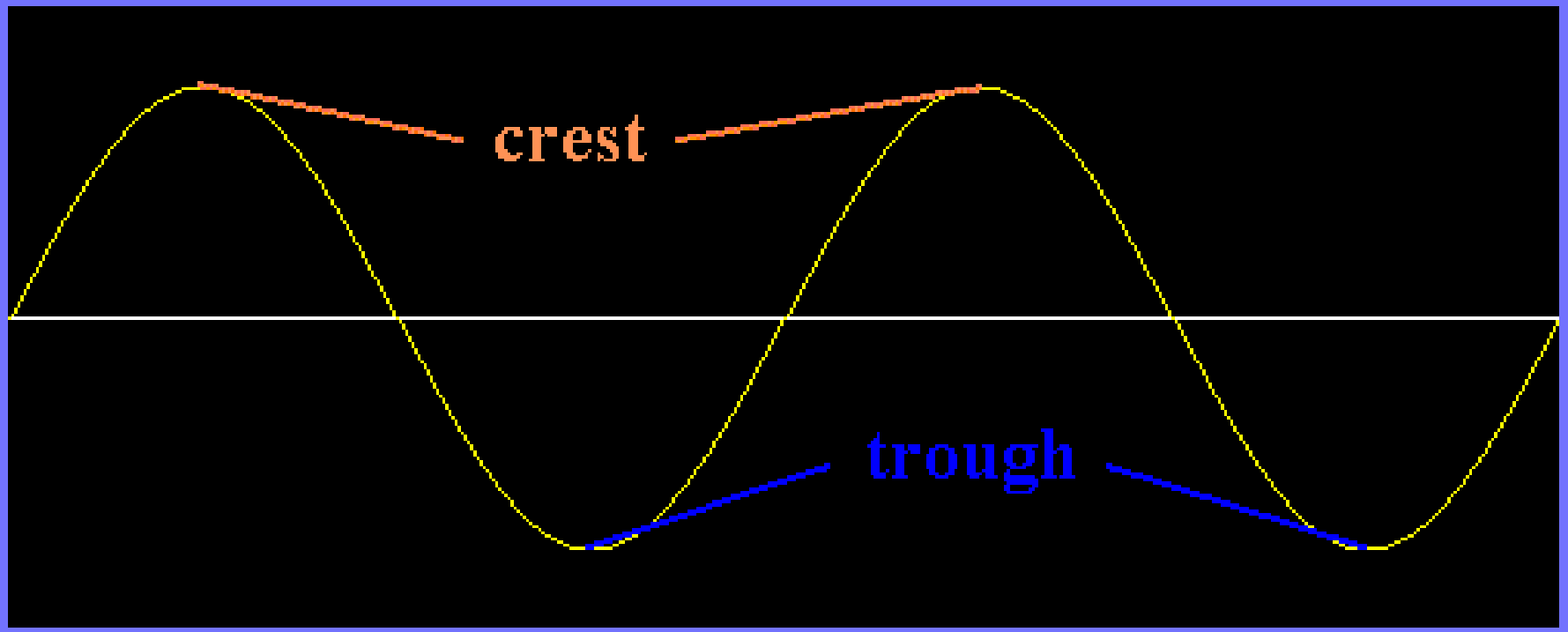
Waves

- Most ocean waves are caused by wind that blows across the surface of the water.
- Friction between the wind and water transfers energy from the wind to the water.

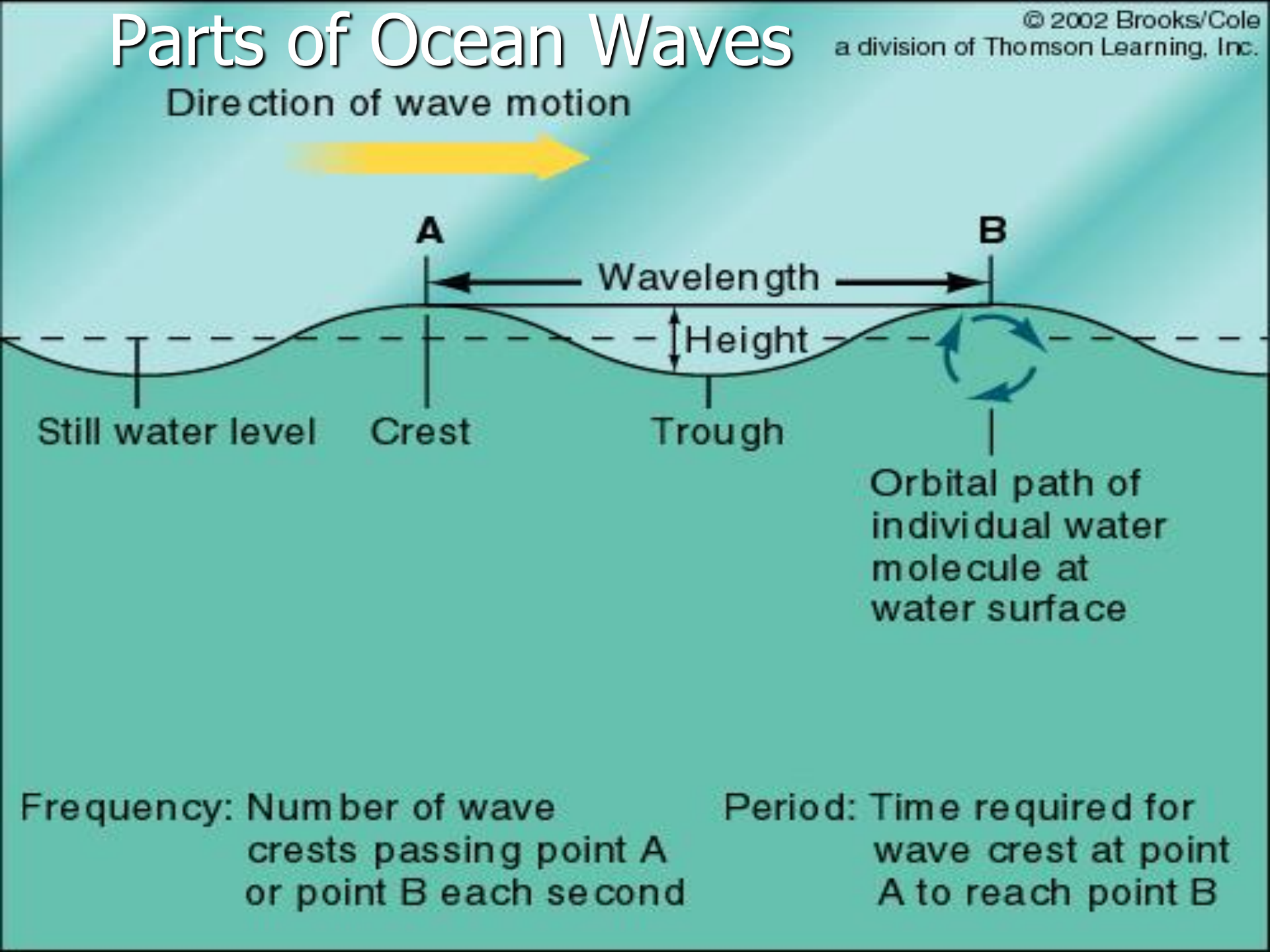

Waves

Waves

- The highest part of a wave is the crest.
- The lowest part of a wave is the trough.

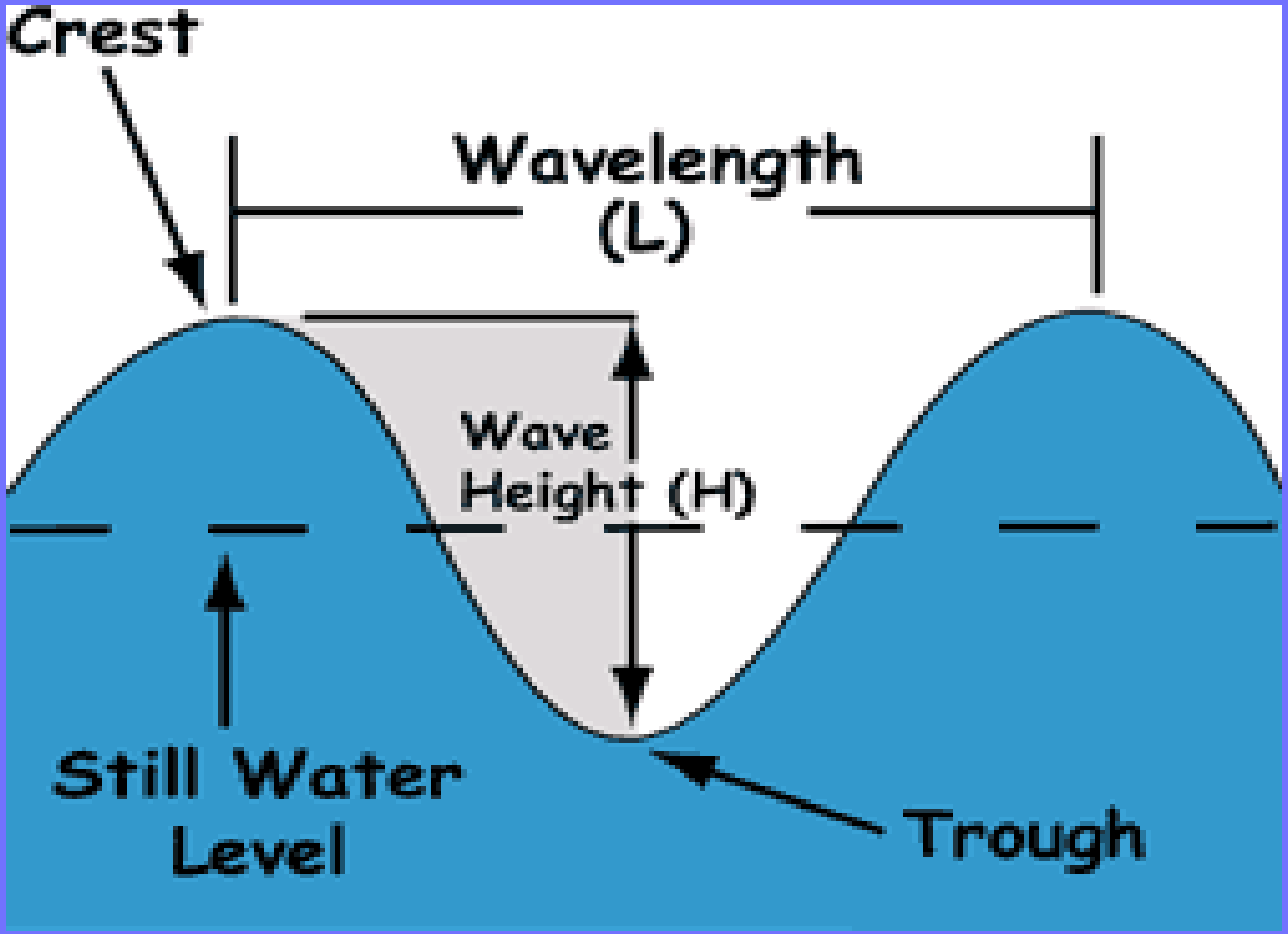


Parts of Ocean Waves



Frequency: Number of wave crests passing point A or point B each second

Period: Time required for wave crest at point A to reach point B

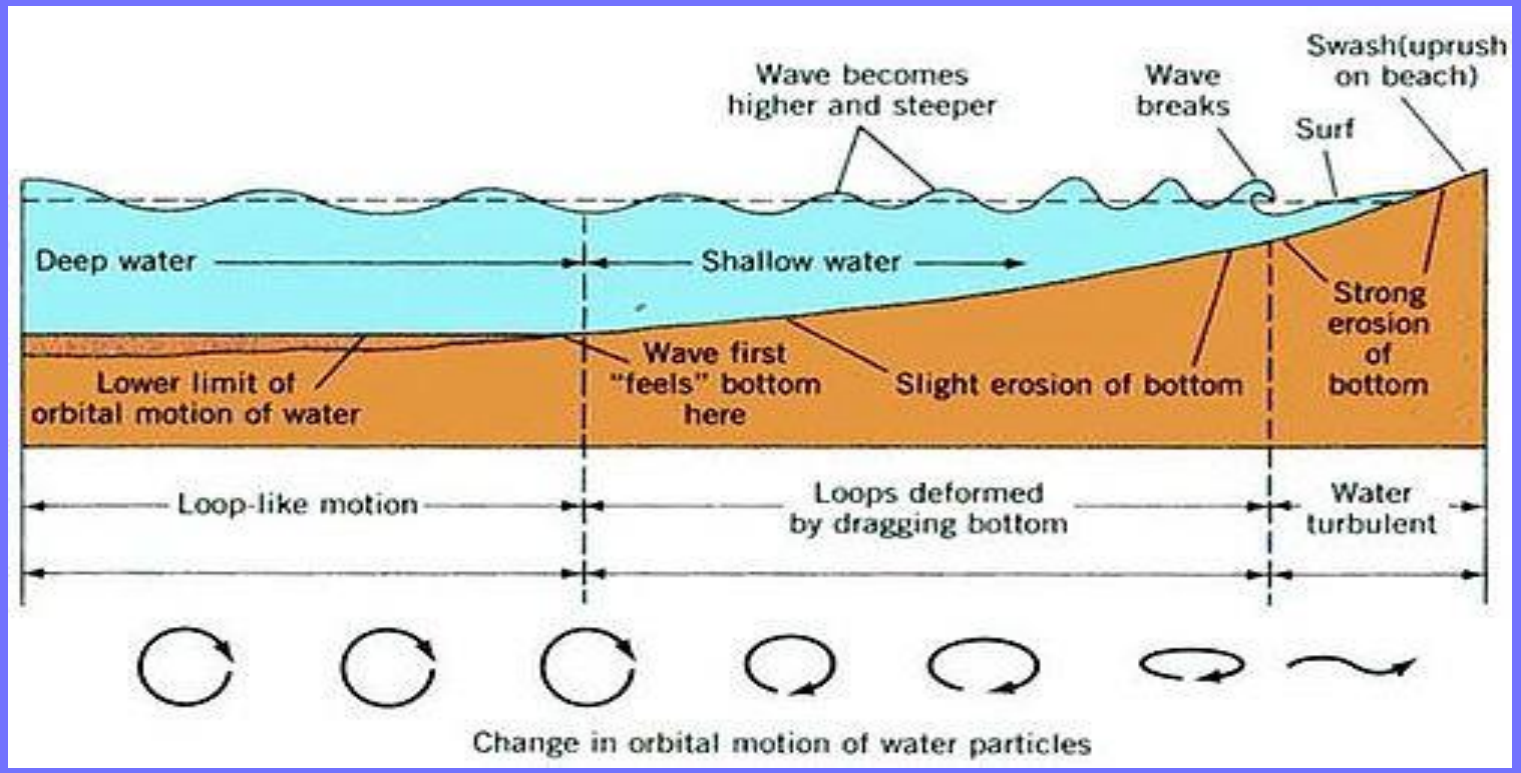

Crest
Wavelength
(L)
Wave
Height (H)
Still Water
Level
Trough

Waves

- The longer and harder the wind blows and the greater the distance over which it blows, the higher the waves become…..

Why Do Waves Break?

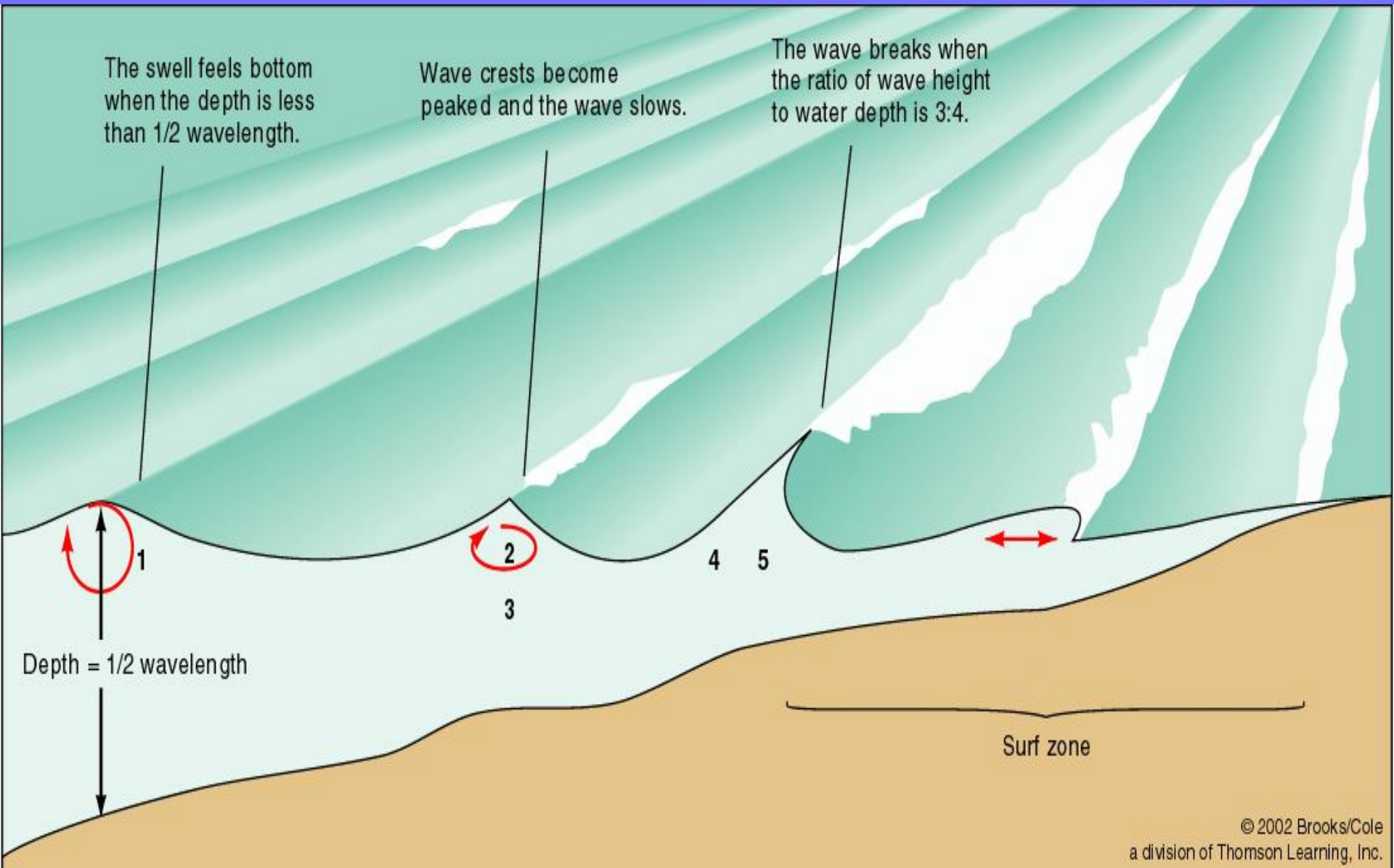
- Water molecules do tend to travel forward as they break on shore.
- Waves break when they approach shallow water.



Breakers

- The bottom of the wave is slowed down by friction with the ocean floor.
- The top of the wave is still moving forward, traveling faster than the bottom.
- Its momentum causes it to move past the bottom part of the wave.
- When this happens the wave topples over on itself, forming a breaker.

Wind Waves Approaching Shore



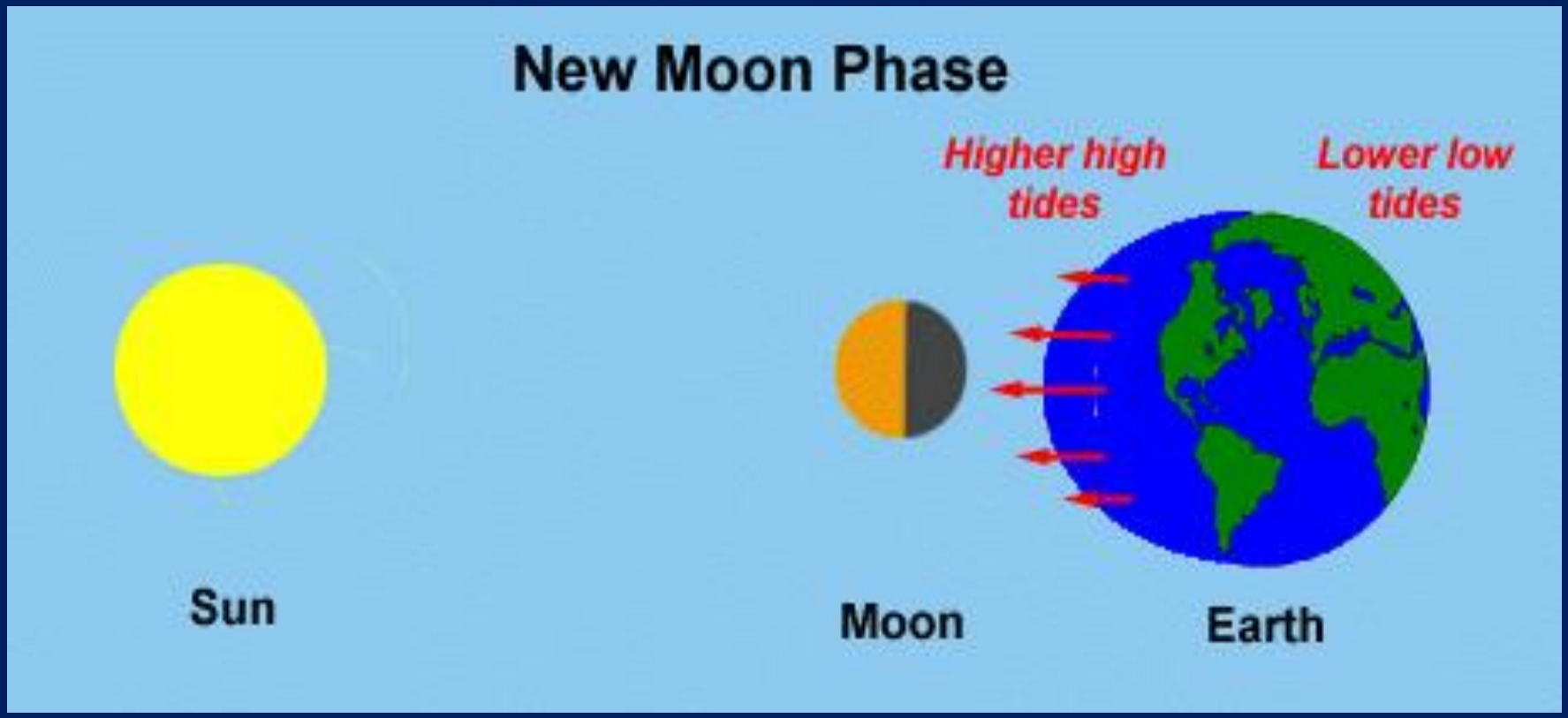
TIDES

What causes tides?

The gravitational forces of the moon and sun on the water causes the tides.

The moon, being nearest, has the greatest effect even though the sun is the larger of the two.

High tides are generated on the sides of the Earth nearest to and farthest from the moon.



During new and full moon phases the moon, sun, and Earth are aligned causing a greater gravitational pull on the Earth.

This results in higher high tides and lower low tides.

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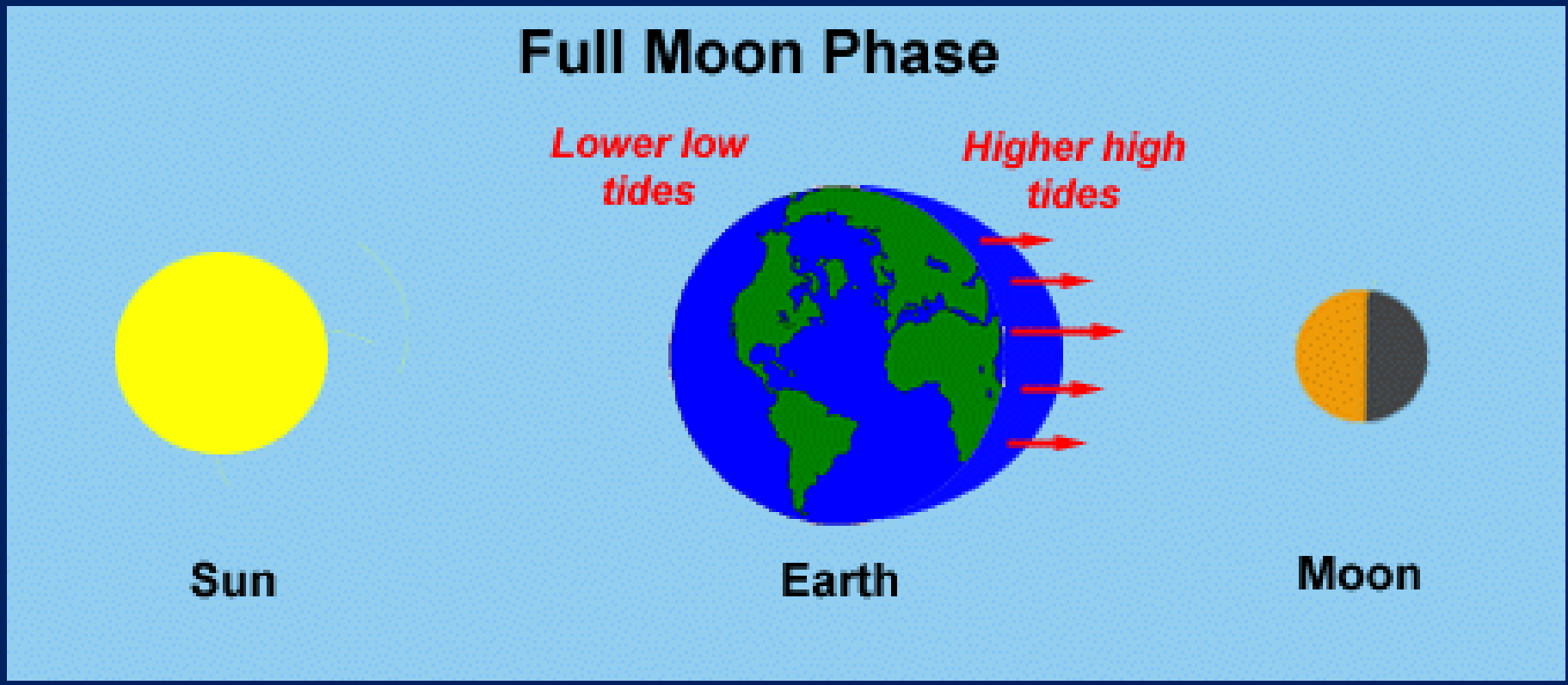
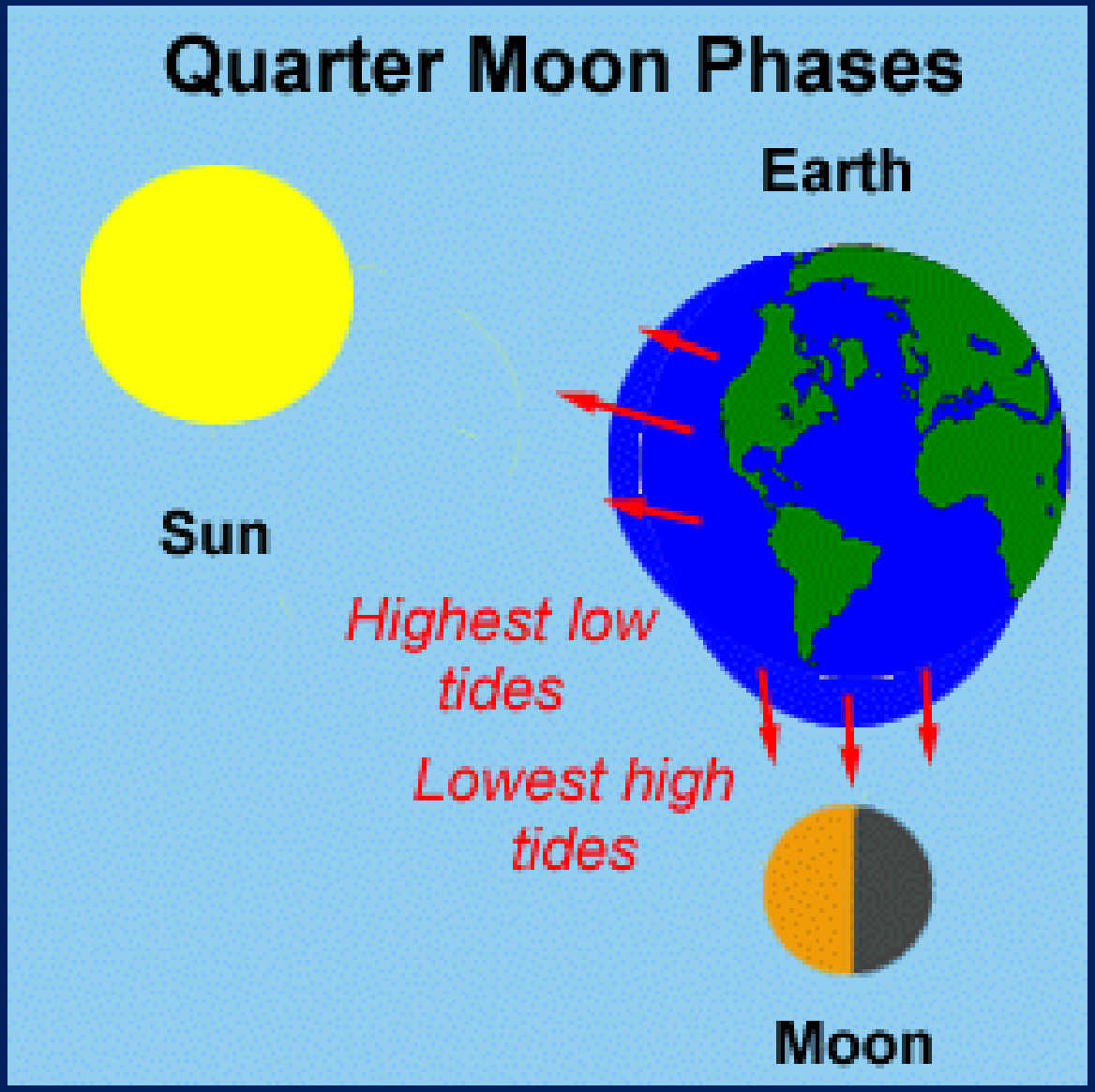


Spring Tides

- The Moon moves around the Earth and the Earth moves around the Sun.
- The Moon, the Earth and the Sun line up twice a month-when the moon is full and when it is new.
- The Moon and the Sun pull together on the Earth's oceans.
- The result is high tides that are very high and low tides that are very low; Spring Tides
- *Spring refers to the "springing up" of the water, not the spring season.*

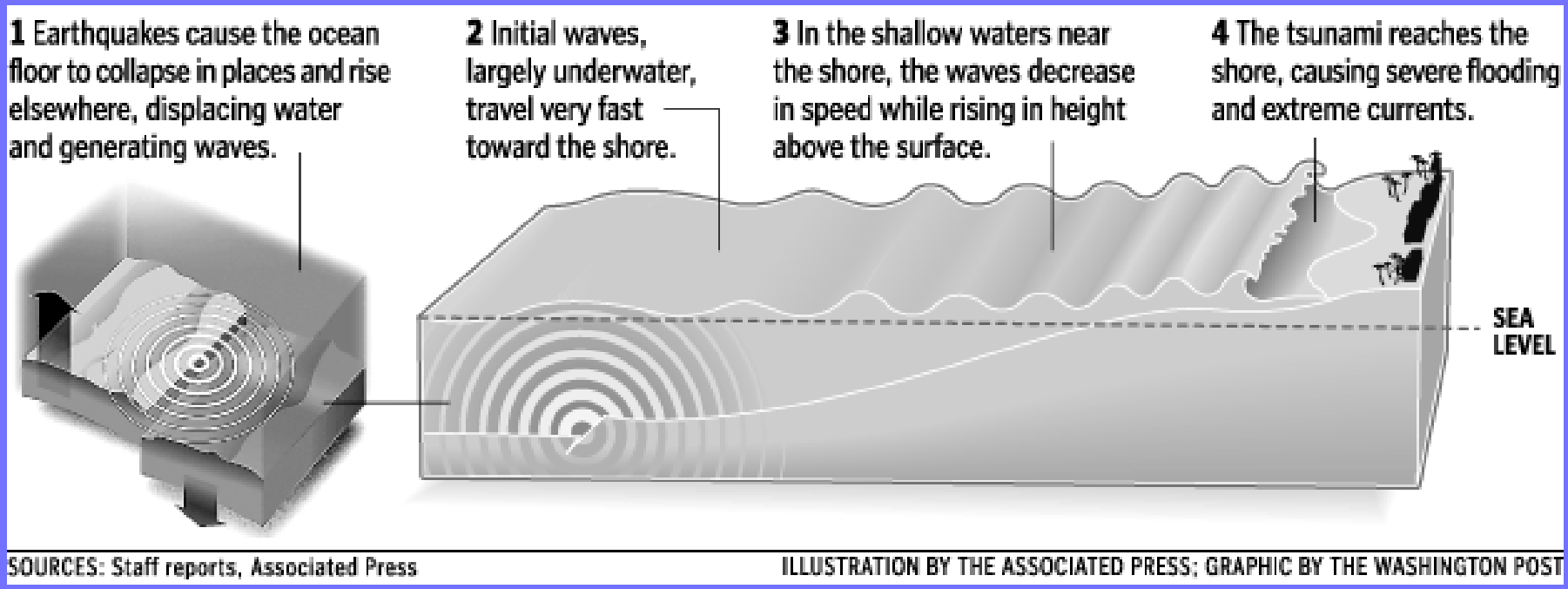
Neap Tides

- When the Sun and the Moon are at a 90 degree angle with the Earth, they no longer pull in the same direction.
- The pull of the Sun works against the pull of the Moon.
- High tides are not so high and low tides are not so low; Neap Tides
- Occur twice each month, when the Moon is in its first quarter and its third quarter phases.


Quarter Moon Phases
Earth
Sun
Highest low tides
Lowest high tides
Moon

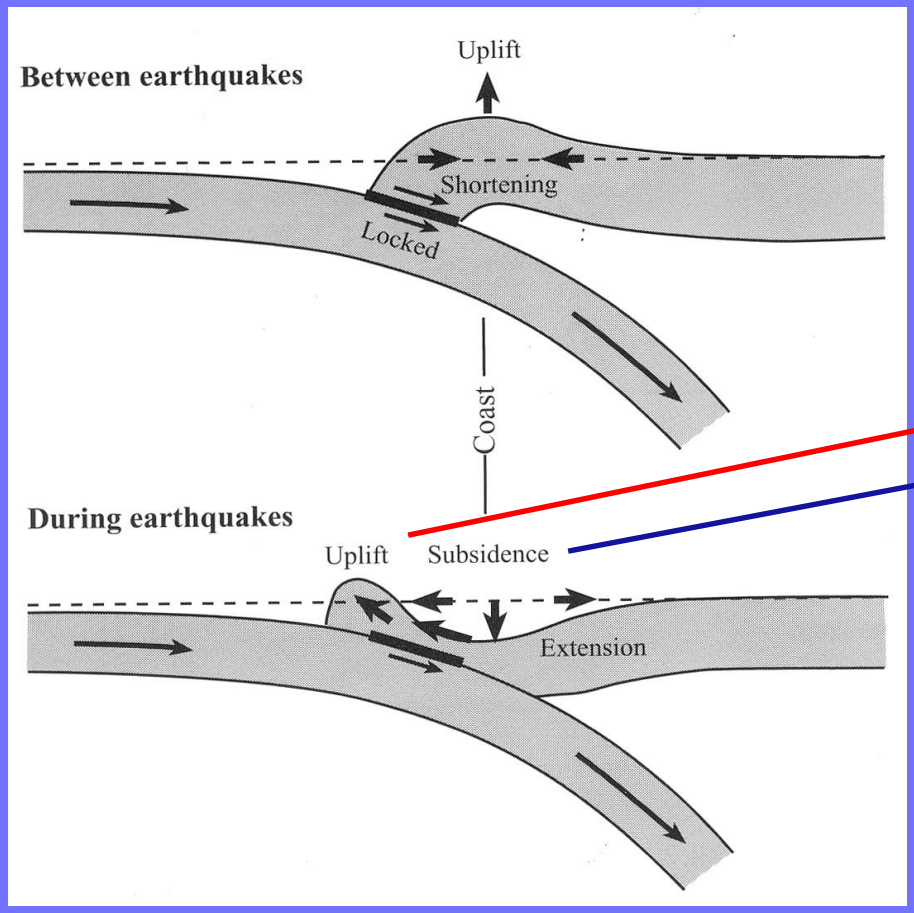
TSUNAMI

TSUNAMI - water wave generated by earthquake



NY Times

TSUNAMI GENERATED ALONG FAULT, WHERE SEA FLOOR DISPLACED, AND SPREADS OUTWARD

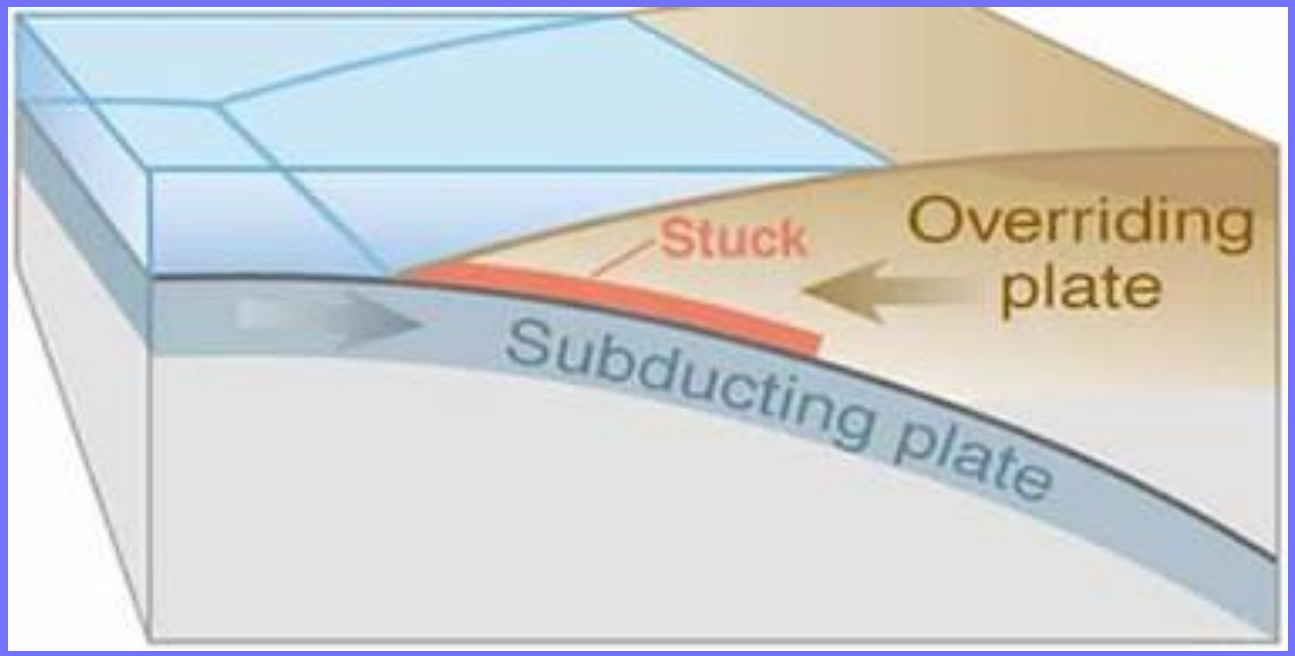


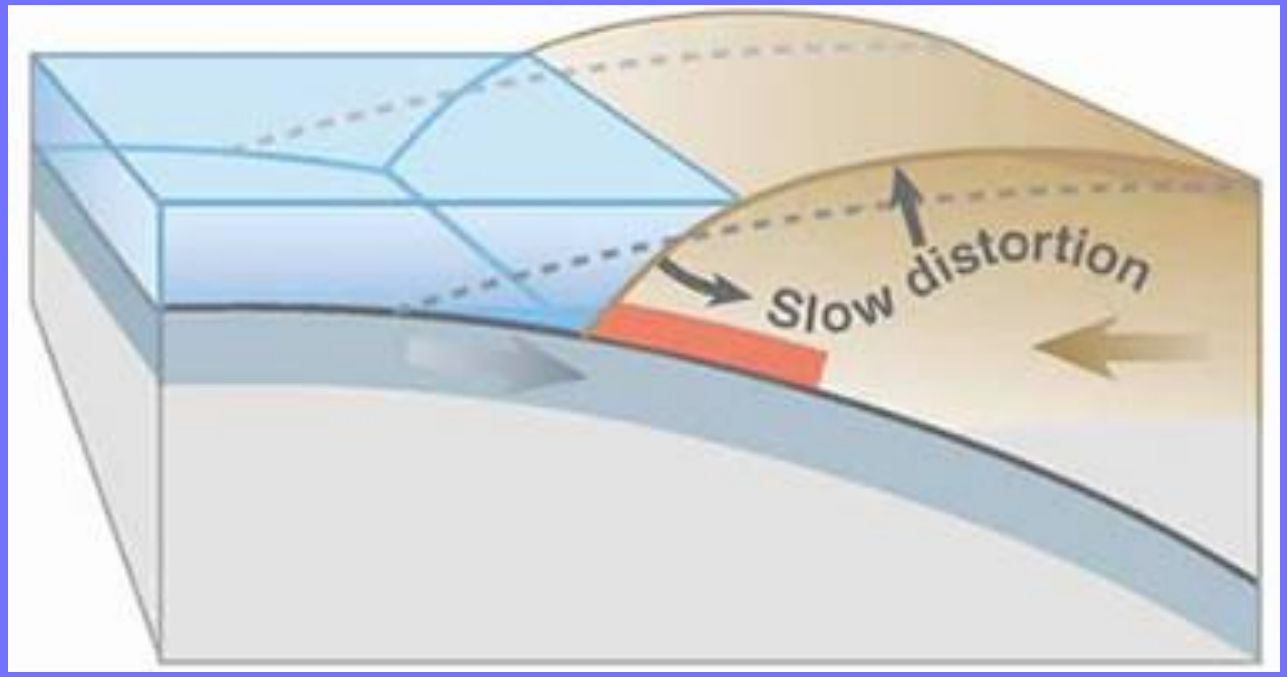
QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

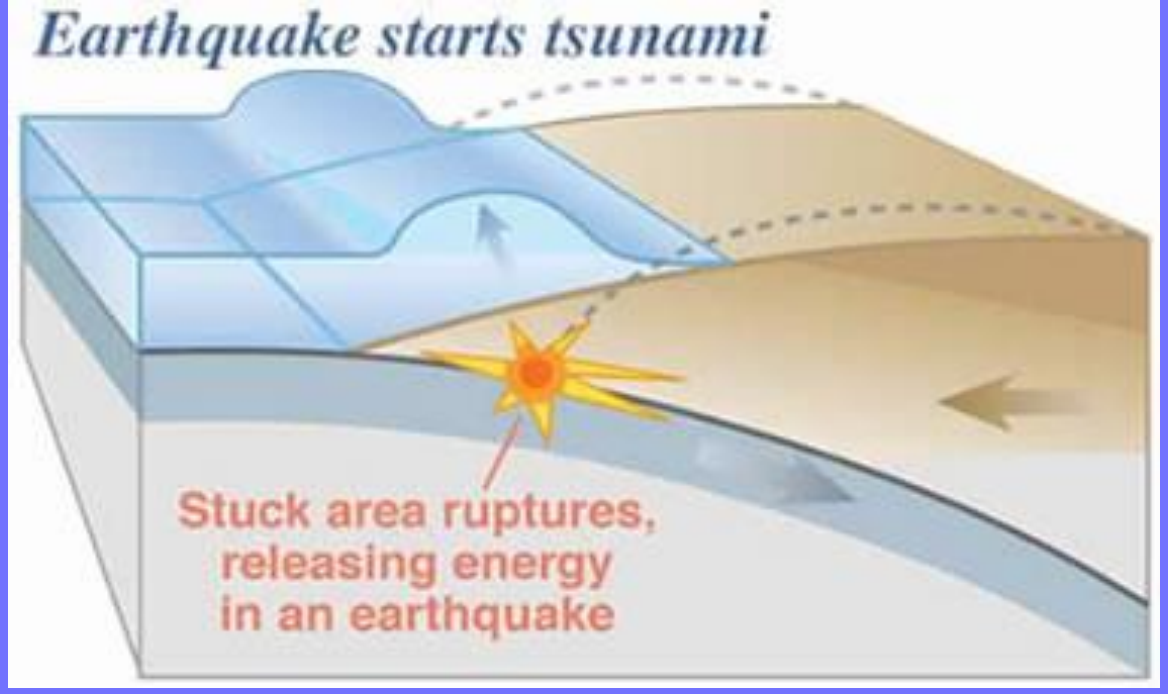
Hyndeman and Wang, 1993

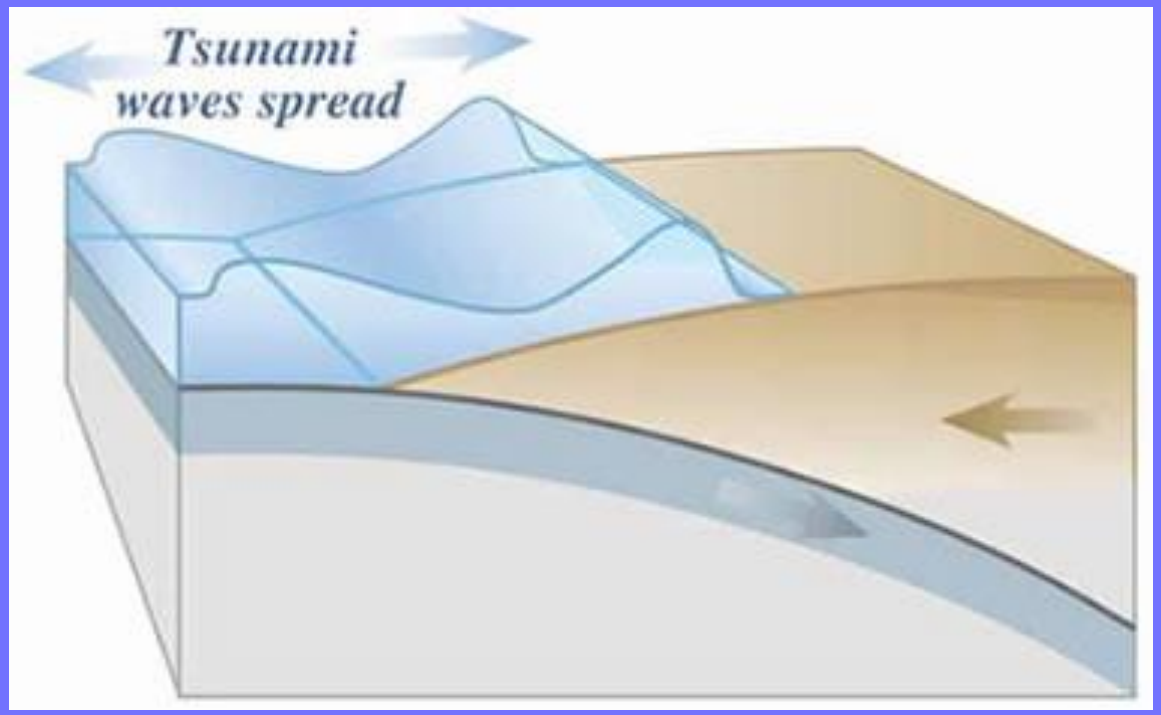
Red - up motion, blue down

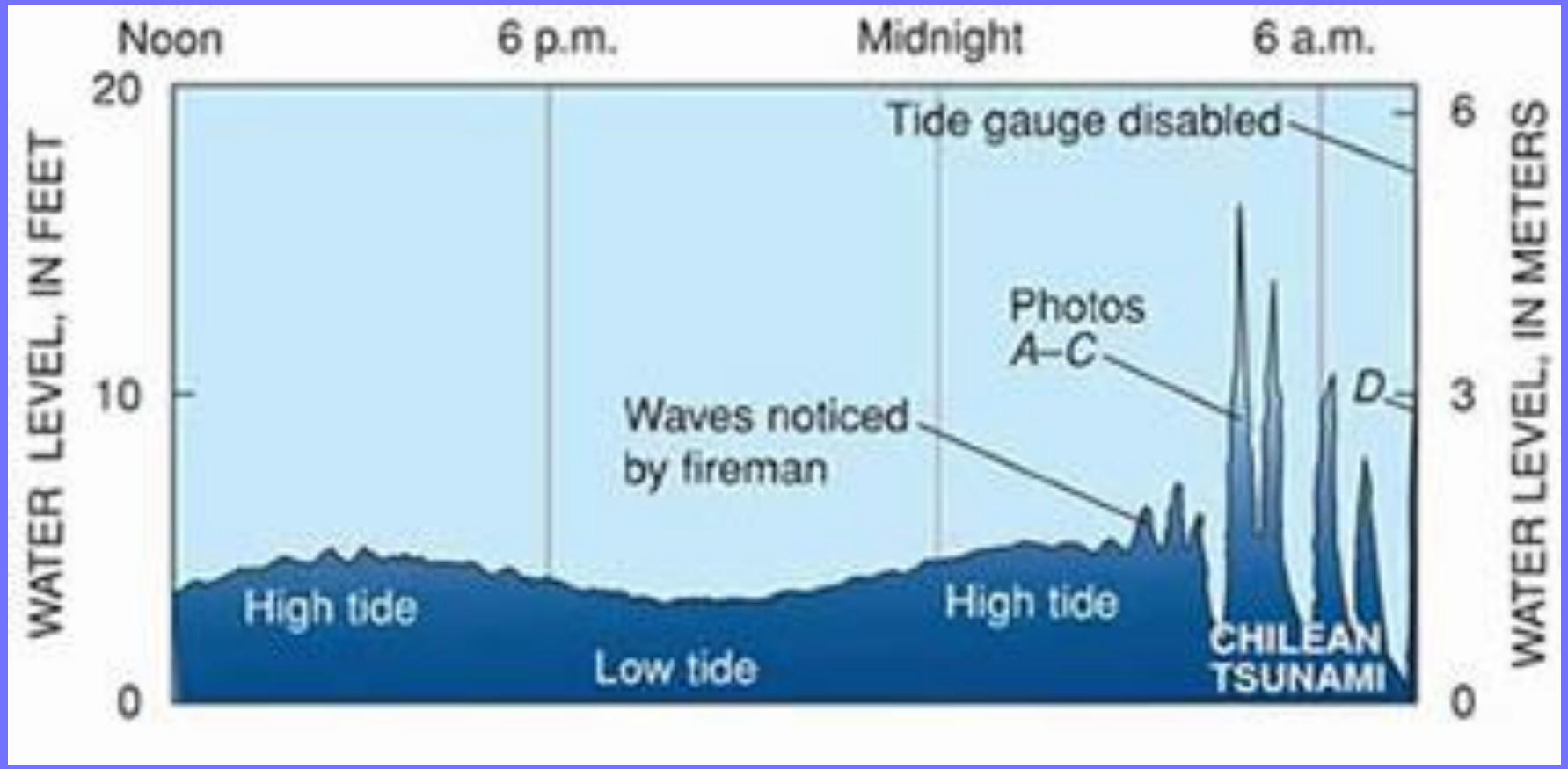
http://staff.aist.go.jp/kenji.satake/animation.gif

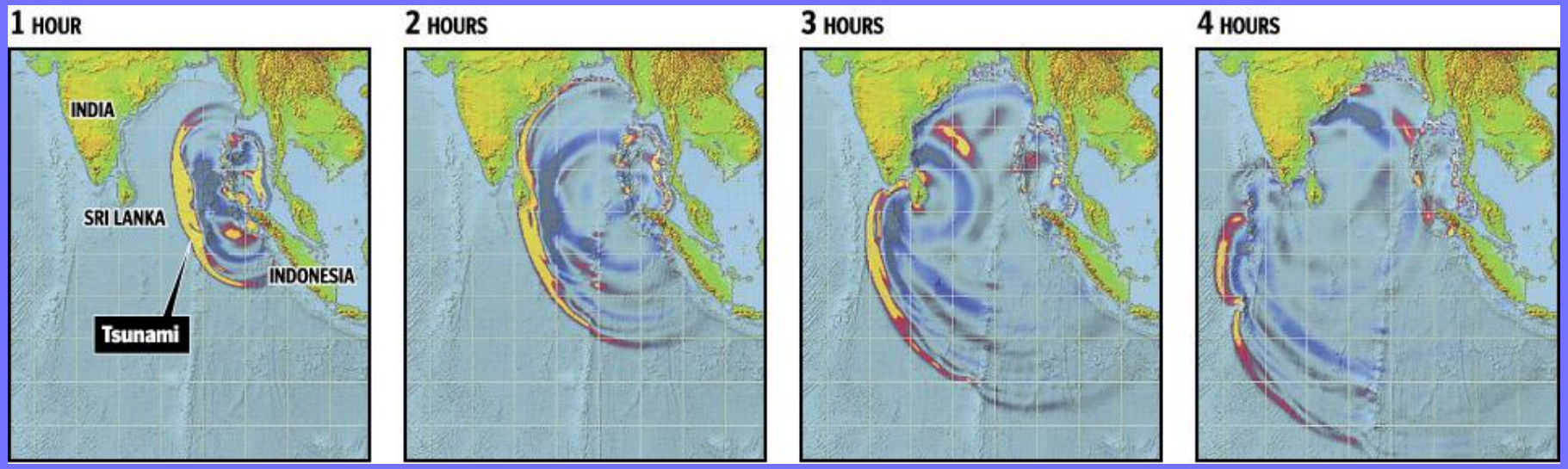

Stuck
Overriding plate
Subducting plate


Slow distortion

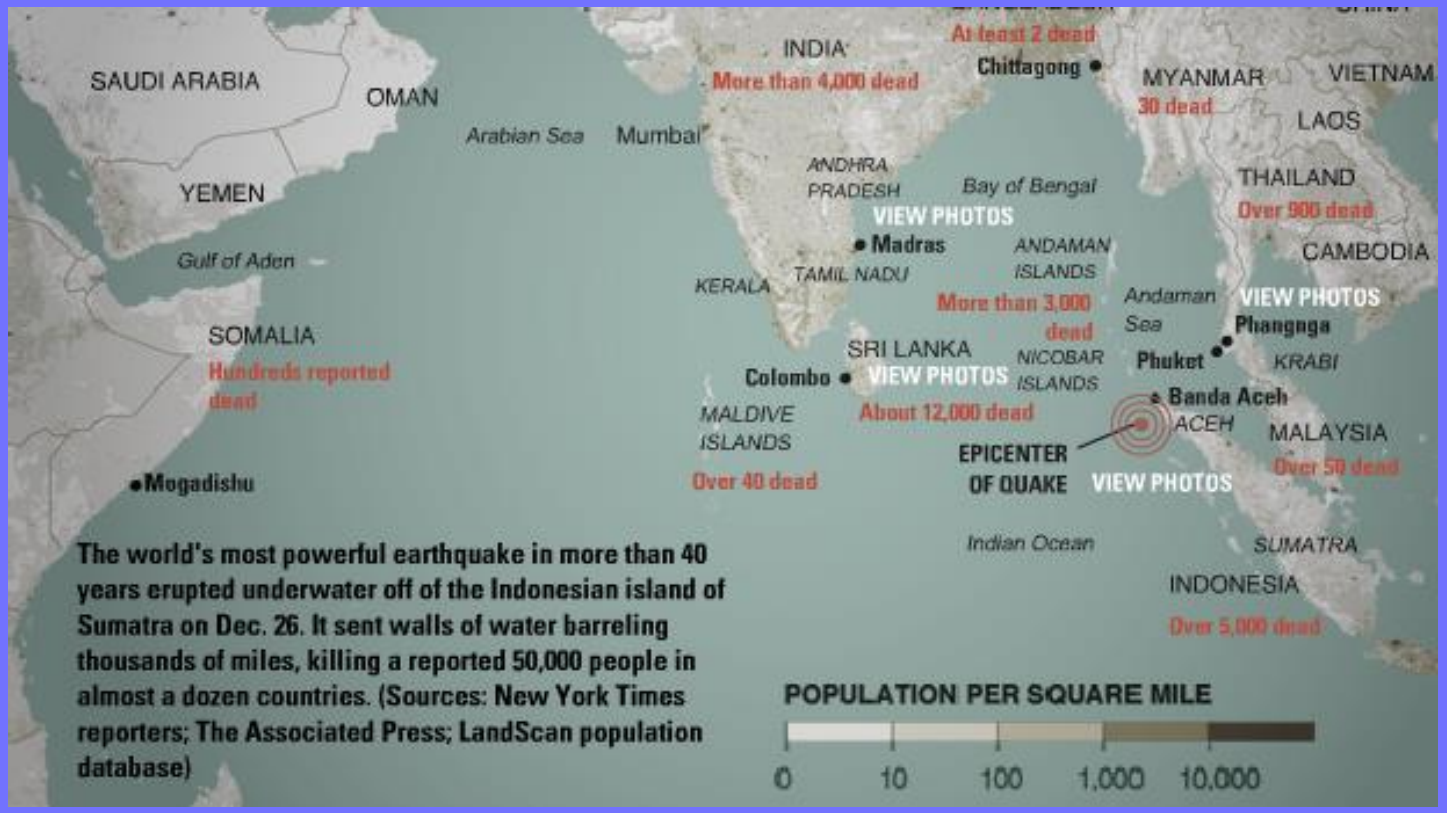

Earthquake starts tsunami
Stuck area ruptures,
releasing energy
in an earthquake


Tsunami
waves spread


Noon
6 p.m.
Midnight
6 a.m.
20
10
0
WATER LEVEL, IN FEET
6
3
0
WATER LEVEL, IN METERS
Tide gauge disabled
Photos
A–C
D
Waves noticed
by fireman
High tide
Low tide
High tide
CHILEAN
TSUNAMI

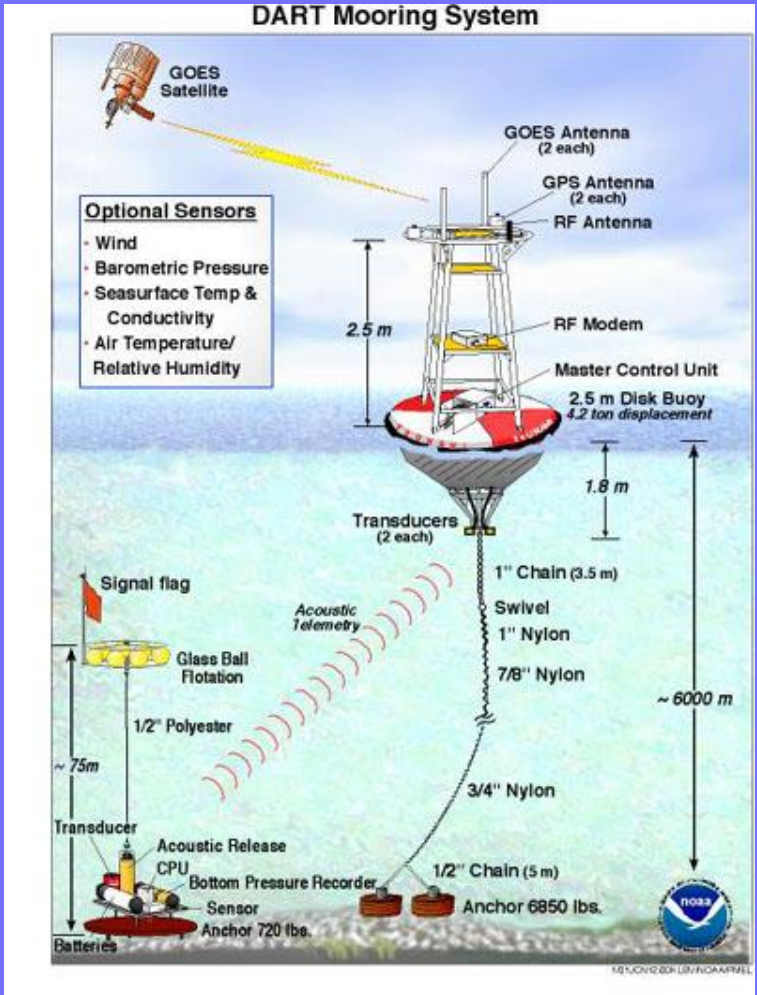

1 HOUR
2 HOURS
3 HOURS
4 HOURS
INDIA
SRI LANKA
INDONESIA
Tsunami

NOAA

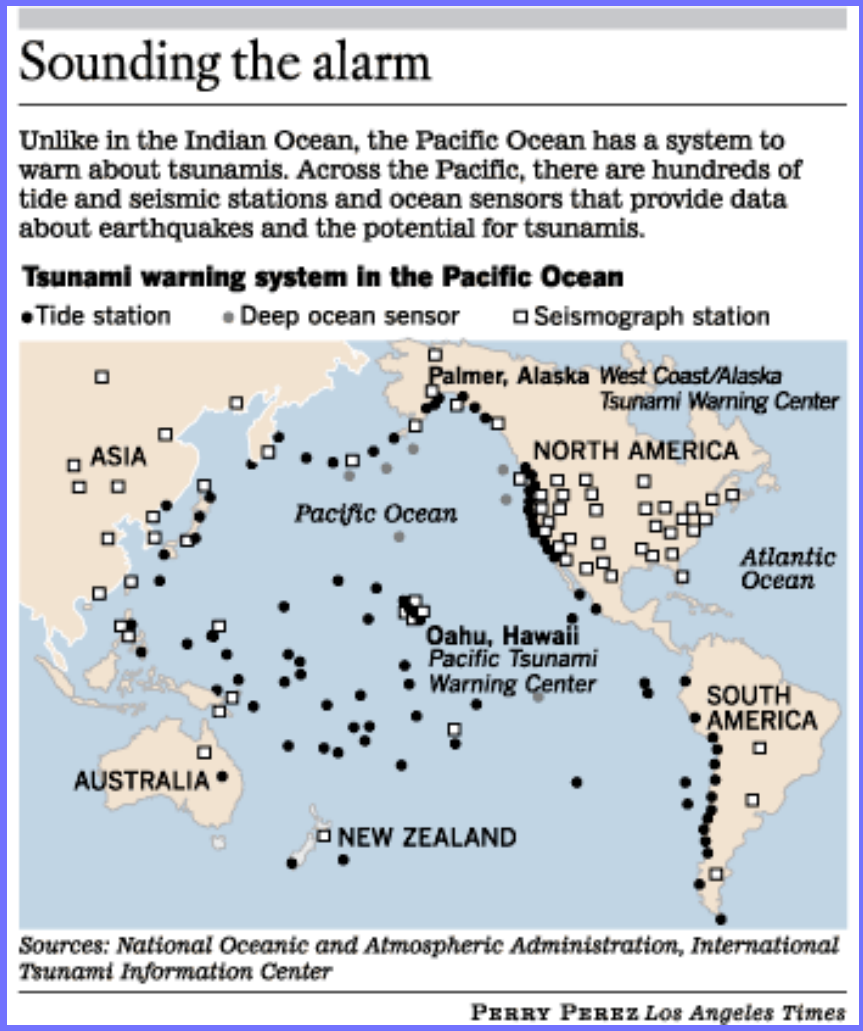

SAUDI ARABIA
OMAN
YEMEN
Gulf of Aden
SOMALIA
Hundreds reported dead
Mogadishu
Arabian Sea
Mumbai
INDIA
More than 4,000 dead
At least 2 dead
Chittagong
MYANMAR
30 dead
VIETNAM
LAOS
THAILAND
Over 900 dead
CAMBODIA
ANDHRA PRADESH
Bay of Bengal
VIEW PHOTOS
Madras
TAMIL NADU
KERALA
ANDAMAN ISLANDS
More than 3,000 dead
Andaman Sea
VIEW PHOTOS
Phangnga
Phuket
KRABI
SRI LANKA
Colombo
VIEW PHOTOS
NICOBAR ISLANDS
Banda Aceh
ACEH
MALDIVE ISLANDS
About 12,000 dead
Over 40 dead
EPICENTER OF QUAKE
VIEW PHOTOS
MALAYSIA
Over 50 dead
Indian Ocean
SUMATRA
INDONESIA
Over 5,000 dead
POPULATION PER SQUARE MILE
0
10
100
1,000
10,000
The world's most powerful earthquake in more than 40 years erupted underwater off of the Indonesian island of Sumatra on Dec. 26. It sent walls of water barreling thousands of miles, killing a reported 50,000 people in almost a dozen countries. (Sources: New York Times reporters; The Associated Press; LandScan population database)


アレトラック
MIYAKO

TSUNAMI WARNING



Deep ocean buoys can measure wave heights, verify tsunami and reduce false alarms



Because seismic waves travel much faster (km/s) than tsunamis, rapid analysis of seismograms can identify earthquakes likely to cause major tsunamis and predict when waves will arrive