Tides and Currents

INTRODUCTION:

OBJECTIVES:

- Define and describe how currents are formed.

- Define the following terms as they relate to currents:
    1. Coriolis effect
    2. Coastal current –
    3. Longshore current
    4. Riptide
    5. Gyre
- Name and locate geographically the following major currents:
    1. North Atlantic Gyre
    2. Gulf Stream
    3. North Atlantic
    4. Canary Current
    5. North Equatorial Current
    6. California Current

- Describe what tides are and what causes them.

- Summarize how we predict tides and discuss why.

- Examine the way tides are measured and describe the equipment used.

- Define the following terms as they relate to tides:

    1. Ebb
    2. Flow
    3. Centrifugal Force

CURRENTS

1. How are currents formed?

    a) There are three main reasons for the occurrence of ocean currents:
        1. The density of seawater varies from place to place, because the salt content is not the same everywhere. Water flows from the regions of higher density to regions of lower density thus producing currents.

        2. Sun's rays fall on the surface of the sea at different angles and produce unequal heating. This generates' convection currents' in the sea.

        3. Winds blowing on the sea surface push water into current. Currents are also caused by the rotation of the earth.

2. Coriolis Effect
    a) The earth's rotation produces clockwise currents in the northern hemisphere.
    b) The earth's rotation produces counter clockwise currents in the southern hemisphere.

3. Coastal Current – Gulf Stream
    a) Amongst the currents, the Gulf Stream is the most important. This stream flows from the Gulf of Mexico northwards to Canada like a river in the middle of the Atlantic Ocean.

4. Major currents
    a) Pacific North equatorial current.
        1. Japan current
        2. North Pacific current
        3. California current

    b) Atlantic, North equatorial current.
        1. Gulf Stream
        2. Canaries current

5. Longshore Current
    a) Develop when the waves are not at a 90-degree angle to the beach. They develop on long and straight beaches.
    b) These currents carry loose sand grains down the shore and deposit them in slow moving areas.

6. Nearshore Current
    a) Created when waves hit the beach at 90-degree angles. These currents flow perpendicular to the beach in the seaward direction. They are very strong and narrow.
    b) They can also carry away large quantities of sand.

7. Riptides
    a) A riptide is an in-shore current running out to sea.
    b) It occurs when wave/tidal action creates a buildup of water between the shore and a submerged sandbar offshore
    c) When excess water reaches a maximum volume it finds a weal spot or low point in the sandbar and rushes out through that low point and quickly dissipates in the deeper water just outside the submerged sandbar.
    d) The strength of the current can vary from weak to very strong and can form very suddenly.

Tides

1. Ask the following questions. What are tides? What causes tides?

2. Tides explanation.

   a) Tides are the periodic rise and fall of a body of water.

   b) The gravitational forces of the sun and moon cause tides. The tides in the upper reaches of the Bay of Fundy can rise and fall over 16 meters (50). This is an extreme case.

   c) The sun exerts a gravitational force 180 times stronger than the moon because of its size, but the moon is much closer, so its force across Earth's diameter is twice as strong as the sun's.

   d) As the moon exerts its force on the Earth, both the Earth and its waters respond by speeding toward the Moon; however, the fluid waters on the side facing the Moon being closer to the gravitational force, speed up more and fall ahead of the Earth causing a high tide.

   e) The positioning of the sun and moon also has an effect on the height of the tidal swell. During a new or full moon phase, the sun and moon are in line, pulling on the earth's surface. This creates a higher level of tide, called the "spring tides".

   f) During a first and last quarter moon phase, when the sun and moon are at right angles to the earth, a lower high tide results. These are called "neap tides".

   g) Another factor is centrifugal force. Centrifugal force pushes outward from the center of rotation. The earth and the moon, orbiting the sun together, form a single spinning body, with a center of rotation inside the earth. In most places the moon's gravitational pull counteracts the effects of centrifugal force on the ocean.

3. How do we predict tides?
   a) NOAA collects data from a network of tide gauges, measuring stations and automated buoys up and down the U.S. coastline. They use this information to predict tide time, heights, speeds and currents.

4. Why do we predict tides?
   a) Tides touch all who sail the sea and live along its shore. Mariners rely on tide tables to steer safely into ports or to avoid shallow areas. Engineers consult tide tables when building bridges or shallow structures. Families buying a beach house, fisherman looking for fish, ecologists, weather forecasters.

5. Beach experiment:
   a) As soon as you arrive on the beach, break students into teams.
   b) Have each team place a stake at the tide line.
   c) At the end of the beach session, have the students measure the difference between the stake and the present tide line.
   d) Discuss your findings.