

## Course Evaluations

- Please pick up:
  - One white question sheet
  - Two bubble sheets:
    - One labeled “BLOOMFIELD Evaluation”
    - One labeled “NOEL Evaluation”
- Respond to the questions, using bubble sheets
- Write comments on the white question sheet
- Place sheets in the plastic drop box

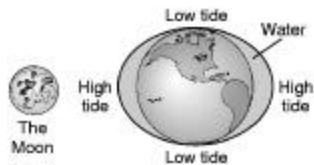
## Question:

You are floating motionless in an inner tube. You are near a beach but far enough from the shore that waves aren't breaking on top of you. You will

1. Drift toward shore at the speed of the waves
2. Drift gradually toward shore
3. Circle as waves pass but not progress toward shore

## The Tide 1

- The moon's gravity acts on the earth
- The moon's gravity isn't uniform
- The earth's oceans are pulled out of round

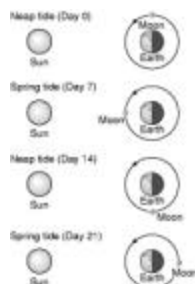


## The Tide 2

- There are two tidal bulges in the oceans
- As the earth rotates, these bulges shift
- Almost 2 high and 2 low tides per day
- Strongest tides near equator
- Weakest tides near poles

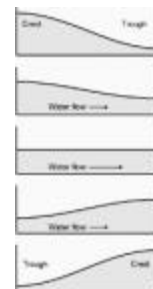
## The Sun's Influence

- Sun's gravity influences tides
- Strongest tides when moon and sun are aligned
- Weakest tides when moon and sun are at right angles



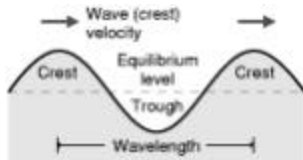
## Tidal Resonance

- Water in a confined channel can slosh back and forth
- It's another harmonic oscillator
- The period depends on the inertia divided by the restoring force
- If the sloshing time matches the tidal period, resonance occurs



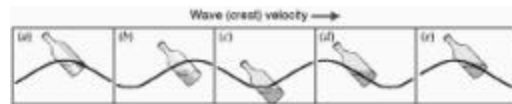
## Water Waves

- Sloshing involves deep water waves: the whole liquid moves back and forth
- Surface waves only affect the liquid's top



## Water's Motion

- The water circles as the wave passes
- Circling is strongest at top
- Circle is small about 1 wavelength below the surface



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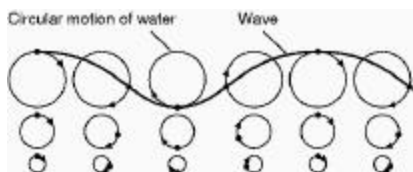
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## Wavelength

- The longer the wavelength of a surface wave:
  - The faster it travels
  - The deeper it moves water
  - The more energy it usually contains
- Tsunamis are very long wavelength, very deep, very high energy waves

## Water in a Wave

- Only the wave travels, the water circles
- Crests are formed from local water



## Breaking Waves

- Surface waves slow down in shallow water
- Waves bunch as the water gets shallower
- Waves get taller as the water gets shallower
- Waves break when water can't form crest
- Gradually sloping bottom: rolling surf
- Steeply sloping bottom: plunging breakers

## Surfing

- Waves act as moving ramps
- Forces on a surfer:
  - Ramp force (Downhill)
    - Buoyancy
    - Weight
    - Lift
  - Drag force (Uphill)
- Net force is zero during steady surfing

## Changing Wave Speeds

- Reflection
  - Wave speed changes cause partial reflection
  - More abrupt changes cause more reflection
- Refraction
  - Wave speed changes can redirect wave
  - Waves bend toward shore as they slow