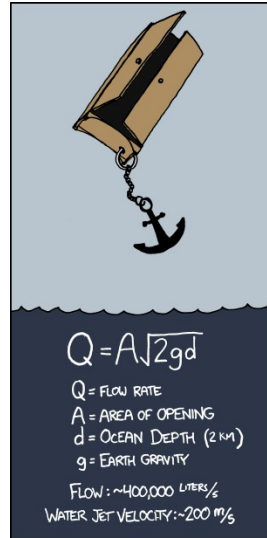November 7, 2012   Physics 131   Prof. E. F. Redish

■ **Theme Music:**
    Sade
       Flow

■ **Cartoon:**
       Randall Munroe
    XKCD

$$Q = A\sqrt{2gd}$$

Q = FLOW RATE
A = AREA OF OPENING
d = OCEAN DEPTH (2 KM)
g = EARTH GRAVITY

FLOW: ~400,000 LITERS/s
WATER JET VELOCITY: ~200 m/s

THE WHITE WITCH DIDN'T
KNOW WHAT HIT HER.

11/7/12   Physics 131   **1**

Quiz 7

	1	2.1	2.2	3
A	0%	7%	**33%**	7%
B	7%	**93%**	**100%**	**80%**
C	**33%**	0%	7%	0%
D	**47%**	0%	0%	0%
E	7%	0%	0%	13%
N	7%	0%	0%	0%

Quiz 7

Avg. = 6.7
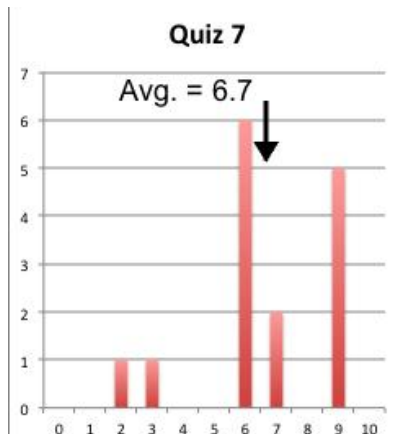
11/7/12   Physics 131   **2**

Foothold ideas: Surface tension

- Due to the intermolecular interactions holding a liquid together, the surface of a liquid experiences a tension.
- The pull across any line in the surface of the liquid is proportional to the length of the line.

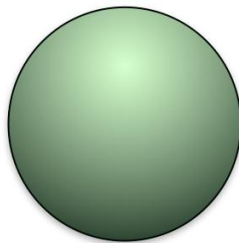$$F_{\text{surface tension}} = \gamma L$$
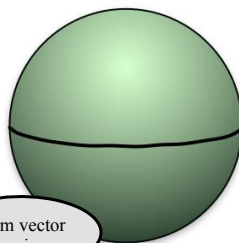
11/5/12   Physics 131   **3**

Laplace Bubble Law

Consider a bubble

Now consider its top half

What forces act on it?

From vector averaging

$$F^{\uparrow}_{\text{air pressure inside}\rightarrow\text{top half}} = \tfrac{1}{2}pA = \tfrac{1}{2}p(2\pi r^2) = \pi p r^2$$
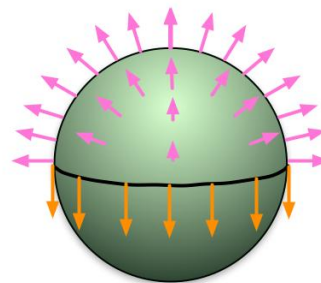
$$F^{\downarrow}_{\text{s.t. of bot half}\rightarrow\text{top half}} = \gamma L = \gamma(2\pi r) = 2\pi\gamma r$$

Force from pressure inside (up) must cancel pull of surface tension from the bottom half (down)

$$p = \frac{2\gamma}{r}$$

SMALLER bubble has bigger pressure!

11/5/12   **4**