All the water that will ever be is, right now.

- National Geographic 1983
When the well is dry, we learn the worth of water
- Benjamin Franklin
Forest Water Resources – 5 Questions

Where does water come from/go?
What does water carry?
How does water affect forests?
How do forests affect water?
How do we affect both?
Fill in the Black Box

How we get water in our homes

I don't have any information on this bit
Course Administrative Debris

• Instructor:
  – Dr. Matt Cohen (mjc@ufl.edu)
  – 328 Newins-Ziegler Hall
  – (352) 846-3490

• Website:
  – http://sfrc.ufl.edu/eco hydrology/fwr.html

• Textbook(s) [recommended]
  – Marston Science Library Reserve
  – Class handouts
Grading

- Two Tests (46% of total grade)
  - Midterm [In Class]: 23%
  - Final [Take Home]: 23%
- Term Paper Assignment (15% of total grade)
- Lab Assignments (30% of total grade)
  - Reports due 1-week after assigned
  - Total of 6 labs each worth 5 points
  - LAB TODAY January 6th (optional Excel Tutorial...bring a laptop)
- Attendance
  - Unannounced quizzes (3 @ 3% of grade each)
  - Missing any lab section without prior approval will reduce your lab grade by 5%
Introductions...

• Name, Major, Birthplace
• Favorite water-y place
• How many liters of H₂O to make a 12 oz beer?
Water Footprint

• 1 12 oz beer – 74 L (19.5 gal)
• 1 lb of butter – 2520 L (665 gal)
• 1 orange – 80 L (21 gal)
• 1 lb of corn – 555 L (146 gal)
• 1 lb leather (one pair shoes) – 7770 L (2045 gal)
• 1 egg – 196 L (51 gal)

• US average – 2,842,000 L/yr (750,000 gal/yr, 2050 gal/d)
  – Mean direct water use ~ 200 gal/d
• Global average – 1,385,000 L/yr (364,000 gal/yr, 999 gal/d)
Quiz #1 – True/False

1. Water contracts when it freezes.
2. Water has a high surface tension.
3. Condensation is water coming out of the air.
4. More things can be dissolved in sulfuric acid than in water.
5. Rainwater is the purest form of water.
6. It takes more energy to heat water at room temperature to 100 °C than it does to change 100 °C water to steam.
7. If you evaporate an 8” glass full of water from the Great Salt Lake, you’ll end up with about 1” of salt.
8. Sea water is slightly basic, natural rain water is ~100x more acidic.
9. Raindrops are tear-shaped.
10. Water boils at 95 °C at Denver, Co.
Key Water Facts - #1: Temperature vs. Density

• Water shrinks as it cools UNTIL 4 °C when the trend reverses.

• Ice is lighter than water
  – Imagine the implications if this wasn’t true
Key Water Facts - #2: Capillarity

• Water has the highest surface tension among common liquids (Hg is higher)

• Capillary rise is based on surface tension
  – How far water rises in a tube
  – Major implications for plant-water interactions

2: Water has high surface tension [TRUE].
Key Water Facts - #3: Relative Humidity

- The quantity of water that can reside *in vapor form* in the air changes with temperature
- Fundamental to the hydrologic cycle
  - If all water in the atmosphere were to condense suddenly, it would yield only 1” of water over the globe
Key Water Facts - #4:
The Universal Solvent

• Water dissolves more materials than any other known liquid

• Fundamentally important for:
  – Geological processes
    • Weathering, Solute Movement
  – Biological processes
    • Nutrient transport, salt transport, cell metabolism
  – Ecological processes
    • Ecosystem nutrition
    • Salt removal

• Caused by charge (polarity) due to molecular geometry

4: More things can be dissolved in sulfuric acid than in water [TRUE].
5: Rainwater is the purest form of water [FALSE].

Key Water Facts - #5: Rain Contains Impurities

- Rain contains impurities
  - $\text{H}^+$
  - Carbonates (hardness)
  - Nutrients (N, P, Ca, K...)
  - Salts
  - Pollutants
  - Dust
  - Viruses
- Not much (0.001%)
- A **key** component of forest nutrition
Key Water Facts - #6:

Phase Transitions (Latent Heat)

- Water has 3 phases at normal temperatures
- ~5.4 x MORE energy required to convert water at 100°C to steam at 100°C than to raise the temperature of liquid water from 0°C to 100°C
  - Note: We measure energy in Joules (J) which is the energy required to raise 1 g of water by 1°C.
- Major implications for the energy budgets of ecosystems
  - Nearly 50% of the solar energy absorbed by the globe is moved to the upper troposphere in the form of water converted to vapor form
Latent Heat (way important)

100°C

100 cal/gm
418.6 kJ/kg
to heat water
0°C to 100°C

melting ice

0°C

phase change

heating ice

100°C vaporizing water

phase change

boiling point heating steam

Heat of vaporization
539 cal/gm
2260 kJ/kg

79.7 cal/gm Heat of
334 kJ/kg fusion

Energy added at constant rate
Key Water Facts - #7: Water Holds Salts

- Water is saturated at 27% (by mass) as salt
- Most water globally does (~3.5% by mass; 35‰)
  - Dead Sea (300‰)
  - Great Salt Lake (200‰)
- Freshwater mostly does not
  - Fresh is < 0.5‰
  - Floridan Aquifer (10 ppm or 0.01‰)

7: If you evaporate an 8” glass full of water from the Great Salt Lake, you’ll end up with about 1” of salt [TRUE]
Key Water Facts - #8:
Rainwater is Acidic; Seawater is Basic

- The sea has pH ~ 8
- Deionized water has pH = 7
- Rainwater (normally) has pH ~ 5.5
  - Presence of CO₂ creates carbonic acid
- Rainwater (acid rain) may have pH ~ 4

8: Sea water is slightly basic, natural rain water is ~100x more acidic. [TRUE]
9: Raindrops are tear-shaped. [FALSE]

Key Water Facts - #9: Rain Drops are Round

• Water has high surface tension
  – Round in the absence of differential pressure
  – Shaped by contact with other objects
    • Air
    • Faucet

• Just FYI

[Diagram showing raindrop shapes: 1 mm, 2 mm, 3 mm, and ≥4.5 mm]
Key Water Facts - #10:
Phase Transition Relies on Pressure

- More pressure = more air molecules per unit volume
- More molecules = more collisions
- More collisions = Reduced escape
- Boiling = 100 °C (at sea level), 95 °C (1,600 m), 90 °C (3,200 m)
Next Time...

- Hydrologic Cycle
- Watersheds
- Water Budgets
- Assignments:
  - Read Syllabus
  - Consider why river networks look like trees (dendritic from Latin word for tree “dendron”)

- Additional Content
- Title: "Next Time..."
- Subtitle: "Hydrologic Cycle, Watersheds, Water Budgets"
- Assignments:
  - Read Syllabus
  - Consider why river networks look like trees (dendritic from Latin word for tree “dendron”)

- Visuals
- Image of a tree against a misty background
- Image of a river network from above