Which of the following is required for all life?

a. Air  
b. Organic nutrients  
c. Vitamins  
d. Oxygen  
e. Water

Because:
- Digestion: Lactose $\xrightarrow{\text{H}_2\text{O}}$ Glucose + galactose
  
Because:
- Digestion
- Movement across membranes

Because:
- Digestion
- Movement across membranes
- Solvent

Polarity

- Solvent
- Surface tension
Because:

- Digestion
- Movement across membranes
- Solvent
- Freezing

When H₂O freezes…

It expands.

Hydrogen bonds

- Surface tension
- Solvent
- Freezing

Isotonic Environment

Iso: equal
Is it worth it?

<table>
<thead>
<tr>
<th>Bottled spring water</th>
<th>Hetch Hetchy system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>25 ppm</td>
</tr>
<tr>
<td>Magnesium</td>
<td>0.73</td>
</tr>
<tr>
<td>Potassium</td>
<td>0.67</td>
</tr>
<tr>
<td>Sodium</td>
<td>8.3</td>
</tr>
<tr>
<td>pH</td>
<td>7.2</td>
</tr>
<tr>
<td>Chloride</td>
<td>10</td>
</tr>
<tr>
<td>Dissolved solids</td>
<td>44</td>
</tr>
<tr>
<td>Pharmaceuticals</td>
<td>0/100</td>
</tr>
<tr>
<td>Coliform bacteria</td>
<td>&gt;500/100 ml</td>
</tr>
</tbody>
</table>
Water

What do you do with it?

Water and The Future

Water Use

How much water?

0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

Surface
Ocean
Ice
Ground
Atmosphere

Surface
Ocean
Ice
Ground
Atmosphere
Is available for us?

Hydrologic Cycle
Which is more productive?

Winter

Spring turnover
Oligotrophic or eutrophic?

Is it renewable?

Water
Water

**Eutrophication**

Biochemical Oxygen Demand

**NH₂, NO₂⁻ and PO₄³⁻**

**JAN FRANCISCO**

*Algae bloom kills Stow Lake carp*

Good news to San Francisco appears to be bad for the carp in Golden Gate Park’s Stow Lake, where about a dozen of the big fish have been found belly-up this week.

Phil Rice, an environmentalist familiar with the park, proposed the cause is a phytoplankton bloom. The lake’s bottom is not deep, and the lake is warm this time of year, conditions that increase the rate of chemical reactions and algal growth.
Biochemical Oxygen Demand

World Wetlands Drained

World Wetlands Drained

Algae bloom kills Slow Lake carp

Good morning. It seems that the carp in the Golden Gate Park’s Slow Lake, where about a dozen of the big fish are living, have been killing off this week. Prof. John, an environmentalist, said that the fish are in a good state. However, the water is becoming more toxic due to the algae bloom. It is a problem that needs to be addressed as soon as possible.

World Wetlands Drained

World Wetlands Drained

World Wetlands Drained

World Wetlands Drained
Tulare Lake, 1883

“From Tulare Lake come the turtles that make the rich turtle soups and stews of San Francisco hotels and restaurants. It is a western pond turtle common in the fresh water ponds.”
What did we do with it?

Tulare Lake, now

San Francisco Bay

What did we do with it?

San Francisco Bay

Filled in
Remaining historical wetlands
Current wetlands
The Balance

- 80% of the precipitation & run-off
- 80% of the need

Boom or Bust

Surface Water

Rain Shadow
"Whiskey is for drinking and water is for fighting"

Water Enough for Fish

Today's agreement marks a victory in California's centuries-old water wars

By Samra Wright McPhail

The California Department of Water Resources and the State Water Resources Control Board said today they have reached an agreement on a multi-billion-dollar plan to improve water management in the state. The agreement includes measures to increase water efficiency and reduce the amount of water wasted by agriculture and urban use. It also calls for the creation of a new water bank to help manage the state's water resources in the future.
What state has a navy?

San Francisco
- Mountain Lake
- Sausalito Water & Steam Tug Company
- Spring Valley Water Co.
- San Francisco Water Dept.

Pinchot v. Muir

Pinchot v. Muir
California Water Plan
Water

All-American Canal

Water is applied to the western San Joaquin Valley, an area with sodium-rich soils. This water plays a crucial role in the valley’s agriculture, helping to grow crops that are essential for the economy. Water is also used to dilute the sodium in the soil, making it ideal for crop production. The All-American Canal, shown in the image, is a significant infrastructure project that transports water from the Kern River to the valley, ensuring a constant supply for both domestic and agricultural needs. This canal not only supports the valley’s agricultural productivity but also contributes to the overall ecological balance of the region.
Los Angeles

- Water colonies
- Owens Valley
- Colorado River Project
- Mono Lake

Owens Valley, Then

Owens Valley, Now

Owens Valley, 1934

“The pioneers, in the sunset of their lives, are again on the trek. Today a man in this valley is closing the store he has conducted for more than 40 years. The man was born here; the store he is closing was started by his father. Now, with his good wife, he is moving on. He is a pioneer once more—a pioneer with his life behind him.”
Water and The Future

What does the Future hold?

• Build more dams

- Habitat destruction
- Global warming
- Short-term solution

What does the Future hold?

• Dams
• Ice Bergs

+ Drinking water
+ Habitat restoration
+ Energy
- Infrastructure
What does the Future hold?

- Dams
- Ice Bergs
- Desalination

Would you drink this H$_2$O?
What does the Future hold?

• Ice Bergs
• Desalination
• Reclaimed water

+ Drinking water
+ Habitat restoration
+ Eliminate water pollution
+ Energy supply

Current Events

Water Rights
1. Arizona v. California
2. Farmers v. ducks & fish
3. Energy v. fish
4. Middle East

Water Scare Countries

• “Egypt will never go to war again, except to protect its water resources.”
• “Jordan will never go to war with Israel again except over water.”
• “The next war in the area will be over water.”