**Introduction to Oceanography Lecture Notes**

*Uses of the Ocean and Reasons to Study the Ocean: A Brief Historical Survey*

**Major Uses of the Ocean**

1. Oceanography really began in the late 1800’s when scientists in different fields (physics, chemistry, biology, geology, etc.) began to realize that they needed to work together to understand the ocean to answer questions and solve problems.

Example: Why is life in the ocean more abundant in some places than in other places?

   Biology & Chemistry:

   Geology: *soils*

   Physics: *ocean currents*

Oceanography is not marine biology! In addition to ocean life, we will study waves, tides, hurricanes, climate, earthquakes, volcanoes, tsunami, beach sand, El Niño, currents, and much more!
Knowledge about the ocean was considered for essential for maintaining the British Empire, the first truly worldwide empire.

Governments began major funding of scientific research – including oceanography – by the early 1930s and 1940s as science became more and more important for fighting and winning wars.

Examples from World War II (What aspects of the ocean needed to be studied in each case?)

Moving troops and supplies quickly, saving fuel:
   ships can be pushed by or have to fight against ______________________________

Landing troops on beaches (e.g., Saving Private Ryan)
   • need beach sand that can support heavy vehicles
   • a high ___________________ so ships can get over underwater obstructions and mines
   • small ___________________ : big ones would knock over troops and landing craft (boats)

Finding enemy submarines with __________________________________________

The military no longer pays for most oceanographic research (though it still pays for a substantial amount, over 25%). Instead, civilian government agencies like the National Science Foundation (NSF) and National Oceanic and Atmospheric Administration (NOAA) are more important.

Examples of Non-Military Uses of the Ocean and Ocean Research

Mineral Resources: Looking for ______________________________.

Living Resources: How many fish can we sustainably catch?
   Discovering new species. Some might make chemicals that can be used to make ________________________.

Environmental issues like ____________________________________________
   that can make swimmers sick or poison our food supply
   Preventing or living with coastal erosion
   Predicting, preparing for, and cleaning up after natural disasters related to the ocean like: ____________________________________________.

As in the past, a lot of people live near the coast because the ocean provides food, an easy way to transport cargo, and a milder climate than farther inland, but this also makes these people more vulnerable to these natural disasters.

   What percentage of the population of the United States lives “near” the coast? _________

Oceanography is a relatively “young” science. There is a lot more to be discovered and understood.
Some Key Concepts and Vocabulary of Oceanography

Maps
Oceanography is a science of maps, diagrams, and pictures.

*Always identify the “point of view” of a picture first.*
- bird’s-eye view (view from above, map view)
- side view (cross-section, profile)

*Always label features:* land, ocean, waves, currents, etc.

Basic Geography of the World
You need to be able to identify:

- the 7 continents:
  - North America, South America, Europe, Africa, Asia,
  - Australia, and ________________
- the 5 oceans:
  - Atlantic, Pacific, India, Arctic, and ________________
- the Poles and the position of the Equator
- the 4 directions (north, east, south, west)
Plankton

Most of living things in the ocean are “plankton,” & most of the biomass in the ocean is “plankton.”

What are plankton? (Algae or animals? What makes an organism “plankton”?)

Phytoplankton

What are phytoplankton?

Photosynthesis

Review Questions

Which of these statements about plankton and phytoplankton are correct?

“Some plankton can swim.”

“Plankton are small.”

“Phytoplankton are plants.”
What Phytoplankton Need

In the ocean, phytoplankton and other algae often have difficulty getting two things that are needed to carry out photosynthesis:

(1)

(2)

Nutrients

− chemicals / molecules in ocean water

− are needed to make the molecular “tools” that carry out photosynthesis (to make “food”): like a hammer is used to build a house, or a spatula is used to make a hamburger

− also needed to make (some) shells

Shells (What substances do ocean algae and animals use to make their shells?)

(1)

(2)

− Origin of Nutrients (Where do nutrients come from? How do new nutrients enter the ocean?)

Thinking Question

Consider the statement: “Phytoplankton eat nutrients.”

In what ways is this statement misleading?
Ocean Animals and Food Chains

Zooplankton (What are zooplankton?)

What gas do animals breathe in?

What gas do animals breathe out?

The (Simplified) Ocean Food Chain

Big fish eat ________________________________.

Small fish eat ________________________________.

Zooplankton eat ________________________________.

Video and Thinking Questions

Phytoplankton and You: How do phytoplankton affect your life?
Thinking Questions: Phytoplankton and the Abundance of Life in the Ocean

“Phytoplankton begin the food chain: they make their own nutrients, and are food for the animals that we eat.”

In what ways is this statement wrong or misleading?

________________________________________________________

“Phytoplankton protect us by breaking down toxic chemicals in the air.”

In what ways is this statement wrong or misleading?

________________________________________________________

Would you expect there to be more ocean life near the surface of the ocean or down deep? Why?

________________________________________________________

Would you expect there to be more ocean life near the coasts or out in the middle of the ocean? Why?
Size and Shape of the Ocean

Size (How much of the Earth’s surface is covered by the ocean?)

Depth (How deep is the ocean?)

Most of the ocean bottom is pretty flat.

- continental shelves: flat areas near the continents (parts of continents that are flooded!)
- abyssal plains: deep, flat areas (about 2 or 3 miles deep)
- continental slopes: steep areas connecting the continental shelves with the abyssal plains

The Mid Ocean Ridge (MOR)
(What is the MOR? What happens at or near the MOR?)

Trenches (What are trenches?
What happens at or near trenches?)
Sediments

Sediments are loose, solid pieces (particles) that settle on the bottom of the ocean, and cover much of the land.

Examples of sediments include: _________________________________________

Kinds of Sediments

(1) (Lithogenous Sediments)

– small ones are moved around by rivers, waves, etc.; large ones are left behind

(2) (Biogenous Sediments)

– includes scales, mucus, fecal pellets, etc. released into the water by organisms

What body part are most biogenous sediments made of?

What substances are these body parts typically made of?

Solid Rock ("Bedrock") of the Ocean Floor:
made of igneous rock (cooled lava) or sedimentary rock (stuck-together sediments)
Winds

Winds are air that gets pushed away from the cold place, and moves in to replace the rising warm air.

Why does the warm air rise?

Why does the cold air sink?

Winds have a big impact on the ocean: they cause waves and currents.

Currents

What is an ocean current?

Describe the motion of the surface currents.

Ocean currents change the ocean environment. For example, ocean currents can bring up or push down nutrients, affecting the amount of life in the ocean. Ocean currents also affect our environment.

How and why do warm currents affect the climate of nearby coasts?

Where does most of our drinking water come from?
**Bacteria**

*Bacteria are single-celled organisms that do not have a “nucleus” to store and protect their DNA.*

What important role do bacteria play in the ocean ecosystem?

How do the actions of bacteria make life even more abundant in the ocean?

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**Humans and the Ocean**

We will look at a variety of issues, including overfishing, coastal development, common ocean pollutants, etc.

What is the most common educational message in the movie *Finding Nemo*?

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**But Wait, There’s More!**

- The Nature of Science: Hypotheses, Theories, & Observations
- Water Chemistry (the Chemistry of Life): What’s so special about water molecules?
- Waves, Beaches, and Tides
- Coral Reefs, Kelp Forests, & Deep-Sea Life
- Tsunami, Hurricanes, & El Niño
- Plate Tectonics (e.g., Earthquakes and Volcanoes)
- Global Warming, the Greenhouse effect, & Pollution
Review Questions

“The middle of the ocean is the deepest part of the ocean.”

a. True  
b. False

What are the 2 major kinds (categories) of ocean sediments?

a. Bits of Rock  c. Iron  e. Salt  g. Shells
b. Calcium Carbonate  d. Mud  f. Sand  h. Silica

“Most of our drinking water comes from the ocean.”

a. true: we remove the salt (desalinate it)  
c. false: most from underground aquifers
b. true: naturally evaporates from the ocean, and then falls as rain  
d. false: most from ice/snow melting up in the mountains

How do most new nutrients enter the ocean?

a. rivers & rainwater runoff  
b. sewage & storm drains  
c. waves & tides  
d. winds