Hydrological cycle
Earth is an ocean planet:
Majority of the water on Earth is contained in the ocean (OLP #1);
Water on the planet cycle through different processes and spend some time in the ocean (OLP #1, 3);
These processes have significant implications on weather and climate (OLP #3).
Life on earth evolve from the ocean (OLP # 2)

Water Budget: Past, present, and future
Sea level changes over times and there are regional differences (OLP #1)
There are multiple factors to affect sea level e.g., time in earth history, global climate, atmospheric pressure (OLP # 1)
Changes in sea level we experience now have significant implications on human lives (OLP #3, 6)

Ocean Basins and sediments
Main ocean basins on earth are connected (OLP : #1)
The ocean basins are constantly evolving (plate tectonics) (OLP: #2)
Tectonic movement is one of the ways through which rocks are formed; there are other pathways of rock formation. (OLP #2)

Plate tectonics, earthquakes, and tsunami
Tectonic movement though is a slow process but could have significant implications for human lives (earthquake and tsunami, OLP #6)) and there are networks to monitor them (OLP #7)

Hydrothermal vents and vent chemistry
<< In class exercise with the Neptune Project to look at vent colony live in HD>>
Hydrothermal vents, cold seeps, and whale falls created oasis in the deep sea
Scientists are still finding these special sites and have lots to learn about them (OLP #7)
One of the ways to locate these sites is to study the chemistry signature of the "vent plume", and these are suggested to be analog of early life on earth and other planet (OLP #3, 7)
It is still unclear how organisms disperse among and adapt to these special environments (OLP #5)

Physical properties of sea water
<< In class activity on melting ice>>
Water density is affected by both temperature and salinity (OLP #1)
(idea of stratification, mixing depth, and the use T/S diagram to distinguish water mass)

Thermohaline circulation
Difference in density drives global circulation (OLP #1)
Without contact with the atmosphere the deep water has unique chemical signature that can be used to identify upwelling water masses
<< In class summative discussion: is "the day after tomorrow possible?">> (OLP #3)

Ocean chemistry I and II
The ocean is a big solute with a variety of salt in it (abundance of major ions) (OLP #1)
Chemical composition differ between water masses
Ocean acidification refers to the process through which excess anthropogenic carbonic dioxide hydrates with sea water (OLP # 3).
Changes in ocean chemistry have significant impact on marine lives and possibly human lives (OLP # 6).

Elements have different isotopes.
Some of these isotopes are “stable” and used differentially by life (enrichment), others are radioactive (decay rate)
These isotopes provide important tool for scientist to study past ocean conditions (OLP #7, 3)
Example of shark aging (Hamandy et al., 2013), penguin diets (Polito et al., 2012)

Zooplankton
Introduction to major type of zooplankton both holoplankton,meroplankton
Plankton are adapted for their drifting lives (OLP #5).

Geochemical proxies
Reminder on some plankton with carbonate shells
Hands on activity on climate reconstruction using isotope signature (OLP #3)

Marine Food Web
Nutrients taken up by primary producer are transferred up the food chain
However, it is a complicated web not just a simple chain (OLP #5)
These interactions have significant impact on biogeochemical cycling (OLP #4)
(homework assignment on box model , as a practice for concept of flux)
Disruption to the marine food web has significant ecological and economic implications (OLP #6).

Ocean and human activities: fisheries and management (OLP #6)
World fisheries and aquaculture role in food production
Fisheries practices on their impact on marine lives (trawling, by-catch, dynamite fishing) → empower students with seafood watch app (home work on diet tracking)
Management practices adopted to ensure sustainable fisheries (ITQs, moratorium, reserves, sustainable indoor fish farming)

Ocean and human activities: pollution and mitigation (OLP# 6, 7)
Coastal pollution (point source and no-point source) could result in eutrophication
These changes in abiotic factor could lead to algal bloom.
Some blooms are termed harmful algal bloom and have significant consequences on human well being.
Monitoring, predictive modeling efforts are on-going to help minimize HAB impact
Discussion: why is HAB on the rise? What are some possible solution ?(Introduction to water treatment in HK)

Ocean and climate change: ocean acidification and hypoxia (OLP #3, 6, 7)
Reading on spreading dead zone impact on tuna
Recap on carbonate chemistry
Hypoxia: formation (pollution, lack of mixing)
Impact of OA and hypoxia on marine lives (sharing on my personal research)

Ocean and climate change: polar seas
Changes in sea ice and consequence on Earth’s climate
Concept check: does changes in polar seas affect sea level?

How does changes in the poles affect marine and human lives? (biogeographic shift, changes in phenology, potential extinction, and also geopolitical debates on NW passage)

Ocean engineering: biofuels and iron fertilization
RECAP on HNLC regions and the effects of iron dust on primary production
Zeng sharing on his research on biofuel

Ocean engineering :AUV, OOI
Virtual tour of sea glider lab at UW
Potential use of these equipment
Recap on basic data analysis using data from Argo float (T-S diagram)