海洋科普實驗室

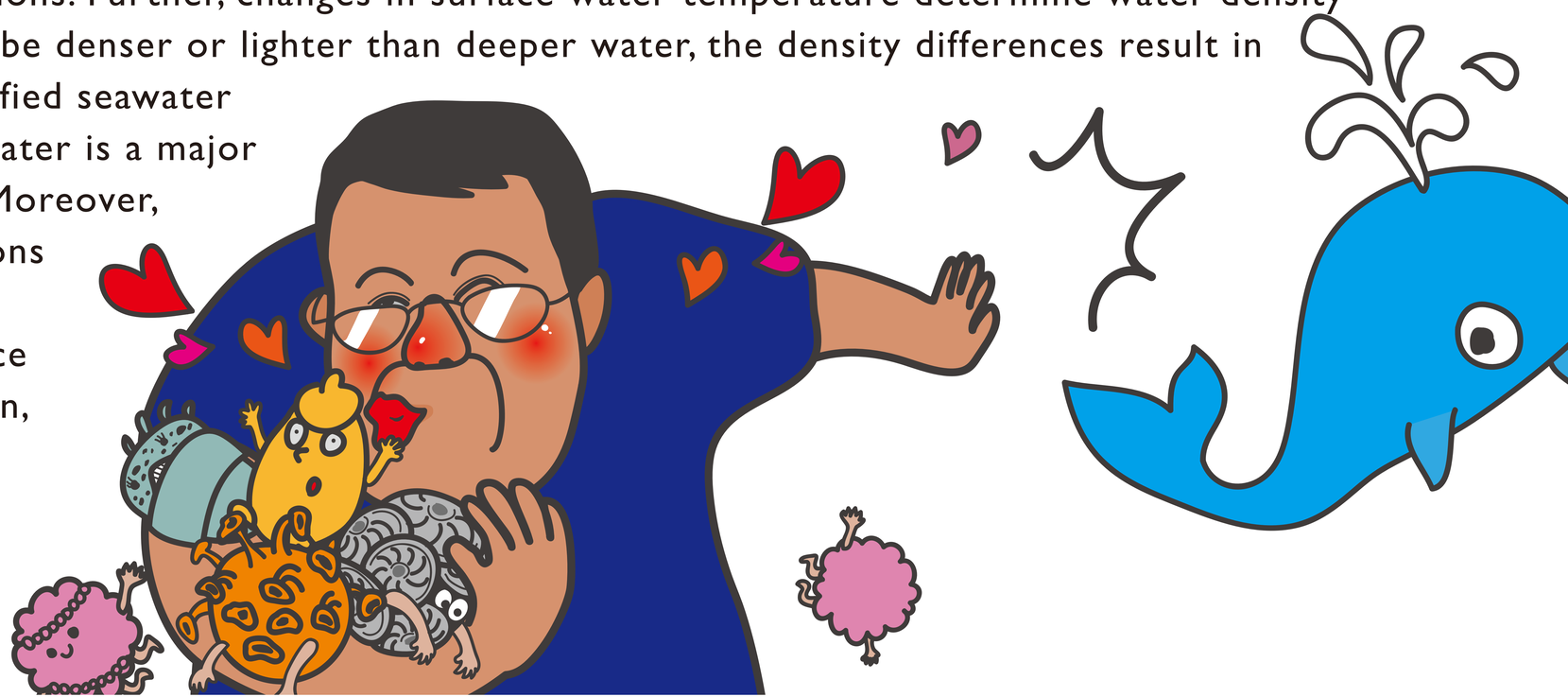
看漫畫學海洋

Learning Oceanography by cartoons

The Content of Oceanography

Dear students and teachers, although whales and dolphins are fascinating, oceanography doesn't focus on the study of fish. In fact, the core of oceanography is actually material and energy cycling processes! Thus, let us use the carbon cycle as an example to explain material cycling processes and the unique multi-disciplinary nature of oceanography.

Currently, one of the most severe environmental issues on the planet is the problem of global warming mainly caused by increasing carbon dioxide. Atmospheric carbon dioxide concentrations have risen over time due to excessive burning (Chemistry) of petroleum and coal by human beings. Because of the molecular absorption spectrum of carbon dioxide (Physics), it is the most important factor in controlling the surface temperature of the planet; further, one of the most important factors in regulating atmospheric carbon dioxide cycling is photosynthesis (Biology). Marine phytoplankton (Biology) accounts for half of the photosynthetic activity worldwide. More importantly, the supply rate (Earth Science) of limiting nutrients (Chemistry) is one of the most important factors in regulating the rapid and dynamic growth of marine phytoplankton (Biology). The factors affecting the supply rate of limiting nutrients are closely associated with climate (Earth Science) and dynamic changes in the movement of seawater and currents (Physics). The other major factor driving material cycling is physical in nature. The effect of physical forces on material cycling starts with the rotation of the earth and the revolution of the earth (Earth Science). Earth's rotation and revolution brings about diurnal and seasonal cycles of daylight and temperature (Physics). These cycles in turn regulate the variations in surface water temperature and sunlight intensity. With the additional influences of the spherical shape of the earth and angle of rotation, surface water temperature and sunlight intensity vary dramatically within the same day or same season in different oceanic regions. Further, changes in surface water temperature determine water density (Physics). Because surface water can either be denser or lighter than deeper water, the density differences result in either the sinking of surface water or stratified seawater layers, respectively. The sinking of surface water is a major driving force for thermohaline circulation. Moreover, wind-driven circulation, caused by fluctuations in sunlight and sea surface water temperature, is the other major driving force of atmospheric and surface water circulation, such as monsoons, winter storms, and typhoons (Physics). On the other hand, wind also affects the movement of surface water (e.g. Kuroshio current) and the



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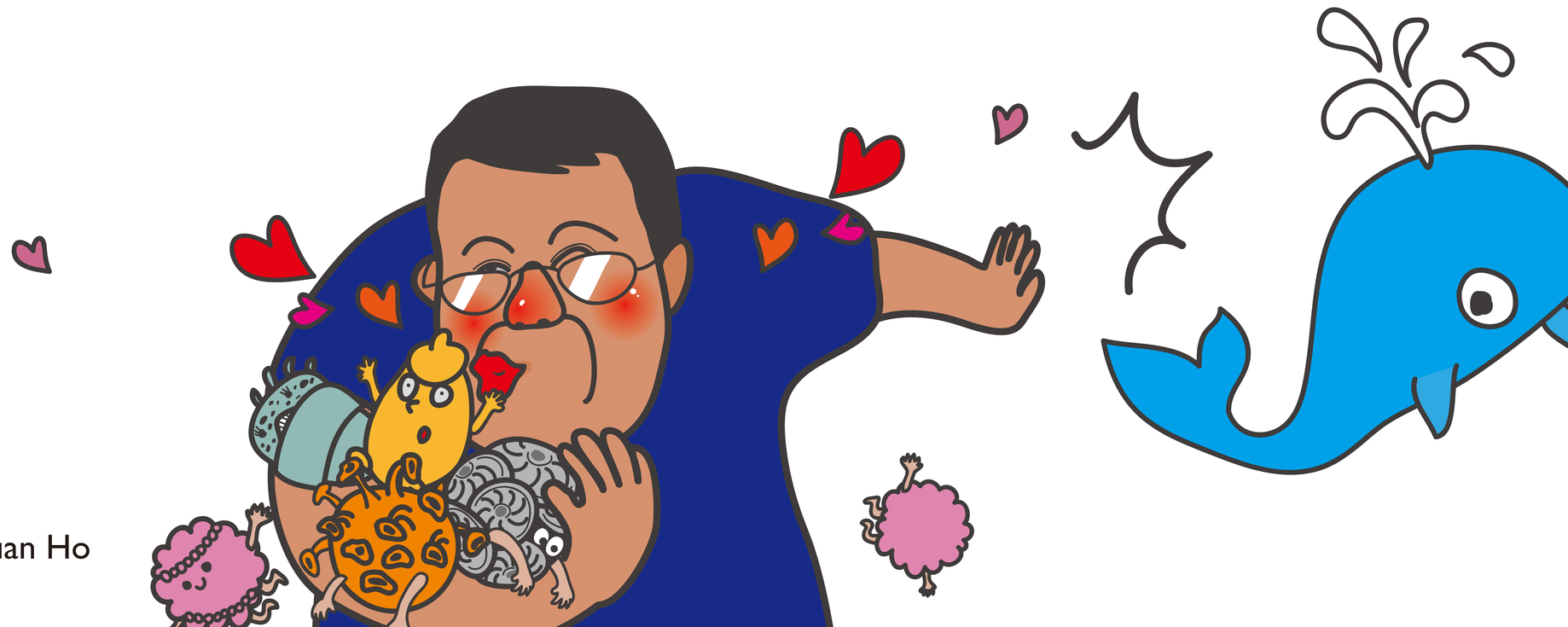
mixing of material in the water. For example, the nutrients in the subsurface water in Kuroshio current is transported to the surface water by physical mixing and the process of upwelling when it encounters a shallower region of the ocean floor (Physics). The mixing and upwelling processes are one of the major causes of biogeochemical reactions in the ocean (Biology). As mentioned above, material cycling in the ocean is closely related to biogeochemical and physical processes. Atmospheric carbon dioxide is also transported to the ocean floor through the photosynthesis and the sinking of organic matter. Microalgae transform carbon dioxide into organic carbon and inorganic carbon shells. Through the process of sinking, both organic and inorganic carbon are transferred to sediment and buried, where they will have to wait until the next mountain uplift event or volcanic eruption (Earth Science) to return to the atmosphere. Moreover, over many decades, carbon dioxide has continuously been dissolving into the surface ocean, resulting in gradual acidification of the seawater (Chemistry). Thereafter environmental conditions for coral reefs and other marine organisms (Biology) have been under great threat. As mentioned in the examples above, it can be seen that material cycling in the ocean is closely connected among the fields of Biology, Chemistry, Physics, Earth Science, and influences global environmental change and climate change.

Therefore, oceanography explores problems on the global scale! Although whales may seem big, their influence on global material cycling is much smaller than plankton! Even though plankton are small, they grow abundantly in rapidly changing communities and are the favorite of Marine Biogeochemists!



Author: Tung-Yuan Ho
Illustrator: Ya-Ling Huang
Translator: Claudia Chern and Tung-Yuan Ho