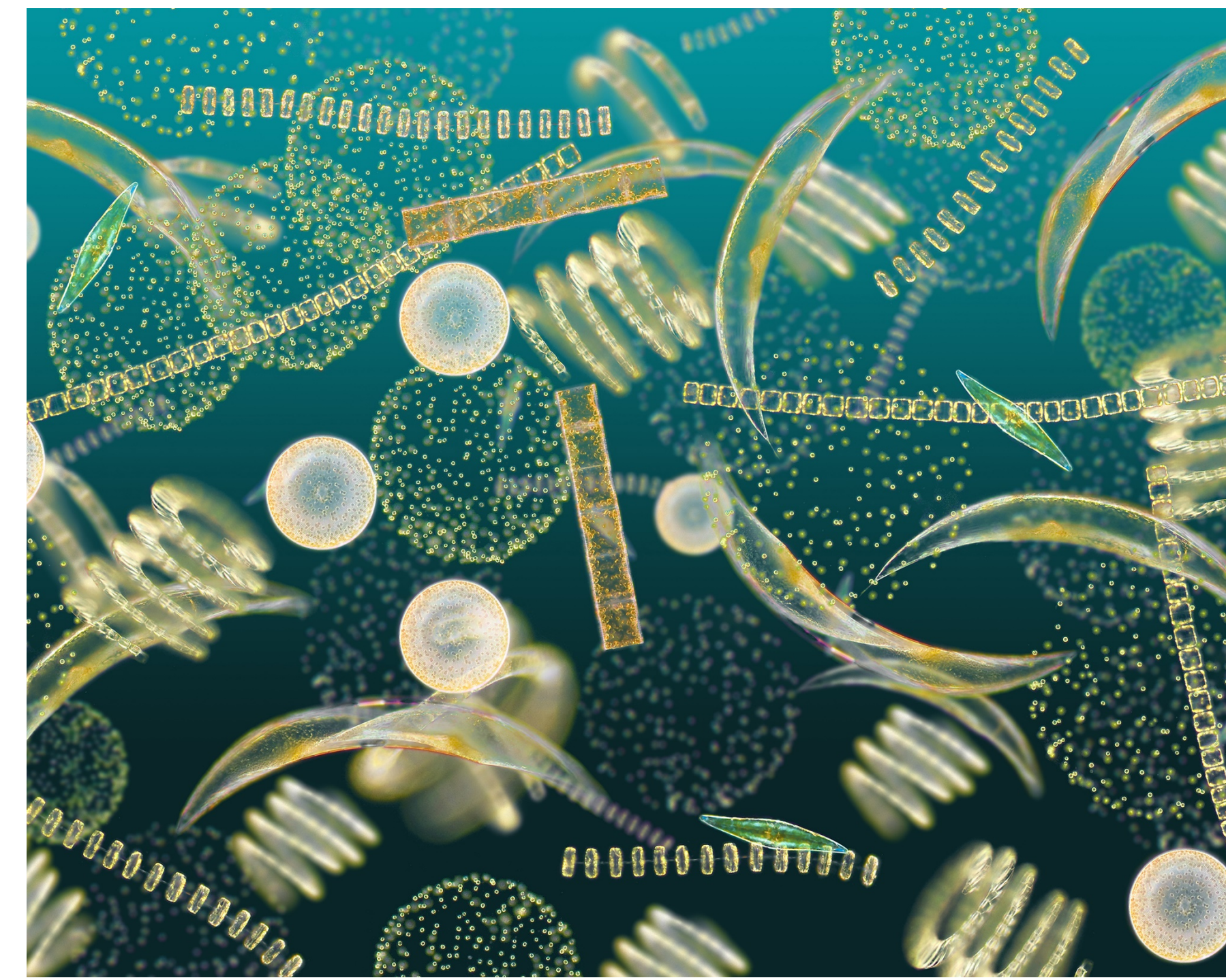


Journey through the marine carbon cycle

Carbon is important to all life on Earth, and is cycled through the planet's atmosphere, land, and oceans. Many different organisms (bacteria, plants, and animals) collectively transport carbon from the atmosphere to the deep sea where it stays locked away for thousands of years. It all begins with the phytoplankton in the sunlit 'photic zone'. Start there and see how far you make it through the different levels of the ocean...

Start here	1	2	3 activity #1	4	5	6	7 activity #2	8	9 going down #1	10
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Welcome to the Photic Zone!

At the surface of the ocean there is lots of sunlight which tiny plants called phytoplankton need for photosynthesis. Illustration: www.secchidisk.org



Which phytoplankton are you?
Take the quiz with NASA!

11
12
13 going up #1

29	28 going up #2	27	26	25	24	23	22	21 going down #2	20	19		18	17	16	15	14
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30



Weird creatures of the Twilight Zone

There are lots of strange animals that live in the deep sea. Do you recognize any in the picture to the left?

Bucklin et al. 2010. *Environmental Science*
Photo credits R.R. Hopcroft and C. Clarke and L.P. Madin

bonus activity

Stop!! Now entering the Twilight Zone!

Here the light starts to disappear so phytoplankton can't survive. When phytoplankton die they leave the photic layer through different pathways, which one will you take?

33 going down #3	34	35 going up #3	36	37 going down #4	38	39	40	41 going up #4	42	43	44
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You made it to the Deep Sea!
Here carbon is locked away for 1000's of years as it travels on deep ocean currents...

45 activity #4				
50	49 going up #5	48	47	46



Photo credit: Woods Hole Oceanographic Institute


Going down...processes that take you deep into the ocean

#1 (box 9): As carbon dioxide you are captured by a diatom during photosynthesis. This phytoplankton sticks together with other diatoms making big particles called aggregates that sink through the water column quickly. **Go ahead to box 14!**

#2 (box 21): You start to stick together with other particles forming big clumps of 'marine snow'. You start to sink even faster...**Go ahead to box 26!**

#3 (box 33): You get consumed by a detritivore! These organisms hang out in the twilight zone eating sinking particles. Those particles get repackaged into even bigger aggregates which sink really quickly. **Go ahead to box 40!**

#4 (box 37): As a particle or a zooplankton, you get eaten by a fish! The fish swims all the way down to the base of the mesopelagic and excrete you as fish poop. You start to sink again...nearly there! **Go ahead to box 48!**

 ***Entering the Twilight Zone!***

Organic matter can make its way through the water column via a number of different pathways. Roll the dice to see which one you take!

If you roll 1-3: You start to stick together with other particles forming aggregates called 'marine snow'. **Continue to box 19**

If you roll 4-6: You are eaten by tiny animals called zooplankton that travel up and down the water column. **Start down the short cut towards box 42**

Going up...processes that slow your progress through the water column

#1 (box 13): As a phytoplankton cell, you die and bacteria in the water start to consume you. They convert you from solid 'organic matter' into a gas. **Go back to box 5 and wait to be captured by a phytoplankton again!**

#2 (box 28): Your big group of particles (aggregate) starts to fall apart and you begin to sink much slower. **Go back to box 19, hopefully there are other particles to stick to!**

#3 (box 35): As an aggregate or a zooplankton, you get eaten by a fish! The fish swims all the way up to the top of the twilight zone and excretes you as fish poop. You start to sink again but it's a long way to go....**go back to box 23.**

#4 (box 41): Bacteria in the water start to change you into carbon dioxide! You then wait to get transported to the surface by deep ocean currents and captured again by phytoplankton. **Go back to box 5!**

#5 (box 49): Not again! Bacteria in the water change you into carbon dioxide and you wait to get transported to the surface and captured again by phytoplankton. **Go back to box 5!**

Activities

#1 (box 3)

Almost all the animals that live in the ocean rely on phytoplankton to provide them with food. That's because they are at the very start of the marine food web. We can see these important microbes from space! Can you guess how?

#2 (box 7)

Phytoplankton, like plants and trees, use photosynthesis to make their food. For this they need carbon dioxide, water and lots of sunlight. As light travels through the ocean how do you think it will change? Try on the different glasses to find out!

#3 (box 31)

The picture on the right has lots of deep sea organisms in it, can you name any?

#4 (box 45)

The size of a particle or aggregate makes a big difference to how fast it sinks through the water column. Can you think of anything else that will affect how it sinks? Make your own aggregates with different materials to see how fast or slow they sink.

#5 (bonus activity)

The twilight zone is dark and cold, with very high pressure. The animals that live in these challenging conditions have adapted special features to survive. Can you think of any ways they have done so?