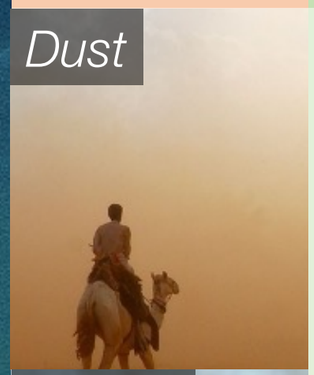
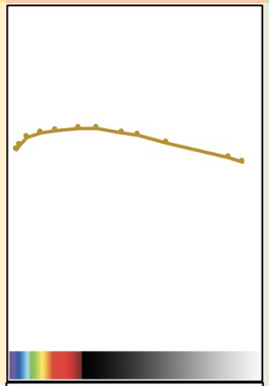
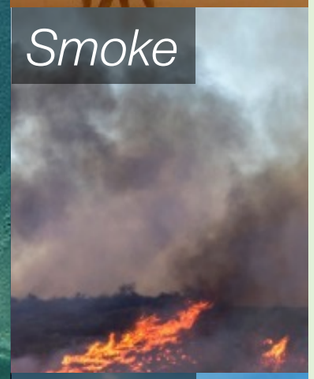
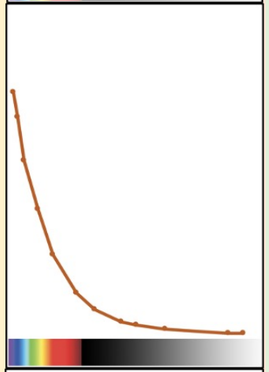
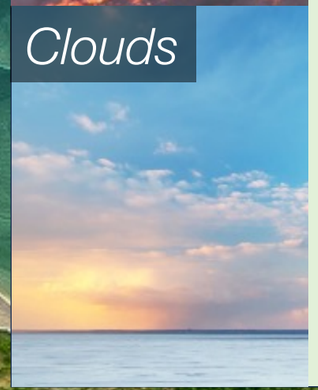
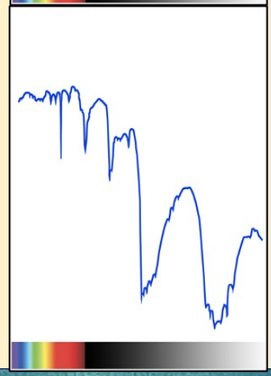
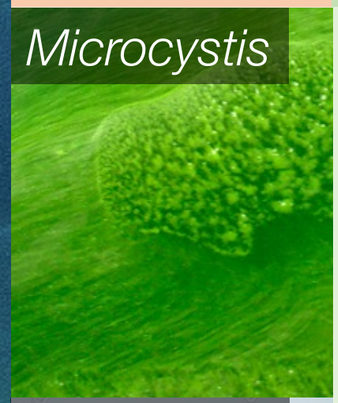
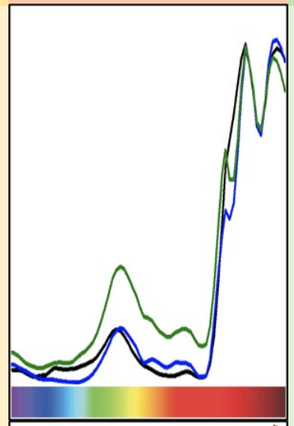
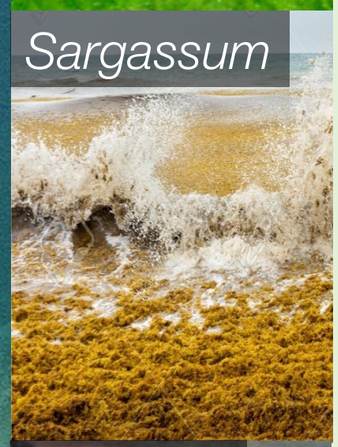
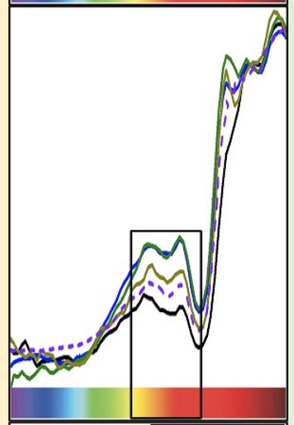
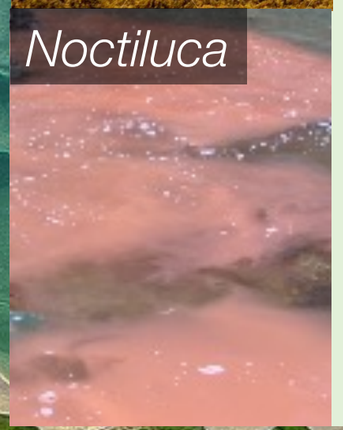
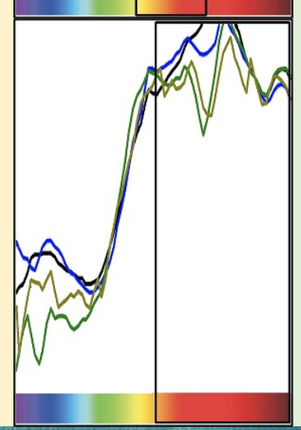
PACE Card Matching Game

Hi, volunteers! Each time a player finds a matching pair of cards, read the information for that matching pair under the corresponding round that you are on. The *Details on the Spectra* column contains supplementary information about spectral signatures.

Type of Matter	Round 1: What will PACE help us better understand? (A lot!)	Round 2: Which type of data will PACE collect? (Spectra!)	Round 3: How will scientists analyze PACE data? (Matching!)	Spectra	Details on the Spectra
Dust 	Dust can travel thousands of kilometers – even across ocean basins. Organisms in the ocean located far from rivers can use the nutrients delivered by dust to grow. On the other hand, humans and animals can suffer respiratory issues when dust particles are inhaled.	Dust reflects strongly over a wide range of the electromagnetic spectrum from visible (left) to infrared (right) wavelengths. Dust is found where soil is blown loose by the wind, such as deserts and dry lake beds or glaciers. Reflectance values are relatively high because many of the minerals scatter light strongly, and dust storms can contain a lot of minerals.	PACE will provide key information on airborne dust. Data from its instruments will help determine the height of dust storms. This information is key for hazard avoidance and predicting how dust storms will move. Other researchers will use PACE data to investigate links between the availability of nutrients from dust and the growth of phytoplankton.		*The orange-red color commonly associated with dust is because it tends to preferentially absorb blue light. Data based on Lee et al. (2017) and Hess et al. (1998).*
Smoke 	Wildfires are unplanned fires that burn in natural areas like forests, grasslands, or prairies. As wildfires burn, large amounts of fine particulate matter are released into the atmosphere and mix with gases to become *aerosols*, tiny particles suspended in our atmosphere.	This spectra is the type of data that PACE's Ocean Color Instrument will collect. Other science instruments onboard PACE will observe smoke in different ways. For example, PACE's multi-angle polarimeters, SPEXone and HARP2, will provide key data on the size of the smoke particles in Earth's atmosphere.	PACE's science instruments will provide information on the atmospheric concentration of wildfire-related aerosols. These particles can significantly reduce air quality, leading to asthma and respiratory distress among vulnerable people. Over the long term, smoke aerosols absorb and reflect different fractions of sunlight, affecting how much energy Earth absorbs from the sun.		*Smoke's spectral signature has a distinct downward slope moving from the visible colors to longer wavelengths. From Sayer et al. (2014).*
Clouds 	Predicting climate involves long-term studies of clouds, which both reflect and absorb sunlight. Clouds interact with tiny suspended particles known as *aerosols* in many ways that are not well understood. For example, cloud drops can from on aerosols and aerosols can be washed out of the air by rain.	Clouds are complex and constantly changing. Sometimes you can see high, wispy clouds situated above low, thick clouds on the horizon. Different types of clouds have different spectral "signatures," which depend on their composition, size, shape, and altitude. And sometimes they look just like animals!	PACE will measure the size of cloud drops and ice crystals, improving the ability to differentiate between ice and water clouds. It will observe the ocean, clouds, and aerosols together to better understand how they interact. These interactions affect how much heat is trapped by Earth's atmosphere and thus are vital for accurate weather and climate prediction.		*Cloud spectra have many "ups & downs" because of variation in absorption among different forms of water. From data based on Dierssen (2019).*

Type of Matter	Round 1: What will PACE help us better understand? (A lot!)	Round 2: Which type of data will PACE collect? (Spectra!)	Round 3: How will scientists analyze PACE data? (Matching!)	Spectra	Details on the Spectra
Microcystis 	Found in freshwater, Microcystis can form colonies that are bound by a thick mucilage (a.k.a. "goo") and become large floating blooms by producing gas-filled bubbles. If consumed by mammals, Microcystis can cause numbness, nausea, dizziness, vomiting, and lead to liver damage or death.	The bright color of Microcystis is captured as a narrow peak in the visible color spectrum at green-yellow wavelengths. The organisms' form and size – colonies made up of round cells that are large enough to been by the naked eye – also contribute to its spectral signature.	Blooms of Microcystis occur almost every summer on Lake Erie, a result of decades of runoff from farms and cities. However, warmer water temperatures can sustain blooms well in fall. PACE will contribute to an "eye-in-the-sky" early warning system, helping to alert the public and local officials when dangerous waters may be in bloom.		*Microcystis reflects in the green-yellow part of the visible color spectrum. From a plot of Reflectance vs. Wavelength for three samples (Hu, 2022).*
Sargassum 	This floating seaweed, called Sargassum, can serve as oases for diverse ecosystems in otherwise desolate parts of our ocean, but has recently become a nuisance along many coasts. Huge quantities have been washing ashore in rotting piles, impeding normal fishing activities and driving away tourists.	Sargassum is a type of "macroalgae," or algae large enough to see with the naked eye. Many organisms have specialized patterns and colors that mimic the golden-brown color of Sargassum, allowing them to be camouflaged in their environment. Sargassum mats have provided shelter to over 100 different species.	PACE's Ocean Color Instrument (OCI) will cover our global ocean, providing unprecedented opportunities to detect, differentiate, and quantify various types of floating matter such as Sargassum. OCI data will contribute to products such as the Sargassum Floating Algal Index, developed by the University of South Florida, whose goal is tracking large blooms in near-real time.		*Sargassum reflects strongly in the yellow and orange parts of the visible color spectrum. From a plot of Reflectance vs. Wavelength for five samples (Hu, 2022).*
Noctiluca 	Microscopic algae known as Noctiluca are among the most abundant "red tide" organisms. Although this red-colored species looks scary (unless you really love tomato soup), it is non-toxic. However, large blooms – which occur worldwide – can be harmful when they die and deplete oxygen from ocean habitats.	Unlike many species of phytoplankton, Red Noctiluca lacks the steep slope within the range of red colors. This may be due to the lack of the chlorophyll-a pigment commonly found in phytoplankton. Red Noctiluca, on the other hand, does not contain pigments unless it feeds on other algae. It is "heterotroph" while many phytoplankton are "autotrophs" (i.e., self feeders).	Noctiluca outbreaks can pose a significant threat to coastal resources, water quality, public health, and tourism. Data from PACE will help accelerate the process of developing Noctiluca-specific ocean color computer algorithms. This may aid better prediction of blooms, improving our ability to better forecast fish kill events and other harmful impacts.		*This species of Noctiluca reflects strongly in the orange and red parts of the visible color spectrum. From a plot of Reflectance vs. Wavelength for four samples (Hu, 2022).*

Background photo: Collected by Landsat 8 on September 24, 2021.