Annotated Script: Ocean Acidification

Show	Say	Notes and Rationale
Title Slide 1: Introduction 	Welcome. My name is {*name*}, and I'm an educator here at {*institution*}.	Introducing yourself as an educator at your institution establishes you, the presenter, as an effective messenger of this information and a trusted resource (*Why Zoos and Aquariums Matter*, Falk, et. al. 2007 AZA).
Slide 2: Seattle Aquarium Solar Video 	Did you know that we have solar panels on our roof? [*Start video*] In this video you can watch the installation of Seattle Aquarium's solar panels taking place over the course of several weeks. You can see in the center of the screen that amidst the bustle of the city the appearance of the/our roof is slowly changing as each panel is added to the array. We worked with our local energy company to update the way we use energy - a practical step toward protecting the health of our ocean. Wait a minute…what do solar panels have to do with the water beneath us? Scientists have discovered that burning fossil fuels like coal, oil and natural gas causes a serious problem called Ocean Acidification. Now that we know about this problem, as concerned citizens, we have a responsibility to be a part of the solution, to protect the ocean for future generations!	This narrative introduces the frame element of Solutions right at the beginning, creating a hopeful frame and foreshadowing the importance of renewable energy. The talking point here cues the Value of *Responsible Management,* which research has shown to be an effective way of productively orienting people to ocean conservation as a social issue.

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Slide 3: Anthropocene Transportation Visualization 	This map shows many ways in which our fossil fuel energy system has helped to connect people around the world. The green, blue and red lines trace land, sea, and air transportation routes. Burning fossil fuels such as coal, oil, and natural gas helps us to move around our planet, power the places we live and work, and create global connections. There is no doubt that our current energy system has done a lot of good, but our heavy use of fossil fuels has also created rampant carbon dioxide accumulation in our atmosphere and in the ocean. What does 'rampant carbon dioxide' mean?	The visual helps to establish the interpretation as a matter of global scale and importance. IMAGE: Relays a full year's worth of data on human transportation. Blue is shipping, red is air traffic, and yellow highway traffic. This image helps to convey the global scale of human impacts by illustrating our worldwide transportation system.
Slide 3: Anthropocene Transportation Visualization 	Some carbon dioxide, or CO2, is needed for life processes. We can call this "Regular CO2." But CO2 is not just something that plants breathe in and we breathe out. It's also something that gets put into the atmosphere when burn fossil fuels for transportation or manufacturing. And these things are putting a lot of CO2 into the atmosphere and ocean. We can call this "Rampant CO2" because there is too much of it and it's getting out of control.	By using the distinction between *Regular and Rampant* CO_2, you can help your visitors easily add to the knowledge they probably already hold about carbon dioxide – that it plays a role in human respiration and photosynthesis. The taxonomy allows them to hold the newer, counter-intuitive information (that CO_2 can also play a harmful role) alongside existing concepts.
Slide 4: CO2 Accumulation Visualization 	You can see this in the image on the screen behind me. The cloud forming around the Earth represents the increase in CO2 in our atmosphere. Of course, CO2 is actually invisible. This cloud is simply a way of visualizing what we otherwise would not be able to see. But, all of that CO2 doesn't just stay in the air…	It is important that there are very clear, crisp connections between what visitors see on the screen and what they hear from the interpreter. This visualization is very short, so plan your timing with the narrative appropriately. You may wish to repeat the visualization to give the audience time to absorb what it is showing.

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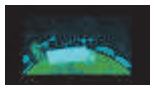
Slide 5: Ocean Acidification Video 	[*Start animation*] Much of it goes into the ocean. Now we are looking at a video that shows how the ocean naturally absorbs much of that rampant CO2. As the ocean absorbs this excess CO2, it reacts with sea water, changing the ocean's chemistry. This process is called ocean acidification. How do we know this is happening?	The narrative explains the mechanism of OA in general terms (changing the chemistry) but refrains from outlining the details of the chemical process and the pH scale.
Slide 6: CO2 Data 	At the Seattle Aquarium, we are working with scientists at the National Oceanic and Atmospheric Administration to monitor CO2 in the atmosphere and ocean. Here is a graph of daily changes in CO2 that we are seeing from one of NOAA's Seattle monitoring stations. In this graph you can see spikes in carbon dioxide that correspond to times of day when there is more commuter traffic. Ocean Acidification has been well documented through global observations conducted over several decades by hundreds of researchers. It has been linked directly to human-caused CO2 in the atmosphere that has been released primarily by fossil fuel combustion.	IMAGE: This graph illustrates data being collected by NOAA scientists in Seattle, WA. This graph also features thought bubbles on how to interpret the data by comparing the peaks in CO2 with the familiar example of daily commuter traffic.

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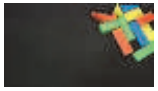
Slide 7: Species Impacted by Ocean Acidification 	Many marine species that live in the Pacific Northwest are being affected by ocean acidification now. Studies of the native Olympia oyster showed that survival and growth decreased with exposure to OA in laboratory and field settings. [*Click 4x - images fade in*] The same appears to be true for other native species like pteropods (a type of swimming snail), red sea urchins, northern abalone, and turban snails. What do all of these animals have in common? [*Pause, solicit response from audience if possible*] They all have a hard shell. Have you seen any of these animals in our tide pools (e.g. crabs, snails, mussels, sea urchins, etc.)? We have examples of some of those animals here at our Closer Look Table too. [*offer shell biofacts, if using*] So, what does ocean acidification actually do to these animals?	This beat in the narrative specifies negative effects on marine life using a concrete local/regional example. The species selected here have been the focus of recent peer-reviewed research (see NOAA/WHOI 20 Facts about Ocean Acidification, November 2013). When selecting species native to your region, seek out scientific research to support the evidence of impacts being observed. Avoid including speculative findings. Connecting the biological impacts of Ocean Acidification to the animals in our exhibits makes this largely unfamiliar issue more tangible and relatable to our visitors. Introduce biofacts and invite hands-on exploration as appropriate to the presentation setting.
Slide 8: "Home" Building Video 	Think of an animal, like a snail, building its shell like someone who is building a brick home. Each colored piece seen here represents calcium carbonate, an essential molecule or brick, which many marine animals use to construct their homes. Ocean acidification reduces the amount of building material, or calcium carbonate, available to animals in the ocean. So while our snail is stacking those bricks, some of them are being taken away. It takes more time and energy for our snail to build its shell and the shell becomes weaker.	Throughout the narrative, the vocabulary is designed to match the visualizations and videos as closely as possible. Content and timing of the script need to mirror what your audience is seeing to avoid cognitive dissonance and distraction. The causal link of observing how OA impacts an animal building its shell reinforces the understanding of larger system impacts to the ocean food web described later in the narrative.

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Slide 9: Pteropod Shell Images 	We are already seeing the effects of ocean acidification right here in the Pacific Northwest {*region*} and around the world. Here is a microscope image of what we just saw; this is what happens to shells when they are exposed to these conditions. You can see the shell of the pteropod exposed to ocean acidification on the right, is weaker and has visible damage, making it harder for the animal inside to survive. How wide spread is this problem?	Now that we have identified Ocean Acidification as a serious problem, it is important to keep the tone of the discussion conversational and reasonable. We can instill a sense of urgency when describing the real impacts of OA while avoiding a crisis tone. This allows for consideration of the problem and potential solutions instead of hopelessness. Pteropods are being considered as a biological indicator for ecosystem conditions under the criteria of the Integrated Ecosystem Standard (or IEA) (see Global Ocean Health Ocean Acidification Report Volume 2, Number 1, October 15, 2015 www.globaloceanhealth.org)
Slide 10: Aragonite Saturation Visualization 	In this video, you'll see another representation of how the invisible chemistry of the ocean is changing. The blue areas show plenty of carbonate available for animals to build their shells. [*animate video*] As time passes and CO2 is added to the ocean, the color changes to orange, indicating that there is no longer enough carbonate for these animals.	This slide creates a transitional bridge between the microscopic scale of OA impacts on individual animals and the global scale of the problem. This visualization is very short, so plan your timing with the narrative accordingly. Before you start playing the video, specifically point out blue and orange areas so that the audience knows what to look for when the animation begins.

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Slide 11: Ocean Food Web  	The loss of these organisms affects the whole ecosystem. And we are all connected to this ecosystem… You can see here how shell building animals, like pteropods, are connected to other species. If these animals struggle to survive it could cause shifts in the ocean food web. This may threaten the balance of the global food web system of which we are all a part. But, we don't want to wait to see how bad it gets. We must take logical steps now to ensure that we will have a healthy ocean in the future. As we have already seen, humans are amazing innovators. We created an energy system that improved our lives but which we now know is causing major problems in our ocean. The key to getting our ocean back to functioning the way it should is to get away from using fossil fuels for energy. What actions really make a difference?	This section brings humans back into the narrative, as we are all connected to the ecosystem. The concept of interconnectedness is expanded as we examine OA impacts on the ocean food web. Connecting individual animals introduced in Slide 7 to the larger global food web system, of which humans are a part, guides people back to the systems view. Now that we have reached the end of the explanatory chain, we briefly summarize the key concepts of the narrative before transitioning back to the solutions mentioned at the very beginning. We cue Values (*Responsible Management* and *Innovation*), identify the problem and its cause, frame the need for collective solutions on a systems scale, and revisit the metaphor of rampant carbon dioxide.
Slide 12: Renewable Energy Solutions  {*Insert a different final sentence here to discuss local or global OA solutions if not located in the PNW.*}	Fortunately we innovative humans have already created other energy systems that do not rely on fossil fuels; systems such as solar, wind, wave, and geothermal energy. Our next challenge is to implement these renewable energy systems on a large scale, replacing our fossil fuel based system with one that will provide us with the same power but without the negative impacts of rampant CO2. We need to change our actions not just at the individual level, but at the neighborhood, city, state, and national level. The more people who take action to tell our energy companies and governments that renewable energy is important to us, the more likely it is that we will see large scale shifts towards a system where renewable energy is the key rather than fossil fuels.	Here we define renewable energy resources, providing concrete examples of renewable energy systems that exist across the United States. Innovation is an effective Value to use in conjunction with the frame element of Solutions. It focuses attention on our ability to be creative and resourceful in tackling problems, warding off fatalistic thinking and encouraging more productive considerations of problems and their solutions.

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Slide 13 Seattle Aquarium Solar Array  *{Insert a different final sentence here to discuss local or global OA solutions if not located in the PNW.}*	That's why the Seattle Aquarium decided to participate in a community solar project, sharing the energy generated by our array of solar panels with others in our community and raising awareness that solar energy systems already exist and are a viable way to power our lives. We have created a system which provides us with great power, but with great power comes great responsibility – the responsibility to replace fossil fuels with more renewable energy sources to ensure a healthy ocean and a healthy planet for our future. And that is how the solar panels on our roof are connected to the water beneath us!	Local or regional Solutions examples are the most powerful. Consider replacing or adding to this example with at least one local or regional example of a systemic/institutional initiative. Connect your selected solution back to impacts on living systems. Changes are affecting ocean ecosystems and animals (plankton as base of the food web, fisheries, migratory animals, ice dependent animals, etc.). Cueing Values at the end of a narrative helps to end on a note that evokes hopefulness and a collective-action mindset.
Slide 14: Closing  Still Shot	Thank you so much for joining us at *{Institution}* today. If you have any questions, please let me know and enjoy the rest of your visit!	Invite your audience to keep the conversation going. Encourage questions. Offer additional resources and information about the solutions mentioned during the presentation. Offer the opportunity to continue exploring the props you have available as well.