Go With the Flow
Workshop

Introduction for Presenter
This workshop uses two stories to model how scientific data can be used to build explanations of events. The first is true story of the spill of a container of Nike shoes into the Pacific Ocean. You will set up the story of the shoe spill and encourage initial predictions. Next the concept of wind-driven ocean currents will be explored with a hands-on activity. Using the wind-driven ocean currents dataset on the SOS, students will refine their predictions. Finally, the actually locations where shoes were found will be revealed.

The second story is the fictional, but not impossible, story of a penguin feather being found by a beach clean up crew in San Francisco. The concept of thermally driven ocean currents will be explored with a hands-on activity. Using the ocean conveyor belt data set, and the wind-driven currents data set, visitors will refine their predictions. An actual possible path for the penguin feather will be revealed. Finally, students will view a simulation of a particle moving around the ocean over hundreds of years and learn that there is really only one ocean.

Learning Objectives
- Visitors will understand that some ocean currents are caused by wind
- Visitors will use wind-driven ocean currents datasets on the SOS to make predictions about where the Nike shoes will end up.
- Visitors will understand that some ocean currents are caused by temperature differences
- Visitors will use thermal and wind-driven ocean currents datasets on the SOS to determine whether or not the penguin feather could have reached California.
- Visitors will understand that all of Earth's oceans are interconnected and water circulates throughout the system over long time scales.

Playlist
- *Hansa Carrier Shoe Spill: Title Screen*
- *Hansa Carrier Shoe Spill: Introduction PIP*
- *Hansa Carrier Shoe Spill: Blank map with ship*
- *Hansa Carrier Shoe Spill: Summer Trade Winds*
- *Hansa Carrier Shoe Spill: Trade Winds over NASA Sea Currents*
- *Hansa Carrier Shoe Spill: NASA Sea Currents*
- *Hansa Carrier Shoe Spill: Animated Wind Driven Currents*
- *Hansa Carrier Shoe Spill: Wind Driven Currents with Cities*
- *Hansa Carrier Shoe Spill: Results*
- *Penguin Feather: Title*
- *Penguin Feather: Introduction PIP*

- *Penguin Feather: Convection Currents*
- *Penguin Feather: Surface Currents*
- *Penguin Feather: All Currents*
- *Penguin Feather: Feathers and Both Currents*
- *Global Circulation*
- *Go With the Flow: Credits*

Acknowledgement

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Hands-on Activities – Materials and Set Up:

Materials:

A common set up is used for both activities:

- 4 tables placed near the SOS.
- 8 Clear plastic or glass pans or bins
- Water to fill each pan 3-4 full
- 1-2 rock "islands" to fit in each pan, or upside down cups

Additional Materials for Activity #1: Wind Driven Currents

- A handful of plastic doll shoes (must be able to float).

Additional Material for Activity#2: Thermal/Density driven currents

- One vial of food coloring for each set up
- A container of enough ice cubes to give three or four to each station.

Workshop Outline

1. **Introduction:** Load the *Hansa Carrier Shoe Spill: Title Screen* as the group arrives. Welcome the group and introduce them to the SOS. Explain that today they will be using the SOS to solve a couple of mysteries involving the ocean.

2. **Introduce Nike Shoe Spill Mystery:** Play the introduction animation clip – *Hansa Carrier Shoe Spill: Intro PIP*. At the end of the clip, move to *Hansa Carrier Shoe Spill: Blank map with ship*.

3. Ask the students "What do you think? What is your initial guess about where the shoes will end up? " Encourage students to turn and talk to a neighbor, then pull the group together and pick a few to share what they think and why. If possible, use any mention of wind as a factor to transition to the next point.

4. **Introduce Wind Driven Currents activity:** Explain to the students that one of the factors that impacts what will happen to the shoes is the wind blowing over the surface of the ocean. Ask students "What impact does wind blowing over the surface have on water?" Explain to the students that will be moving to the activity stations. At the stations, they will find a model of the ocean (the pan of water). Explain that they need to blow across the surface of the water observe the effect on the water.

5. **Transition to the hands-on activity:** Break the group into 8 smaller teams. Send the teams to each table and prompt chaperones to each take a table. Move from table to table and remind students of the instruction to blow across the water with the straw. Ask "What do you notice about how the water is moving? What happens when the water reaches one of the rocks?"

6. **Add shoes to the hands-on model:** Move from group to group and add plastic shoes. Encourage the students to keep blowing across the surface of the water. Ask "What do you notice about how the shoes are moving? What happens when the shoes reach one of the rocks?"

7. **Pull group back together and transition back to the SOS.** Tell the students that you are moving to the sphere now to see what's happening in the ocean. Ask for 2-3 volunteers to share their observations of the activity. Then move the SOS to the *Hansa Carrier Shoe Spill: Summer Trade Winds* dataset. Explain that the data set shows the average direction of the trade winds, the primary winds responsible for creating currents. Have the students take a look at the position of the ship during the spill, and share whether or not they would change their original predictions with someone next to them.

8. **Discuss the NASA Sea Currents data set:** Move to *Hansa Carrier Shoe Spill: Trade Winds over NASA Sea Current*. Explain that this data set is a model of

wind-driven ocean currents. The yellow and green sections are places where the water is moving faster than the surround water, or the ocean currents. Ask the students what they notice about the dataset. The NASA Sea Currents model shows a number of interesting features to ocean currents. The two most frequently noticed features are:

1. The circular eddies that appear where water is moving around land – particularly in the pointed ends of Africa and South America.
2. The gulf stream – a strong current of water moving from the Gulf of Mexico up the eastern seaboard of the United States

9. **Refine Predictions:** Tell the students you are now showing them a more simplified map of the major currents they can use to revise their predictions about where the shoes might have washed ashore. Move to the *Hansa Carrier Shoe Spill: Animated Wind-driven Currents*. Ask the students "Where do you think the shoes will end up now?" Give students a chance to share their ideas. Encourage them to expand their answers from just the city name to include why they think that the shoes will end up in the location that they have chosen. You can hand a laser pointer to the students to have them show you what they think will happen if you chose. You can also move to *Hansa Carrier Shoe Spill: Animated Wind-driven Currents With Cities* for a still map with current names the students can reference when explain what path they think the shoes will take. This is particularly useful if you don't want to hand over a laser pointer.

10. **Reveal Results:** Run *Hansa Carrier Shoe Spill: Results*. Congratulate/commiserate with students about the results of their prediction versus what actually happened.

11. **Introduce Penguin Feather Mystery:** Move to *Penguin Feather: Title.* Explain to the students that they are now going to use their knowledge of ocean currents to solve another mystery. Play *Penguin Feather: Introduction PIP*. The clip ends with the locations of emperor penguin habitats highlighted around Antarctica. Ask the students **"**What do you think? What is your initial guess about whether or not it is possible for a penguin feather to reach California?" Pick a few students from the audience to share what they think and why. If possible, use any mention of ocean currents as a factor to transition to the next point.

12. **Wind-driven Currents:** Bring up the *Penguin Feather: Surface Currents* dataset. Ask the students to use the same techniques they used with the shoes and determine whether or not the penguin feather could reach California. Have a few volunteers share their thinking. The overwhelming response will probably be no --- the wind-driven currents the students just learned about will not be enough to make that happen.

13. **Introduce hands-on activity:** Explain to the students that wind is not the only thing that causes ocean currents. Explain that the groups will now look at what happens below the surface. Explain to the group that they need to add one drop

of food coloring to the water in the pan, and not move the pan in anyway as their first task. Have the groups and the chaperones move back to their original set up.

14. **Add ice to the pans:** Ask each group to describe what the food coloring is doing in the water. If the table as not been shaken, the food color will primarily just sink to the bottom. Rotate through the groups and add ice to each pan. Have the students add another drop of food coloring. Encourage students to watch and describe what is happening. Ask "What do you notice about how the water is moving? What happens when the water reaches one of the rocks?"

15. **Transition back to the SOS:** Have the students return to the SOS and share some of their observations. Explain that in the pan, cold melted water from the ice cube is denser (has more water packed into a smaller space) than the warmer water in the pan. It sinks and moves along the bottom where it eventually warms up and rises to the surface. Explain that they will next exam how that works in the ocean with the SOS.

16. **Refining predictions with the Convection Current data set:** Move to *Penguin Feather: Convection Current* data set. Explain that just like the pan of water, the oceans of the earth are not evenly heated. The poles are colder than the equator. The cold water of the poles is denser, and sinks to the bottom of the ocean and starts to move towards the equator. This creates large scale deep currents. These currents are responsible for moving large amounts of water from one part of the world to another. Ask the students take a look at the data set – does it change their answers to whether or not a penguin feather could have ended up at Ocean Beach.

17. **Putting up both current sets:** Explain to the group that to help them refine their predictions, you are going to put both sets of currents at once. Load *Penguin Feather: All Currents.* Encourage them to take a look and share their final ideas about whether or not a penguin feature could be carried via ocean currents from Antarctica to California.

18. **Present the mystery end:** Run the *Penguin Feather: Feather plus Both* dataset. Congratulate/commiserate with students about the results of their prediction vs what actually happened. Explain that it is possible that a penguin feather might be brought all the way from Antarctica to San Francisco in the ocean currents. However, it takes a really long time for that to happen, on the order of hundreds of years. Ask, could an object placed in the ocean end up anywhere if it stays in the ocean long enough?

19. **Conclude with Global Circulation simulation:** Move to the *Global Circulation*, but don't start the animation yet. Explain that scientists have run simulations to see what happens when you add an object to the ocean. This is important in thinking about what happens to pollution that gets added to the ocean. Is it

contained to one area? Does it spread? How far will it spread? Explain that this data set is a model of what happens a sample particle added to the Pacific Ocean. Run the simulation and encourage students to share what they are noticing about the path of the particle. Explain that if we let the simulation run long enough, our pollutant moves throughout all the worlds oceans. In fact, the idea that there are seven seas, or a number of different oceans is really a misnomer. All oceans are connected, and thus anything that happens to the ocean in one part of the world can affect the ocean in other places.