

# Exploring Marine Transportation

## Don't Get TIDE UP

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### Synopsis of the Activity

The goal of this activity is to familiarize the public with what tides are and how they are monitored and recorded. The activity will involve a hands-on tidal demonstration using a model of a cargo ship passing under the Bayonne Bridge on its way to the port. We will be incorporating real-time data and tidal charts to help judge when is the best time for the cargo ship to pass under the bridge (high or low tide).

### Audience

This activity is best suited for learners over age ten but the concepts apply to all age groups. Aspects of the hands-on activity can easily be modified for younger audiences. The poster will contain information to help the observers get an overall view of how tides and marine transportation are connected.

### Activity Goals

Visitors will be given an opportunity to learn how to interpret tidal charts and real-time data. We will be using a modified version of this data and only highlight specific parts of the charts and graphs. A hands-on activity demonstrates how tides play a crucial role for harbor pilots navigating cargo ships safely to port. The goal is for visitors to gain knowledge about tides and how this information may be useful for future experiences in their own lives.

### Background Information

Gravitational forces between the earth, moon and sun create tides and these forces combined influence the rising and falling of sea levels. The tides follow the position of the moon as the earth spins on its axis and the moon orbits the earth. During a full or new moon tides tend to be at their highest during high tide and lowest during low tide, which is called a spring tide. Neap tides occur when the moon is at right angles to the sun and earth. This happens during quarter moon phases and produces weaker tides. This creates the opposite effect of a spring tide producing the highest low tides and the lowest high tides. In our area there are two high tides and two low tides that occur every twenty-four hour and fifty minute tidal day. Knowing the tides is extremely important for commercial and recreational boaters

### Ocean Literacy Principles

- The earth has one big ocean with many features
- The ocean and humans are inextricably interconnected
- The ocean is largely unexplored

### Vocabulary

- **Tides:** the regular rise and fall of the surface of the ocean due to gravitational forces between the sun and the moon.



- **Spring tide:** their pulls combine and cause very high tides and extremely low tides. Spring tide usually occurs during a full or new moon when the sun, earth, and moon are in perfect alignment.
- **Neap tide:** are especially weak tides and occur during quarter phases of the moon.
- **Tidal charts:** are used to predict the time and heights of high and low water in a particular area.
- **Real-time data:** the most up to date information provided with the aid of satellites and computer systems.
- **Harbor pilot:** assists the captain of the vessel by guiding the ship through busy areas so they can dock and unload cargo.
- **Tidal bulge:** happens when the gravitational forces of the moon pull the oceans towards it on either side of the earth forming a bulge. The bulge closest to the moon creates a high tide and the bulge furthest away is low tide.
- **Air gap:** the distance between the bottom of the bridge and the top of the ship or clearance needed for the ship to pass under safely.
- **Draft:** the distance from the waterline to the bottom of the ship (hull).
- **Tidal cycles:** occurs every twenty-four hour fifty minute period in a day.
- What is the action of the water called going in and out on the beach?
- What if I told you that in NJ and NY there are two high tides and two low tides in a day? How can this have an effect on your shell collecting?
- What do you think causes the rising and falling of the oceans?
- Have you ever seen those large cargo ships passing by on their way to the port?
- What do you think they are transporting in those colored containers stacked high on the cargo ships?
- What concerns does the captain/harbor pilot have in relation to tidal changes when navigating into port?
- How do think a ship is able to pass under a bridge?
- What do you think would happen to a heavy ship if the water were too low?
- What would happen is the water was too high?
- How do you think the people in charge of the port facility are able to bring the ship into port, unload the cargo, and make sure that it gets out in time before low tide?
- Did you know that the NY/NJ Newark Bay port is the third largest port in the United States?

## Guiding Questions

- Have you ever gone to the beach and you thought you placed your towel in a great spot and hours later the water was all of sudden very close to your towel?
- Why do you think that happens?
- Have you ever gone shell collecting on the beach?
- Why do you think the shells are sometimes close to the water and other times higher up on the beach?
- Did you ever notice how on the shore the ocean is sometimes covering and uncovering the sand and rocks?

## Materials

- Aquarium
- 2 battery operated bilge pumps (water can also be added or taken out with a bucket)
- Water
- Sand
- Shells
- Tidal marker (scale to read the tide heights)
- Toy cargo ship
- Real-time data sheets

- Bridge model to place in tank (string or paper can also be used as a marker to simulate a bridge)
- Poster display: Will include images of tidal disasters and tidal fluctuations, a tidal monitoring station, and a cargo ship traveling under the Bayonne Bridge.

## Set-up Procedure

An aquarium with sand placed inside the tank to represent a channel. Using the two bilge pumps water can be drained and added to the tank as needed. A tidal marker (feet) should be placed on the front portion of the tank allowing visitors to monitor the actual level of the tide according to the size of the ship and height of the bridge. A plastic boat representing a cargo ship will be placed in the aquarium. Place the plastic model of the Bayonne Bridge inside the tank.

## Activity Description

Start the activity by inviting the visitors to raise and lower the water in the demonstration. While the visitor is exploring the demonstration the presenter should ask “Have you ever gone to the beach and you thought you placed your towel in a great spot and hours later the water was suddenly very close to your towel? Why do you think that happens?” If the visitor can’t relate to the previous question consider asking, “Have you ever gone shell collecting on the beach? Why do you think the shells are sometimes close to the water and other times higher up on the beach? Did you ever notice how on the shore the ocean is sometimes covering and uncovering the sand and rocks? What is the action of the water called going in and out on the beach?”

Hopefully at this point the visitors will mention tides. If not, the presenter will

discuss the concepts of tides (show an image of shells at high and low positions on the beach). They will then state to the visitors “What if I told you that in NJ and NY there are two high tides and two low tides. How can this have an effect on your shell collecting?” Maybe we will use hula-hoops to demonstrate how the moon orbits around the earth and how this causes the pull of the oceans. The presenter will ask, “Have you ever seen those large cargo ships passing by on their way to the port? What do you think they are transporting in those colored containers stacked high on the cargo ships? What concerns does the captain/harbor pilot have in relation to tidal changes when navigating into port?”

The presenter will then ask, “How do think a ship is able to pass under a bridge? What do you think would happen to a heavy ship if the water were too low? What would happen if the water was too high?” The presenter will ask “How do you think the people in charge of the port facility are able to bring the ship into port, unload the cargo, and make sure that it gets out in time before low tide?” The visitors will be invited to view real-time data and tidal charts and apply the information to the demonstration to bring the cargo ship safely to port without hitting the bridge.



*This activity was developed by students in the Spring 2010 Communicating Ocean Science for Informal Audiences (COSIA) class at Rutgers University.*