WELCOME TO THE WADDEN SEA

Essential Question

How can changes in one ecosystem affect another ecosystem?

Overview

During a visit to the Schleswig-Holstein Wadden Sea (*Wattenmeer*), a German national park north of Bremerhaven, you will explore ecosystems of the tidal mudflats that are considered the most important wetlands in Germany. You will be expected to look for patterns in data to identify cause-and-effect relationships, use those relationships to predict future changes, and evaluate competing design solutions for maintaining biodiversity and ecosystem services for migratory waterbirds that use the East Atlantic Flyway.

The Wadden Sea is the largest tidal flat system in the world and is listed as a UNESCO World Heritage site. It stretches along the coasts of Germany, Denmark, and the Netherlands. The Trilateral Wadden Sea Cooperation, a collaboration of those three nations, is responsible for the preservation and management of the massive wetlands. The Wadden Sea is divided into three different sections—the Northern, Central, and the Southern Wadden Sea. The German part of the Wadden Sea is in the Central region. The German *Wattenmeer* is also divided into three different parts: the Schleswig-Holstein Wadden Sea, the Lower Saxony Wadden Sea, and the Hamburg Wadden Sea. All of these are in protected National Parks. On our visit, we will concentrate on the Schleswig-Holstein portion of the Wadden Sea.

Text by Lori Chen

Schleswig-Holstein Wadden Sea National Park (*Wattenmeer*)

Leaving the *Klimahaus* in Bremerhaven, you board the bus for the Schleswig-Holstein Wadden Sea National Park or, as it is called in German, *Nationalpark Schleswig-Holsteinisches Wattenmeer* (pronounced: ˈvatn̩meːɐ̯,). Opening the lunch bag your chaperone gave you as she took attendance, you settle in for the 45-minute ride to Friedrichskoog, Germany. As you travel north toward Friedrichskoog, the sky becomes increasingly gray. A light rain splashes against the bus window. It's not the type of weather you had envisioned for a day at the beach.

The bus intercom crackles on. "I hope you enjoyed your walk around the world. This afternoon you will be taking a walk on the famed mudflats of the *Wattenmeer*. In English, that's the Wadden Sea."

Peter continues, "Our guide for the afternoon is with us. So, I will turn the microphone over to Riya."

Peter passes the microphone to Riya. "*Guten Tag*." Hearing no response, Riya again says, "*Guten Tag*." (Pronounced: ˈ/ˌguːtn̩ ˈtaːk/.)
This time everyone replies, "*Guten Tag*."

"That's better." Riya laughs. "It doesn't seem like a good day, but the weather app on my phone predicts a break in the rain while we are on the mudflats. On the bright side, there will probably be fewer tourists at the beach."

"In 2009, the *Nationalpark Schleswig-Holsteinisches Wattenmeer* was designated by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as a World Heritage Natural Site. That puts the *Wattenmeer* on par with the Serengeti, the

Great Barrier Reef, Yellowstone National Park, and Wood Buffalo National Park , which are also UNESCO World Heritage Natural Sites. The *Wattenmeer* is shared by the Netherlands, Germany, and Denmark. It earned its World Heritage designation for its unique landscape, unique sea biodiversity, and unique sea wildlife. The *Wattenmeer* is managed as a natural environment with guaranteed protection. The national park also includes the Halligen, a group of islands which you learned about at the *Klimahaus*."

"Like all tides, the tides of the *Wattenmeer* are driven by the rotation of the Earth, as well as the gravitational force between the moon and Earth and sun. The revolution of the moon around the Earth changes the gravitational force, which affects the height of the tides. During the quarter moons, the force of the moon and sun are perpendicular to the Earth. Therefore, weak tides—called neap tides—occur. During the new moon, the sun and moon are pulling in the same direction, which causes higher than usual tides. During the full moon, the sun and moon are on opposite sides of the Earth, which causes higher than average tides. The higher than average tides are called spring tides, from the German word *springen*, which means to jump."

"Every 24 hours and 50 minutes coastal areas experience two low tides and two high tides. A solar day is 24 hours, but tides are on a lunar calendar day. So, daily, the clock time of low tides and high tides changes," Riya says.

"We will be touring the mudflats during low tide, and we will experience the slow return of the sea as we walk back to the beach. Don't worry, we will have plenty of time to experience and explore before we worry about high tide."

“Overcast days or windy days are not that unusual even during the summer. During July there is only a 25 percent chance of a clear sky. When the sun is out, the radiation is high due to our far north latitude. On a sunny day the high temperature averages 22º C. I think that would be in the low 70s in Fahrenheit. Peter said you are all prepared with light jackets and shorts or pants you can roll up. Here at the *Wattenmeer*, we can walk the mudflats in our bare feet.”

“We are arriving. You will be leaving your shoes and socks at the education center. Please bring your sunglasses, hat, and jacket. If you have sunscreen, you might want to put some on your face. Even though there are clouds, the solar radiation is still high enough to cause a burn.”

A cool, misty, breeze greets you as you step off the bus. You zip up your jacket and put on your cap. You and the rest of your tour group follow Riya up the steps to the education center, where you settle into seats for a safety orientation.

“We will be exploring an area completely covered by seawater during high tide. It is important that you stay together and listen for directions. I think the weather will be okay, but if a storm moves in, we will need to be prepared to leave the mudflats quickly.” Riya continued, “Leave your shoes and socks here. Let’s go.”

The fine beach sand gives way under your feet, making it difficult to walk fast. At the edge of the beach, you step onto the mud. The dark, wet silt is more tightly packed than the beach sand. As you walk, water from the mud temporarily puddles around your toes and heels. The mudflat stretches to the horizon. The tide has taken the water of the *Wattenmeer* far out into the North Sea. In the distance, shorebirds skim over the mud, circling and hovering

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before landing to capture their prey. Other shorebirds creep along the mud, pecking and digging for food. A small island rises out of the mud. It is hard to believe that when the tide returns, the island will be completely cut off from the beach. Riya tells the group to stop. You turn and look back at the beach, amazed at how tiny the buildings and scattered people appear. Without landmarks, it is difficult to tell how far you walked from the beach.

Riya instructs the group to form a circle. “Does the mud feel solid to you?” The response from the group is no. Smiling, Riya, asks for a volunteer. You raise your hand, and Riya beckons you into the center of the circle and says. “Rock your feet back and forth.”

As you shift your weight from one foot to the other, the mud begins to give way. A pool of water forms at the surface. Your friends cheer you on. You sink deeper into the mud until you are up to your knees in sandy mud. With a little help, you free yourself from the mud and climb back onto the surface. Although the weather is breezy, damp, and cool, the mud and water are surprisingly warm.

“As you demonstrated, the mud is not as solid as it seems. The mud is rich in nutrients that support animals that burrow into the mud.” Riya turns over the mud with a small shovel, uncovering two cockles at a depth of about 2 to 3 centimeters. “Please stand quietly and observe.”

Slowly the cockles begin to turn, opening and closing their shells, and each cockle digs into the mud, disappearing in a matter of minutes. Mud fills in behind the cockles and covers their tracks. “Why do you think the cockles burrow into the mud?” Riya asks.

“To hide from birds.” “To stay wet.” “To get food.” “To avoid being beat up when the tide comes back.”

“Are you telling me that the mud habitat provides protection from predators, nutrients, shelter, and conditions to support life processes?” Riya asks. The group members nod their heads and say yes. “What information do you need to support your claims? Think about it. We will talk later at the education center. For now, we need to find more signs of life in the mudflats before the tide returns.”

Kendra and Mehdy notice bubbles erupting in the mud. “What’s with the mud volcanoes?” asks Mehdy.

The group gathers around, as Riya carefully extracts a worm from the mud. “The bubbles you see are from U-shaped lugworm burrows. The burrows are 25 centimeters deep. Lugworms eat sand, digest bacteria and algae living in the mud, and excrete typical worm castings made of cleaned fine sand. Those are your mud volcanoes.”

“In addition to worms, there are crabs, mussels, snails, and microorganisms that make the mudflats richer in biomass than a tropical forest. Do you see the brown stripes in the mud? Those are left by snails. We may not see the snails now, but we can see evidence that they were here from the food trails they leave. There can be as many as 120,000 snails in a square meter. The snails are most abundant in the seagrass beds you can see if you look over toward the island.”

“I found a crab!” Cara exclaims with excitement. “It’s so tiny.” After showing everyone the crab, Cara carefully returns it to the mud.

As time passes, the mud becomes soft and soggy. “Let’s gather up our tools and head back to the beach. The water rising through the mud is a sign the tide is returning.”

The wind begins to pick up as dark clouds gather on the horizon. Riya urges the group to pick up the pace. You make it back to the education center as rain begins to fall. After washing mud and sand from your legs and feet, you towel off and return to the education room to put on your socks and shoes.

While everyone cleaned up, Peter and Riya set a table with snacks. “When you take a snack, take a map, too. We will be working together to explore the *Wattenmeer* ecosystem.”