# Lesson: "How can you save a town from a hurricane?"

## VIDEO TRANSCRIPT

### EXPLORATION VIDEO 1

Hi, it's Doug! Do you recognize this? Is a view of a hurricane from space. You might know that a hurricane is a giant swirling bunch of storm clouds, but do you realize how big it is? You see this? That's the US state of Florida right there. That's how big a hurricane is. It's a storm as big as an entire state. Hurricanes always start out as small storms over the ocean. They grow bigger and bigger and eventually, sometimes, reach the land. That's when they're most dangerous: when they hit places along the coast, like the southeastern parts of the United States. In 2005, the US was hit by one of the worst hurricanes in its history—Hurricane Katrina. This hurricane traveled from the Atlantic Ocean, past Florida, and into the Gulf of Mexico. It reached land in New Orleans, Louisiana. And it was a disaster. Hurricane Katrina brought tons of rain. Water filled the streets, flooding nearly the entire city. Areas that used to be roads were now covered in water. Cars were ruined. Houses and buildings destroyed. Many people were trapped without food to eat or clean water to drink. They had to be rescued in boats or helicopters. But where did all this water come from? I mean, we know the hurricane brought the water. But how did so much water get into the swirling hurricane clouds? Why would the clouds carry so much rain? There are two important clues to keep in mind. First of all, hurricanes start out over the ocean, all the way out here. Second, they only form during certain parts of the year, usually starting in late summer from August to November. With those two clues in mind, what do you think? Why do you think a hurricane carries so much rain with it? Why would a hurricane have so much water?

## EXPLORATION VIDEO 2

Hurricanes form over the ocean in late summer when the water is warm. Warm water evaporates more easily than cold water does to form rain clouds, just like you saw in a previous experiment. So as a hurricane moves over the warm ocean, its rain clouds get bigger and bigger as more and more ocean water evaporates. As a hurricane hits the coast, all the water that had evaporated from the ocean falls as rain onto the land. This is why Hurricane Katrina had so much rain. It's because so much warm ocean water evaporated to form the clouds of the hurricane. This was the problem for New Orleans. When it rained so much during Hurricane Katrina, it caused terrible flooding. But the rain from a hurricane isn't the only problem. There's something else about a hurricane that causes flooding: ocean waves. Remember, hurricanes aren't just rainclouds. They're also super strong windstorms. The winds of a hurricane push on the surface of the ocean, creating waves that can come all the way up onto the shore. That causes flooding. When this happens, it's called a storm surge. Storm surge waves can be incredibly destructive. Some people who live near the ocean have to build their houses up on stilts to protect them from getting flooded in a storm surge. The stronger the winds in a hurricane, the higher the storm surge. Together, the storm surge and the rain both add water to the city. And if the water has nowhere to go, the city will flood. But here's something to note. Even though Hurricane Katrina brought a storm surge and heavy rains, not all of New Orleans flooded. Let's zoom in on the city of New Orleans to see what happened. Here's the ocean. And here's the center of the city downtown. There's a big river running through the city. And to the north of the city is a lake, Lake Pontchartrain. After Hurricane Katrina, some areas of the city were completely covered in water, most of the north and southeast parts of the city. But other parts, like the southwest, didn't have nearly as much flooding. Why might that be? The whole city got hit by the same hurricane. Why do you think some areas had worse flooding than others?

## EXPLORATION VIDEO 3

Hurricane Katrina brought a storm surge and heavy rains, flooding most of the city of New Orleans and causing terrible destruction. But not all of New Orleans flooded. Why were some parts saved from the flooding? It turns out, the flooding caused by hurricanes depends on more than just the amount of rain and the size of the storm surge; it also depends on the shape of the land. For example, the first places to flood during a hurricane are the places closest to the ocean. Ocean water from a storm surge can flood the land near the shore and flood buildings if they aren't raised up on stilts. Places farther from the shore aren't as likely to get flooded by the ocean storm surge because they're higher up. We say they're higher elevation, meaning they're higher up from the surface level of the ocean. In New Orleans, all the areas close to the coast flooded. But this place marked in yellow didn't flood because it's pretty high up, it has a high elevation, and it's far from the ocean coast. But now wait, what about this place here? This part of New Orleans is on the north side of the city, far from the ocean. And yet, this part flooded. Why do you think that is? Well, what else do you notice? Notice that it's next to something else. There's a lake up here and a river going through the city. Think of all the rain a hurricane drops. That rain starts to fill up lakes, rivers, and canals, and with enough rain, all of those things will overflow. That makes the areas near the lakes, rivers, and canals the next most likely places to flood after the places on the ocean coast. So in the case of New Orleans, the ocean storm surge came from this direction, quickly flooding all of the low areas on the coast. Then the rain came, filling up the lakes, rivers, and canals throughout the city. Many of the canals had barriers around them, called levees, which are walls made of concrete and soil. A levee keeps water out of the city. But during Hurricane Katrina, many of the levees breached, meaning they broke open, or there was so much water that it started flowing over the top of the levees. In this picture, taken from a plane high above the city, the levee on the left side of this canal has broken. A boat actually smashed into the levee during the storm, creating a hole where water could rush out. Water then spilled into the city. In order to see where all that water went, we need to look at the shape of the land. You know that water flows from high places to low places. Places that are low elevation get more flooding because water naturally flows downhill and collects there. Just like puddles forming in a low spot. Now, during Hurricane Katrina, you might expect that water would flow out of New Orleans toward the ocean, since the ocean and coastline are low elevation. But that's not what happened. Instead, water stayed in the city. That's because New Orleans is a very low-elevation city. The land is actually below the level of the ocean in some places. It's hard to keep a low-elevation city safe from flooding. After Hurricane Katrina, engineers had to come up with ideas for how to make sure the city wouldn't flood in the future if another hurricane hit. The first thing engineers had to figure out was how to protect the city from a storm surge. They figured out that one way to do that would be to build a seawall, a giant cement wall along the ocean shore to block the storm surge waves. Another way to prevent storm surge would be to plant wetlands between the city and the coast. When a storm surge washes over the bushes and grasses in a swampy wetland, the waves slow down and get weaker. Another thing the engineers had to figure out was how to prevent rainwater from overflowing lakes, rivers, and canals. Engineers decided they could build stronger, higher levees to keep water from getting into the city. Finally, engineers could also elevate individual buildings, putting them up on stilts or platforms. That would keep buildings from getting flooded, even if water did get into the city. Now suppose you were an engineer. What would you do if you were in charge of protecting a town from flooding during a hurricane? You'll get a chance to figure that out in today's activity.

## ACTIVITY INTRODUCTION VIDEO

In today's activity, you're going to protect a town from flooding during a hurricane. The town you're going to protect is a pretend town called Beachtown. It's located along the Gulf of Mexico. Of course, Beachtown has great beaches. You could have guessed that from its name. It also has many historic buildings. Here's a map of the town. There's a famous hotel on the river that flows through town. There's an old city hall and many more historic buildings. Tourists come from all over to relax on the beaches and visit the town's old buildings. Unfortunately, Beachtown is in the path of hurricanes. When the last hurricane swept through Beachtown, it caused a lot of problems. The storm surge sent ocean water into many buildings near the shore, flooding them. Water from the heavy rains made the river overflow, flooding buildings nearby. It took months to clean out the water and rebuild all those historic buildings. Before another hurricane comes along, the town council wants to add some kind of flood protection to the town. Your job is to find a solution to Beachtown's flooding problem. If you're working as a team, each member of the team will be a different kind of engineer, with a different solution to the flooding. If you're working alone, you'll think like all four engineers. I'll show you how to get started, step by step.

## ACTIVITY STEP 1

If you're in a class, form a team of four and then choose a team leader. If you're working alone, you can just skip this step. When you're done, click the arrow on the right.

## ACTIVITY STEP 2

Get these supplies. You'll get more supplies later, but each team needs these things. If you're working alone, you'll still need all four engineering sheets.

## ACTIVITY STEP 3

Each person on your team is going to be a different kind of engineer. Now, each engineer gets a different sheet. Take about 15 seconds to choose which engineer you'll be and get the right sheet. Be sure someone fills out every sheet, or you won't be able to save Beachtown. So if you're working alone, you'll fill out all four sheets. I'll start the timer. OK. Time's up. Go to the next slide.

## ACTIVITY STEP 4

To protect Beachtown from flooding, you need to know where the water that flooded each building came from. Take a look at your sheet. On the map, find flooding that came from the ocean's storm surge. Make a small red X by every historic building flooded by the storm surge. Remember, each historic building is marked with a star. If a historic building is only partly flooded by the storm surge, it still gets a red X.

## ACTIVITY STEP 5

On your map, find flooding that came from the river. Make a small, blue X by every historic building flooded by the river overflowing.

## ACTIVITY STEP 6

Look for where river flooding overlapped with storm surge flooding. Historic buildings flooded by storm surge and the river should have both red and blue Xs. Trade papers with a team member to check each other's work.

## ACTIVITY STEP 7

Team Leader: divide this sheet into four parts by cutting on the thick black lines. Then, Engineers, take your part.

## ACTIVITY STEP 8

Each Engineer: read about your solution to flooding on your engineering sheet. Every Engineer has a different way to solve the problem. Then follow instructions one through four on your sheet. You'll use paper cutouts of your flood solution to show how you'll protect Beachtown.

## ACTIVITY STEP 9

Now that you're an expert on what your type of engineer can do, get your final supplies. Your team needs each of these things.

## ACTIVITY STEP 10

Now you're going to work together as a team to solve Beachtown's problem. Come up with a name for your engineering company, and write it on question number one on this sheet. Don't spend too long on this. Just spend about 15 seconds to come up with your name. I'll start a timer. OK. Time's up. Make sure your name is written down. Then go to the next slide.

## ACTIVITY STEP 11

The town council had many discussions about how much money they could spend on flood protection. Finally, they decided on a budget of $1 million. Go ahead and write that in question two of your budget sheet.

## ACTIVITY STEP 12

Put your maps on the table so everyone can see them. And make sure your flood solutions are placed where you want them.

## ACTIVITY STEP 13

Now it's time to share your engineering expertise. Each Engineer will report on what buildings their flood solutions can protect. Seawall Engineer: tell the team about seawalls. If it's helpful, you can use the sentence starters below. If you're working alone, you can skip this step.

## ACTIVITY STEP 14

Do number three on your worksheet. Write down the number of seawalls the Seawall Engineer has on their map. Then figure out the total cost, and write the answer here. You'll be filling out the rest of the chart in the next few steps.

## ACTIVITY STEP 15

Environmental Engineer: tell the team about wetlands. If it's helpful, you can use the sentence starters below. Everyone: write the number and cost of wetlands on question number four of your budget sheet.

## ACTIVITY STEP 16

Levee Engineer: Tell the team about levees by using these sentence starters. Everyone: write the number and cost of levees in question number five of your budget sheet.

## ACTIVITY STEP 17

Structural Engineer: tell about putting buildings on stilts. Everyone: write the number and cost of buildings on stilts on question number 6 of your budget sheet.

## ACTIVITY STEP 18

What would it cost if you decided to do everything each Engineer recommended? To figure that out, add up the costs of all the solutions. Use the back of the paper for your math, then write down the answer on question number seven. That's the total cost of doing everything.

## ACTIVITY STEP 19

$1 million seems like a lot of money, but I'm guessing you spent more than that. Now you have to figure out how to lower costs to under $1 million. Discuss how your team can spend less money and still save all the historic buildings. Look at your maps. Do you really need all the solutions? Write your cost-saving ideas on question number eight of your budget sheet. We have some hints for you on the next slide, but spend a minute or two discussing what you think before looking at our hints.

## ACTIVITY STEP 19B

Here are some hints for question number 8.

## ACTIVITY STEP 20

Now that you have some ideas, try them out. Put the paper flood solutions on the Master Plan map. Move them around until you have a plan you like. You can use the back of the budget sheet to figure out the cost of your new plan. Can you save all the historic buildings for $1 million dollars or less?

## ACTIVITY STEP 21

Decide on your final plan. Use gummy dots to stick paper flood solutions in place on your map, like this. Then, Team Leader: fill in the Final Plan worksheet with the team's help.

## ACTIVITY STEP 22

If you're working in a class, now's your chance to see what other teams have done. Your teacher will tell you how to display your plan. Then walk around to see all the other team's plans. There's more than one solution to Beachtown's problem.

## ACTIVITY STEP 23

Did other teams have ideas you didn't think of? Here are some questions to discuss after looking at other plans. Be sure to watch the final video when you're done.

## WRAP-UP VIDEO

In the activity, you had four different kinds of flood protection that you could build to save Beachtown: seawalls, levees, building on stilts, and wetlands. One million dollars might have sounded like a lot of money at first, but you couldn't build all of these things and stay within that budget. You needed to pick and choose among the different kinds of flood protection to figure out a combination of them that would protect all the historic buildings. As is almost always the case, there's more than one way to solve a problem. A group of us here at Mystery Science did this activity ourselves, and here was one solution we came up with. We knew we needed to protect these buildings from storm surge. We could do that with seawalls or with wetlands. Since wetlands cost less, we decided to go with those. It would take four wetlands to protect all those buildings, costing a total of $800,000. But we still needed to protect these buildings here from river flooding. We decided to use levees to do that. That took five levees, which cost $250,000. Adding all of that up, that came out to $1,050,000—just over budget. So we asked ourselves, is there a way to cut costs? We realized that protecting this one building right here was using both a levee and a wetland, a total of $250,000. But there's a cheaper way to protect the building from storm surge and river flooding—stilts. So we took out one wetland and one levee and put that building on stilts instead, and did the math again. Three wetlands, plus four levees, plus one building on stilts, equals $950,000. We did it, that's under $1 million!  It's within budget. In engineering, the town budget was an example of what we call a constraint. A constraint is something that is limiting what you can do when you solve a problem. It's the idea that you always have to work with what you've got. So if you have a limited amount of money to spend on something, that's a constraint. We almost always have a limited amount of money to spend on a project, so money is almost always a constraint. But it's not the only kind of constraint. Like, say a town member had said, “I hate mosquitoes. I don't want any wetlands in town.” That would be another example of a constraint. Or you might have had a limited number of materials to build with. Maybe you had no wood for house stilts. In that case, you would have one less option to protect the city against flooding. That's a constraint. Constraints are just a part of life. It doesn't mean you can't solve the problem, it just means you have to get creative. Being creative to work within constraints is a skill that you can develop with practice. Engineers have to get really good at it. They're always having to think about constraints, like how much money they can spend or which materials they can use or any deadlines they have to meet. But it's not just engineers who have to deal with constraints. I guarantee you have constraints right now in your everyday life. And you can practice getting creative with them. Maybe you go to the movies and your parents tell you that you can spend $5. There's popcorn, there's drinks, there's candy. You won't be able to get everything. Do you even have enough money to get two things? What can you buy? Well, you can get creative. Maybe you and your friend decide to split the cost of the popcorn. You probably also have to choose how you spend your time after school. Like, I bet it's challenging to play with friends and play sports and join an after-school club. There's just not enough time. But you can get creative. When you think about it, maybe you decide to join an after-school club that combines sports and your friends. You get the idea. Keep thinking about it. See if you notice other constraints in your life and come up with creative ways to work with them, just like an engineer. Have fun, and stay curious!