mystery science

Lesson: “Why do you have to clean a fish tank but not a pond?”

VIDEO TRANSCRIPT

EXPLORATION VIDEO 1

Hi, it's Doug! When I was a kid, I loved to keep animals as pets. I kept just about everything you can imagine. I kept frogs, I kept lizards. I even kept one of these. It's called an axolotl and it's a type of salamander. One time, a friend of mine was moving and he had some fish that he couldn't take with him, so he asked me if I'd like to keep them. I actually had never kept fish before, so I said sure. I was excited to care for a new kind of pet. "Okay," my friend said, "first we need to set up "the habitat for the fish." So, he came over with an empty fish tank and we started by putting gravel and plants in so that the fish would have places to hide. Then we filled the tank up with water from the sink. Now, it turns out water from the sink contains a little bit of chlorine in it like in pools. It's not enough to harm you when you drink it, but it could harm fish, so you need to put in a few drops of a special chemical to get rid of the chlorine. So we did that. Finally, the habitat was ready. We put the fish into the tank. Now, before he left, my friend gave me a container of fish food and told me to feed the fish a little pinch of food twice every day. Then he said, "Good luck! Keeping fish is really hard." I thought, really? I mean, how hard could it be? It seems like you barely have to do anything. My fish swam happily around their tank and they were fun to watch darting around, flashing different colors. But, only about a week later, I noticed something looked wrong. Some of them were swimming really slowly, kind of drifting around the water and occasionally turning upside down. They were still eating and breathing,

but they looked sick. What was going on? I checked through everything I knew. I was using the right water without chlorine. I was feeding them the right food. And, they didn't look like they had anything wrong on their bodies. What do you think was wrong with the fish?

EXPLORATION VIDEO 2

I went to a nearby pet shop to find someone who might know what was going wrong with my fish. I asked an employee who was in charge of the fish section at the store. "I bet we can figure it out," she said. “Lemme ask you some questions. First of all, how much are you feeding the fish?” I told her I was only giving a couple of little pinches of it every day. "Okay, that's good," she said, "You don't want to over-feed them." Then she asked about the water I used in the tank. I told her I used sink water treated with a special chemical to take out the chlorine. "Okay, that's good," she said. “Now let me ask, what kind of filter are you using for the tank?" Uh, I said, I don't have a filter. She said, "Well, that's probably it. Your friend probably forgot to give you a filter for the fish tank,” she explained. "When fish eat, they excrete waste. They poop, just like other animals do. If you don't have a filter for a fish tank, the waste builds up in the water until it becomes really unhealthy for the fish." So I bought a filter that day and I brought it home. After I let the filter run for a few days, my fish started moving around again and they made a complete recovery. All that I had learned about keeping fish, though, made me curious. Near my house was a small pond. If you looked closely at the water, you could even see fish swimming around in there. But there was no filter hooked up to the pond. Why do you have to clean a fish tank but not a pond?

EXPLORATION VIDEO 3

Waste does build up naturally in a pond, both from fish and from other animals that live in the pond. And it's not just their waste that's a problem. When plants and animals die, their bodies don't have anywhere to go. If you look at the bottom of a pond, you'll find what's called pond muck. It's a mix of waste and dead plant and animal material. Over time, pond muck builds up. There's always a layer of it on the bottom of the pond, and yet, ponds seem to stay healthy, even with all that muck. How is that possible? Well, if you look closely at pond muck, like with a microscope, you can start to figure out why. Pond muck is full of microscopic fungi and bacteria, both of which act as decomposers. They break down dead material, like dead leaves, dead insects, and animal waste, releasing micronutrients into the pond. So, you see, the reason animals living in a pond don't drown in their own waste is that a pond has decomposers to break that waste down. In my fish tank, there weren't any decomposers to break down waste, so I had to get a water filter to make sure that the waste didn't build up in the first place. But some fish owners actually put decomposers, like certain kinds of bacteria, into their fish tank so that they don't have to just rely on water filters. Now, it might seem like the more decomposers in a pond or fish tank, the healthier your fish, but there's actually a downside to there being too many decomposers. It has to do with the gasses that animals and decomposers need to breathe. Just like animals, many decomposers take in oxygen and they release carbon dioxide, which pond animals can't breathe, so pond animals and decomposers are actually competing for oxygen. The more decomposers you have, the more carbon dioxide there is in the water, and the harder it is for fish to breathe. But, can you think of anything that could help lower the amount of carbon dioxide in a pond?

EXPLORATION VIDEO 4

Though decomposers help to get rid of waste and dead material, they also give off carbon dioxide, which can make it hard for animals in the pond to breathe. Luckily, there's something that can help lower the amount of carbon dioxide in the pond: these. Plants. In a pond, plants play a very different role from animals and decomposers. Plants are producers, meaning they produce their own food. They don't have to take food or hunt for it the way that animals do. Instead, plants make their own food using carbon dioxide that they take in from the environment around them. In the process of producing their own food, plants also release oxygen. All these bubbles you see on these underwater plants, they're bubbles of oxygen being released. It's an ideal situation because animals and decomposers living in the pond need that oxygen in order to breathe. And plants aren't the only producers in a pond. That green slimy stuff on top of a pond is called algae, and it's also a producer. And if you look at pond water under a microscope, you'll find tiny phytoplankton floating around. They're microscopic plant life that just drifts around in the water. The word phyto means plants, and plankton means drifting. Algae, phytoplankton, and plants are all producers that take in carbon dioxide and give off oxygen. So, living things in a pond depend on each other. Fish depend on plants, both as food to eat and as a source of oxygen to breathe. Decomposers break down dead plants and animals and give off carbon dioxide. And plants take in that carbon dioxide and give off oxygen. All these different living things have a different role to play. They all affect one another. It's what we call a system—in this case, an ecosystem, a system of living things. It's a system because if one part were to disappear, the whole thing would break down. Living things in ecosystems depend on each other. And a pond isn't the only kind of ecosystem. Every habitat is a different ecosystem, each with its own roles and ways that things interact with one another. Scientists who study these

different ecosystems, like a forest, for example, often create a diagram or a model to show all the different parts and how they interact. For example, you could connect the plants in a forest to the decomposers in a forest, because when plants die, decomposers break down all that dead material. And you can connect decomposers back to plants, because decomposers release micronutrients into the soil, which helps the plants grow. Now you give it a try. How would you draw a model of a pond ecosystem to represent the connections between the living things in a pond?

ACTIVITY INTRODUCTION VIDEO

In today's activity, you're going to design a model of a pond ecosystem. You want to make your ecosystem a healthy home for this fish called a pumpkinseed sunfish. It's the biggest fish in the pond. You'll design your pond ecosystem using cards to represent animals, plants, and other living things. As you add to the pond, you need to pay attention to what each living thing needs. You'll also have to keep track of the carbon dioxide level in the pond's water. You'll use all of this to play a game called Big Fish. I'll show you how to get started, step by step.

ACTIVITY STEP 1

Find a partner. You and your partner will share cards and build an ecosystem together. If you're working alone, that's okay for the first part of the activity, but you'll want to get some partners to play the card game later. When you're done with this step, click the arrow on the right.

ACTIVITY STEP 2

Get these supplies; you'll get more supplies later.

ACTIVITY STEP 3

Cut the dotted lines on each card sheet to make a set of cards.

ACTIVITY STEP 4

Here's how to set things up. On the Fish-O-Meter sheet, cut off the corner down where the pointer is. Then put the Big Fish in the Holding Tank. Be sure to read what the Big Fish needs. Now, keep in mind, you can't put the Big Fish in your pond until the pond has everything that the Big Fish needs.

ACTIVITY STEP 5

Find the carbon dioxide tracker on your Fish-O-Meter sheet. And then put the pointer at 15. That's the carbon dioxide level of a pond with just water. No animals, no producers, and no decomposers.

ACTIVITY STEP 6

To practice using the Fish-O-Meter, you need to put a card in your pond. So spread out your cards. Each card tells you how much carbon dioxide that organism adds to or takes away from a pond. With a partner, find any of the cards that adds carbon dioxide to your pond. Then go to the next step.

ACTIVITY STEP 7

Now you'll practice building your pond. You'll build it over here, to the right of your Fish-O-Meter. On the Fish-O-Meter, notice there are arrows. Those arrows show you where to buy Big Fish food cards, producer cards, and decomposer cards. Check what your card is. You'll find that information in parentheses, then put your card where it belongs. So, for example, tadpoles are Big Fish food, so we put them here where the Big Fish food arrow points.

ACTIVITY STEP 8

Now, let's practice using the carbon dioxide tracker. First, check how many points of carbon dioxide your card adds to your pond. For example, our card adds two points, so we're going to move the pointer to the right two times to add those points. See, now it's on 17. Move your pointer now to add the number of points on the card you picked.

ACTIVITY STEP 9

Okay, one last thing before you do the activity on your own. Practice putting in an organism that takes away carbon dioxide from your pond. So, for example, find something that takes away carbon dioxide, like this organism. Put it in the right place in the pond. Our card was a Producer, so we put it here. Then, move the pointer to the left to subtract points. Now, in this case, our card says “minus three,” so we'll subtract three points: one, two, three. Now our pond level is at 14 carbon dioxide points. It's still in the healthy zone. Go ahead and do one yourself and then go to the next step—you'll be ready to do the activity on your own.

ACTIVITY STEP 10

It's time to build an ecosystem for your Big Fish. Choose cards and put them in your pond one by one. Adjust the carbon dioxide level, and with each new card, pay attention to what your Big Fish needs. It'll need at least three fish foods to eat, at least two decomposers to get rid of waste, and a healthy carbon dioxide level. When you think your pond is ready, add the Big Fish. Make sure the carbon dioxide level is still healthy with the Big Fish in the pond. When everyone is done making their ecosystem, go to the next step.

ACTIVITY STEP 11

Discuss.

ACTIVITY STEP 12

Now you know a lot about how the pond ecosystem works, which organisms add carbon dioxide and which take it away. So it's time to play Big Fish, a game where you win by being the first to make a healthy home for a big fish.

ACTIVITY STEP 13

This is a four-player game. You and your partner find another pair of partners to play with. If you've been working alone, this is where you'll need to find a friend or a few friends to play the game with you.

ACTIVITY STEP 14

Go ahead and get these supplies.

ACTIVITY STEP 15

Choose who will be the Card Cutter. While that person cuts up the action cards, the other three of you decide who will be Card Dealer, who will be Rule Reader, and who will be Pond Checker.

ACTIVITY STEP 16

Every player: set up your Fish-O-Meter. Cut off the pointer if you need to. Put a Big Fish card in the Holding Tank. Make sure each player has one Big Fish card. Remember, you're not working in partners anymore, each person tries to win the game on their own.

ACTIVITY STEP 17

Card Dealer: mix all the cards really well, including the action cards that you just cut apart. You can mix them by hand or shuffle them. Then, deal five cards to each player, like this.

ACTIVITY STEP 18

Card Dealer: put the Pick-a-Card sheet in the middle of the table and set the remaining cards facedown on the Pick-a-Card square. Everyone can look at their own cards.

ACTIVITY STEP 19

Before you start playing, remember: the winner is the first player to meet all of a Big Fish's needs. And here's one more important rule: you have the keep the pointer in the healthy zone at all times. So don't play a card that would move the carbon dioxide levels either too high or too low.

ACTIVITY STEP 20

I'll walk you through the first play. The player to the dealer's right picks a card from the Pick-A-Card pile. Then they can play any card from their hand in one of three ways. Your first option is to put any of the cards in their hand in the pond and adjust the carbon dioxide level. Or instead, they can read an action card aloud if they have one, follow its instructions, and then discard. Or they can throw any card away in the discard pile. Go ahead and do the first turn. I'll leave your choices on the screen. Then go to the next step.

ACTIVITY STEP 21

Go around the table taking turns. Rule Reader: if anyone forgets the rules, you can read them aloud. Some of the rules are on screen, but all rules are on the Pick-A-Card sheet. Keep playing until the first player ready for a Big Fish says “Big Fish”! Once someone says “Big Fish,” go to the next slide to find out what to do.

ACTIVITY STEP 22

Congratulations to whoever said “Big Fish”! Now, the group has to double-check your work to be sure that your pond can really hold a Big Fish. Pond Checker: this is where your job kicks in.

Read the Check the Pond worksheet. Get answers from the person who said Big Fish. Everyone else, fill in your sheet at the same time. If everything checks out, that person wins, but if not, keep playing until someone wins. When you have a winner, advance the slide to watch the final video.

WRAP-UP VIDEO

You played a game to model the interactions between animals, producers, and decomposers in a pond. Creating a model is something that scientists often do when they want to figure out what's going on in a complicated situation. One thing they can do with a model is follow the movement of stuff, or matter, just like you did when you tracked carbon dioxide in your pond. Carbon dioxide starts as a gas in the atmosphere or underwater. Then plants use that carbon dioxide to build the material of their bodies. They turn carbon dioxide into their bark, leaves, stems, and roots. Those are all made using carbon. They're carbon substances. When plants are eaten by animals, the animals break down the carbon substances of plants to use as building materials for their own bodies. When animals die, the carbon substances in their bodies get broken down by decomposers, turning it into carbon dioxide gas again that goes back into the air or in the water. So, using a model, you can see how it's possible to follow carbon along a pathway through the living world. It's taken in by plants, consumed by animals, then released again by decomposers. It forms a cycle. Scientists call this movement of carbon through the living world the carbon cycle. So, why do you have to clean a fish tank but not a pond? Most fish tanks are not a complete ecosystem. They're missing one or more important parts. For example, if you have fish that like to eat plants, but you don't have any plants in there, you'll have to give them fish food. And without plants, there's also not going to be enough oxygen in the water, so you'll have to add a bubbler. Some people find it easier to just include live plants in their fish

tank. But even that's not a complete ecosystem. Can you think of anything else that's missing? Decomposers. Without decomposers to break down waste, you'll have to clean the water regularly. Many fish owners do this. They purchase filtration systems and do regular water changes. But there are some fish tank owners who try to create complete ecosystems. They put in living plants and they include bacteria so that they don't need to buy filter systems or to change the water so frequently. How would you create an aquarium if you had one? Have fun, and stay curious!