Lesson: “Why do plants grow flowers?”

VIDEO TRANSCRIPT

EXPLORATION VIDEO 1

Hi, it's Doug! You ever seen a lemonade stand before? When a kid wants to make some money, it's the obvious thing to do. A hot summer day, something cold and refreshing people want to buy—a lemonade stand is a great idea. But you get to thinking about it—you know what's colder and even more popular than lemonade? Ice cream! That's the ticket: make ice cream. You're going to get people lining down the block to buy it. It'll be great. OK, so you’ve gotta offer at least two flavors, right? Chocolate and vanilla. So you head to the grocery store to buy the ingredients. Now, for the chocolate flavoring, you know that you can buy chocolate syrup. It comes in a big bottle and it's not too expensive, so that's done. For the vanilla flavoring, though, you're not so sure. What do you use to make something taste vanilla-flavored? Well, you ask around and someone explains that vanilla flavoring comes from vanilla beans. That's the seed pod from a vanilla plant. And, holy smokes, each vanilla seed pod costs $6 just for one bean. That can't be right. You ask a grocery store attendant, "Um. Excuse me, sir, is this the correct price on here?" "Yup, $6. That's what you'll need for vanilla flavoring," he explains. “You get the flavoring by squeezing the bean and the seeds that are inside. You'll need at least five or six beans.” Ugh, that's going to get expensive. But wait a minute—you have an idea. Could you plant a vanilla bean and just grow more vanilla beans? You ask the store attendant and he says, "Well, it would take a while, but yeah, you can do that. When you plant a vanilla bean it'll grow

into a vanilla plant. At first, the plant we'll have beautiful flowers growing on it. But after several weeks, some of the flowers will shrivel up and vanilla beans will grow right at the base of where those flowers were." *Whoa*, you think. Hey, forget about selling ice cream. At $6 per bean, you could be making way more money selling vanilla beans themselves! And this actually might be a simple thing to do: just plant some vanilla seeds in a garden and then collect their seed pods once they've grown. This is genius. You think to yourself, *Pssh. Lemonade stands are for babies.* Now, to grow vanilla seed pods, you're going to want to grow a lot of them—as many as possible. And for that, you're going to need to find some space to grow them. So you ask around and it turns out that in nearly every community—this is true—there's a community garden where members of the community can plant and grow things. Now, as luck would have it, there's extra space in the community greenhouse, so you get to work planting your vanilla seeds in there. They soon sprout and grow up into vanilla plants, which look like this. All right! Soon, you're going to have vanilla beans. Cha-ching! That's going to be a lot of money. Your vanilla plants grow these pretty flowers, but they're not growing any seed pods. What's going on? Finally, you decide, well, I should look for pictures and videos of vanilla plants that do grow beans to see if there's something I'm doing wrong. When you look more closely at videos of vanilla plants, that's when you notice this: all these bees were hanging around, landing on each flower, buzzing around from flower to flower. Oh, yeah, bees! That's right, you've heard about that before. Bees are always hanging around flowers when the flowers are blooming. They're important, aren't they? What are they doing exactly? Something about pollinating the flowers, right? But what does that mean? You didn't have any bees in your greenhouse. It was all closed off. Could that have been why you didn't get any vanilla seed pods? Hmm. What do you think? What exactly is it that bees are doing for flowers and plants? What do you know about pollination?

EXPLORATION VIDEO 2

When we talk about vanilla beans, or seed pods, it's important to keep in mind what this part of the plant is. Inside of a seed pod are the plant's seeds, and the seeds of any plant are just like babies—they're plant babies. It sounds funny to say it that way. We don't often put the word “plant” and “baby” next to each other, but seeds really are plant babies. Once the seeds are planted, they'll grow up into adult plants. So, again, your vanilla plants, they grew well and they grew flowers—but, as you learned, the flowers are supposed to eventually shrivel up and become vanilla seed pods. That never happened. Watching the video of vanilla plants in the wild, you were reminded that bees are somehow important. In the wild, flowers bloom. Bees are attracted to them, and eventually, the flowers turn into seed pods. It's almost as if the bees perform some kind of magic on the flower and that turns the flower into seed pods. What is it that bees do? Well, notice how it's the center of a flower that the bee is interested in. It crawls down in there. That bee is in there for a few seconds, and then it comes back up and flies away. When a bee does this, it comes out all covered in this yellow powder. Do you see that? This yellow powder is what we call *pollen*. Notice that the reason the bees are getting covered in pollen is because, as they climb down onto the center part of the flower, the flower has all these pollen dusters surrounding the center. You see the yellow pollen at the tops? The bees bump into those pollen dusters in order to get to where they're going, so the bees wind up getting really coated in pollen. There's a second part of the flower center to notice, and that's this thing right here in the middle, sticking up above the pollen dusters; it's this knob-like thing. Now, if you touch the end of this knob, you'll feel that it's sticky. It doesn't matter what kind of flower you have—if you look at the middle of any flower, there's always a knob-like thing that's poking above the pollen dusters, and it feels very sticky to the touch. Scientists call this sticky knob the

stigma. It might be helpful for us to remember it as the *sticky stigma*. So, as bees are flying in and out of a flower, not only are they getting covered in pollen from the pollen dusters, but they're occasionally bumping into the sticky stigma, and so some of that pollen gets stuck to the stigma. Scientists noticed all this and wondered if maybe that's the reason that flowers will drop their petals and then a seed pod will begin to form. Is there something important about pollen getting stuck to the sticky stigma? One scientist got curious and did an experiment in a greenhouse, taking some pollen from one flower and going around and dusting the sticky stigmas himself instead of having bees do it. Sure enough, now the flowers dropped their petals and seed pods grew. So, in order for seed pods to grow, there is an important process involved. The sticky stigma in the center of the flower needs to get pollen on it. This process of pollen needing to get on the sticky stigma in order for seeds to form, scientists named it *pollination*. Take a moment now, see if you can spot these two important flower parts—the pollen dusters and the sticky stigma—on some different kinds of flowers, like flowers you might find where you live.

EXPLORATION VIDEO 3

So, after learning all this, you go ahead and try to pollinate your vanilla plant flowers yourself. Using a toothpick, you carefully take some of the pollen from the pollen dusters and move it over to the sticky stigma. As you're doing this, you think, this is a little crazy that plants can't do this by themselves. All they need is for some of the pollen from the pollen dusters to get onto the sticky stigma. It's so close. But whatever—if this is what it takes to make vanilla beans, if you have to do this with a toothpick, you got to do it. So you do this. You wait a few weeks. And when you go back to check the plants—ugh, still nothing. The flowers still aren't turning into seed pods. It didn't work. What is going on here? Did you do something wrong? Didn't the

scientist put pollen onto the sticky stigma and it worked? What's missing? Let's watch a video of bees landing on flowers again—but this time, watch a little more carefully. See if the bees are doing anything different from what you were doing.

EXPLORATION VIDEO 4

So, you know that a flower needs pollen on its sticky stigma in order for its seeds to develop. But when you moved pollen from a pollen duster to a stigma, like this, it didn't work. Why not? Well, did you notice a clue in the video you watched? You already know that bees are interested in the center part of the flower; they're doing something in there. But did you notice anything else in this video? There was a clue, an important detail which you hadn't noticed earlier—right here. In this video of a bee, you could really notice the bee is flying from flower to flower to flower. It would land on one flower and crawl around toward the middle, do something, and then fly away to the next flower and repeat. This clue hadn't been obvious the first time. The pollen a plant needs on its stigma can't come from its own pollen dusters. Or, in other words, a flower can't pollinate itself. It needs pollen from a different flower to create seeds. For example, for this lily to form a seed pod, its sticky stigma has to get dusted with pollen from another lily over here, or one down the street. This even makes a little sense, if you think about it. Remember that plant seeds are baby plants. Well, just like animals, for a plant to have a baby there needs to be two parents: a mother and a father. In order for seeds to form, one plant has to get pollen on it from a separate plant. So, there are two parent plants involved, just like a mother and father. This means that, with your vanilla flowers, it won't work to use pollen from each flower's own pollen dusters. You won't get seed pods this way. On each flower's stigma, you have to get pollen from a different vanilla plant—say, one that's over here on the other end of the greenhouse. There need to be two parents. Now, how does a plant do this? That's easy, right?

The plant just gets up and walks over to the other plant, and they trade pollen. Ha, no. Of course they can't do that. Plants can't walk. Ah, so that's why bees are involved, do you see? Bees—unlike plants—can move around from flower to flower. So that's why it's such an important clue to notice the bee flying from flower to flower. And in the earlier example, the scientist had used pollen from one flower and walked around the greenhouse pollinating different flowers. So, now that you know this, it's time to solve your vanilla bean problem: what do you need to do in order to get the seed pods to finally grow?

EXPLORATION VIDEO 5

So now that your vanilla plant flowers have gotten pollen from other vanilla plant flowers, your seed pods will finally grow, and you'll make lots of money selling vanilla beans. Congratulations! That just leaves one question, though: in real life, I said that it's often bees that do pollination for many flowers. Why do bees help plants out like this? I mean, how would bees even know that plants need pollen to be moved? Are bees just somehow geniuses who study plants and want to be really helpful to them? "Here, I can see you're having trouble forming seed pods. Let me help!" No, no, no—there's a much simpler explanation, and the clue is what those bees are doing when they land on the flower. We already know that when bees are inside the flower they bump into the pollen dusters, which coats them and pollen. By the time they crawl out of a flower, they're covered in pollen. What we should ask ourselves is, why do the bees crawl in in the first place? Is there something about the center of the flower that they like? Well, check out this video. This is a bee that's landed on the center of a flower—and watch what it does. You see that, right there? What is that? That is the bee's tongue. It's sticking out its tongue and drinking something at the base of the flower's center. There is a liquid there, which the flower makes. If you were to take your finger and sample some of that liquid yourself, you'd find out

that it's very sweet. It's a little sweet treat, a tiny pool of sugar water made by the plant—we call it *nectar*. If you ever want to see a bee's tongue close up, just soak a paper towel in sugar water and leave it out for a bee to land on. You'll see it. Isn't that cool? Now, in order to get the nectar a flower offers, a bee has to crawl around the pollen dusters and also brush up against the sticky stigma. It's almost like a trick or trap. The flower tempts the bee with nectar, a sweet treat, but in order to get the treat, the bee gets pollen on itself. Once the bee is done drinking from that flower, it will go to another flower to get more nectar, but now it's covered in pollen. And as it crawls in, pollen will get stuck to the sticky stigma. Now that flower can make seeds. You know, it's not even fair for me to call this a trick—it's really more like a trade. Both the bee and the flowers are getting something that's good for them. I always thought it was a little surprising that plants could create a little puddle of sugar water for bees to slurp up, but plants are full of this nectar stuff. You might have already even known about it. Like, sweet maple syrup comes from the nectar inside of a maple tree. And sugar itself is just the boiled down nectar of a sugarcane plant. So, you eat nectar too, just like a bee. Here's a question for you: besides bees, do you know of any other animals that drink nectar from flowers?

ACTIVITY INTRODUCTION VIDEO

In today's activity, you're going to make a flower out of paper, and a bee using pipe cleaners. You're going to add some pretend pollen to your flower, and then fly your bee from flower to flower looking for nectar. The flower you're making is a model of a real flower. It looks like a lily, and it has the parts that a lily flower needs to make seeds. It has a pool of nectar at the center, it has a sticky stigma, and it has pollen dusters. Now, in a real flower, the pollen grows on top of the pollen dusters. That's not easy to do in your model. So, for your model flower, you'll pretend that the pollen has fallen off onto the petals of the flower where the bee lands. This happens in

real flowers too. See the pollen that's fallen on to the pedals here? Once you've created your flower model, you and a partner can practice seeing what happens when your bees land to drink nectar at each flower. Afterwards, you'll check your flower stigma to figure out whether your plant will make seeds. Are you ready? We'll show you what to do, step by step.

ACTIVITY STEP 1

Get these supplies. You'll get pollen for your flower later. When you're done with this step, click the arrow on the right.

ACTIVITY STEP 2

Choose colors for the pollen dusters, the nectar, and the leaves. Color the key and the flower parts. Leave the petals white so it's easier to see what's going on inside your flower.

ACTIVITY STEP 3

Cut along the dashed line to cut out the flower template.

ACTIVITY STEP 4

Take your flower base and put glue on the triangle, like this. Then, match the edges of the triangles. Press the flower onto the base to glue it down.

ACTIVITY STEP 5

Practice making the flower into a cone shape. You're going to move the petal like this, so it covers the gray triangle. Once you get the hang of it, you'll glue it in the next step.

ACTIVITY STEP 6

Put glue on the gray triangle. Make the flower into a cone and glue it together, like this.

ACTIVITY STEP 7

Now it's time to make a bee. I wanted mine to be striped, so I twisted two pipe cleaners together. But you can make these as simple or as fancy as you want.

ACTIVITY STEP 8

Find a partner to work with on the next few steps.

ACTIVITY STEP 9

Get pollen. Each group needs two kinds of pollen. It isn't real pollen, but it works like pollen in this activity.

ACTIVITY STEP 10

Put a big pinch of pollen in your flower. Use a different pollen than your partner's using.

ACTIVITY STEP 11

Now you'll add a sticky stigma. Hold out your thumb. Partner, peel the back off the sticky label. Wrap it around the thumb with the sticky side out. Make sure the sticky side is out.

ACTIVITY STEP 12

Put one hand behind the flower to hold it steady and stick the stigma on the black spot, like this.

ACTIVITY STEP 13

Switch jobs. Make a sticky loop around your partner's thumb so they can add a stigma to their flower.

ACTIVITY STEP 14

In a minute, your bee is going to fly into the flower. But first, discuss these questions.

ACTIVITY STEP 15

It's time for you and your partner to pollinate some flowers. Let your bee search for nectar in your partner's flower first, and then in yours. Your partner will do the same. Go back and forth from flower to flower.

ACTIVITY STEP 16

Look at the stigma of your flower to see if there's pollen on it. Then answer the questions on the bottom of your Flower sheet.

ACTIVITY STEP 17

Discuss these questions.

ACTIVITY STEP 18a

Discuss this question.

ACTIVITY STEP 18b

Here are some of our ideas.