But Why: A Podcast For Curious Kids

How Does Popcorn Pop?

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[Jane] This is *But Why: A Podcast For Curious Kids* from Vermont Public Radio. I'm Jane Lindholm, your host. This is a show led by you. You send us questions and Melody Bodette and I take those questions and find answers. Sometimes your questions are quite difficult and we don't necessarily have easy answers like “Who invented words?” and “Why are there so many religions? or like our last episode, “Why can't we all just live in one giant country together? Why do we have to have borders? We love those questions because it makes us all think and when we share our ideas and theories it helps us understand one another and the world a little bit better. But sometimes you send us questions that have definitive answers. And today we are going to tackle a bunch of them.

We're calling this our popcorn episode because we're going to go through a bunch of questions that pop up one after another. So it seems really fitting to start with this one.

[Will] Hi, my name's Will. I'm 6. I live in Watertown. I have a question: How do pop corn kernels pop and turn into popcorn to eat?

[Jane] Hi Will. What a coincidence? I just so happened to be standing in my kitchen in Vermont in front of my stove with a little bottle of popping corn in my hand. So I'm going to answer your question: but why not make some popcorn while I do?

Half a cup of popping corn kernels. All right, I’m going to put them into my pot. Add three tablespoons of oil. Ok, now I'm going to turn the heat to medium and I'm going to put the lid on but leave it slightly open so the steam can come out. So while that's heating up, let's talk about popcorn.

OK. So first of all picture a tiny kernel of un-popped popcorn. I'm going to get one in my hand. It's teeny tiny. You know what it looks like, it's yellow it's kind of shaped like a teardrop. Well, on the outside that yellow part is a hard outside coating known as the husk. The husk protects the rest of the seed and doesn't let any moisture in or out and it kind of protects the seed from getting crushed too.

Inside the husk is a tiny little droplet of water surrounded by something called the endosperm. The endosperm is what you're actually really eating when you eat popcorn. Do you know what endosperm means? OK. All of you 10 year olds can stop giggling right now.

Endosperm literally means “inside of a seed” or “within the seed.” The word comes from the ancient Greek language. “Endo” means in or inside, “sperm” means seed. So endosperm is a starch, or a fuel, and it's protection for the inner part of this seed. The germ is really the part of the seed that can turn the seed into more ears of corn, more corn plants. Anyway this endosperm is a starch or a fuel and this protection. And in the case of popcorn it's very hard. Try biting into a kernel of popcorn and you'll see it feels like you're going to break your teeth.

Yeah. Can't do that. Here's what happens when you heat up a kernel of popcorn. That tiny droplet of water I mentioned before, well, it starts to get really hot it gets hotter and hotter. And what happens to water when it gets really hot. I mean even after it starts to boil? The water turns into steam so that steam pushes through that and sperm and turns the endosperm kind of soft and gelatinous that endosperm builds up pressure. It wants to expand.

So it builds up and builds up and builds up. And finally it has enough force that it can explode through that hard outer coating that husk. Listen we're starting to hear it happen right now. So it explodes outward breaking through that outer shell, the husk, and you hear that process as the popping sound that gives popcorn its name because the kernel explodes and it pops right out of it. And then it might even hit the side of your pot and make an even louder bang. When it explodes that soft gelatinous endosperm hits cooler air and it hardens up in whatever weird wild popcorn shape it has exploded into.

So that's why popcorn has all those funny shapes in it feels kind of like foam. It's that soft material, that starchy endosperm, that has exploded and then hits the cold air and sort of freezes. Now actually popcorn, Will, is a very special kind of corn, not every kind of corn would do that if you heated it up. For example, let's say your family is having corn on the cob for dinner some summer night. If you took a kernel of that corn and dried it out and then tried to pop it in a popcorn popper, it probably wouldn't work.

People have actually been making popcorn for more than a thousand years. Archaeologists even found popcorn in a cave in the southwestern United States that are more than 5,000 years old. This species is indigenous to the Americas. Do you remember what “indigenous” means? We've talked about it in a couple of previous episode. Indigenous means something that originates or comes from a specific place. It's native to a specific place. So indigenous people in North and South America figured out how to popcorn from this species of corn that was growing here in many, many years ago and they showed colonists from Europe how to make it and it took off as a snack from there. Popcorn was especially popular in the United States in the 1800s people used to peddle carts around in the cities and give, well, sell people popcorn for five or ten cents a bag. And today the National Popcorn Board says Americans eat about 14 billion quarts of popcorn every year. That is a lot of popcorn!

By the way have you ever wondered why some kernels of popcorn don't pop? Apparently those kernels are called spinsters and they usually don't pop because something is wrong with the kernel. Either there isn't enough water inside the center of the kernel to build up that steam and that pressure or sometimes that outer shell, that husk is actually cracked. And if the shell is cracked the pressure can build up inside it because the steam can just kind of escape through that crack. So when the water droplet gets heated up it never explodes.

All right, our popcorn is done popping and I'm going to move it off of the stove. And Will I hope that answers your question.

Now I'm going to take some popcorn with me in the car and I'm going to leave my kitchen and head back to the studio to answer more questions.

Good popcorn.

Our next question comes to us from Juneau, Alaska.

[Brook] I'm Brook and I'm five and I want you know how salmon get back to the place where they lay their eggs and how to spawn?

[Riley] Hi Brook. I'm Riley Woodford with the Alaska Department of Fish and Game here in Juneau, Alaska. Every summer I watch salmon spawning here in Juneau. I've recorded what it sounds like on salmon streams and you can hear: It's amazing on a summer day by a salmon stream in the forest to see hundreds even thousands of big fish filling a stream splashing and swimming around. Close to the ocean and in the intertidal, seal swim up the streams and catch salmon to eat. The spawning salmon attract a lot of birds and ravens, bald eagles and gulls are everywhere, swooping down to the water and sitting on the riverbank feeding on the eggs and the dead and dying fish. And here in Alaska we often see bears catching and eating fish at the salmon streams.

To be sure everyone understands your question, I'll clarify what you mean about spawning and getting back to lay their eggs.

Salmon are not like most fish. Fish in many lakes and rivers live their entire lives pretty close to where they hatch out of eggs. Salmon and some other kinds of fish are anadromous. That means they're born in freshwater, swim out to the ocean and live most of their lives in saltwater, and then return to freshwater to spawn, that is to lay and their fertilized eggs. Some anadromous fish return to any freshwater stream, they aren't specific. Others like salmon, almost all return to the same stream where they hatched. Most anadromous fish, including all salmon, die after they spawn. Salmon quit eating

when they enter freshwater and their bodies begin to break down. They change color and often their heads and bodies change shape.

There are five different kinds of salmon in Alaska and they spawn at different times between June and October. Some like pink salmon are 16 or 18 inches long and weigh three or four pounds. Some, like Chinook salmon, can be as long and as heavy as a second grader at your school. After the eggs hatch in the fresh water in early spring the different species of salmon do things a little differently. Some immediately go down river to the ocean. And others live in freshwater for a year or two years before they go to the ocean. They live in saltwater from two to six years before they return. There's a lot of food in the ocean. That's the benefit of being anadromous.

Alaska salmon can swim thousands of miles out in the Pacific Ocean and you want to know how they find their way back to their natal stream, the stream where they were born? When those young fish are still in the freshwater they learn to identify the way their natal stream smells. They imprint on the chemical nature of the water. They also have a kind of salmon GPS. Salmon sense the earth's magnetic field and when they're young they also register the location of the stream, kind of like logging a GPS waypoint. When they're far out in the ocean, their internal compass helps them navigate back to their natal stream and when they are close their sense of smell helps guide them in.

Some salmon spawn just a few hundred feet upriver from the ocean and others may swim hundreds of miles or even a 1,000 miles up a big river to spawn in the headwaters. They lay their eggs and die and the cycle starts over.

[Jane] Riley used one word that might ring a bell to you if you have listened to a lot of episodes of our podcast. When we went to the main coast a few episodes ago we learned about a type of fish called an Alewife. And our guests described alewives as anadromous: fish that live in salt water but are born and lay their eggs in freshwater. If you missed that episode you should go back and listen. We also learned about cannibalistic lobsters, but now you know a couple different kinds of fish that are anadromous, and you've been reminded of another vocabulary word.

We gave Riley Woodford another question to answer, this one is about rabbits.

[Riley] My name is Riley. I am six years old. I live in Pelham, New York. How do rabbits change colors?

[Jane] From one Riley to another!

[Riley] Hi Riley. My name is also Riley. I’m Riley Woodford. I work with the Alaska Department of Fish and Game in Juneau, Alaska.

I was hiking in a forest here in Juneau and I saw a white snowshoe hare and I wondered about the same thing you ask. It was early in the spring and there were no leaves on the trees, or the bushes yet and the grass was still brown. But all the snow had melted. So this white snowshoe hare was really easy to spot. He stood out against the brown grass and leaves on the forest floor. Why hadn't he turned brown when the snow melted, I wondered. Here's what I learned: lots of mammals shed twice a year. They shed their summer and winter coats and grow a new coat of fur and hair that's more appropriate for the warmer or cooler season.

Birds also molt their feathers every year and grow new feathers and some birds like ptarmigan grow white feathers for the winter. A white coat against winter snow is the next best thing to being invisible. And that's important for predators and prey animals. Turning white is good camouflage in the snow. It helps predators like Arctic foxes sneak up on their prey and it helps prey like lemmings and snowshoe hares to better hide from animals that want to catch them and eat them.

You ask about rabbits but these are actually snowshoe hares, not rabbits. Rabbits like the European rabbits that people often keep as pets don't change color.

Rabbits and hares are closely related but rabbits tend to live in groups and underground burrows and hares do not. And hares tend to be bigger than rabbits. Like you, a lot of Alaskans call snowshoe hares rabbits. Alaska is also home to the tundra or the Alaska hare, a large cousin to the snowshoe hare and they also turn white in the winter.

Pigment gives your hair and your eyes and skin color. Hair is white because it doesn't have any pigment. Animals have cells that produce melanin, the natural pigment that gives hair color. When the snowshoe hair is shedding its summer coat and growing in its winter coat for the fall, melanin production is shut off and the fur comes in without pigment.

So how does the pigment production shut off? Animals register changes in the photo period, the hours of daylight which spurs the secretion of hormones such as prolactin and melatonin. Hormones tell the cells what to do, to shut off the production of pigment in the fall and to turn it on again in the spring. It's not because the days and the nights get colder or warmer it’s because the days get longer and shorter. You can test this with hairs that are kept indoors away from sunlight and the normal day length. Scientists have done this indoors. They shorten a photo period. Shortening the photo period induces hormone production and the growth of the white pigment-free winter coat and lengthening it stimulates the spring time phase.

So if the hare I saw was able to avoid the hungry goshawks or coyote for a few more weeks that spring he would probably have been OK.

[Jane] Riley Woodford has a radio program in Alaska called Sounds Wild. It's all about the fish and wildlife in that state. We have a link on our Web site www.butwhykids.org if you want to check it out.

[Zoey] My name is Zoey. I'm from Richmond, Vermont and I'm eight and I have a question: why does television fry your brain?

[Linda] Hi, Zoey.

[Jane] That's Linda Holmes. She watches a lot of TV for her job talking about pop culture and entertainment for NPR.

[Holmes] So why does TV fry your brain? You know, I don't think TV necessarily fries your brain. I watch, and I have watched, a lot of TV and I think I have a pretty good brain and I would guess that a lot of other people who watch TV have pretty good brains.

I think the reason why people tell you that TV fries your brain is probably that TV, like a lot of other things, comes in lots of shapes and sizes. There's good TV and there's not so good TV. And for some reason bad TV sometimes is the kind that people will watch lots and lots and lots of. It's almost like with food, that you have to be careful what you pick. So it's not so much that food itself is good or bad for you, it's just that you have to be you know picky about your choices.

I think TV is the same way. For me the kind of TV that's good is anything where you learn something or you find out about how other people live, or what other people do. There are lots of shows about maybe families that aren't like your family or kids who aren't like you or people who live in other parts of the world or animals or people who have interesting jobs. There's a lot of stuff like that out there. The stuff that I tell people to stay away from is things where it's fun but it's mean. Where it's mostly about making fun of people, or making people feel bad. I think those can be things that aren't so great.

The other thing that you have to be careful about with TV and the other reason why I think sometimes people tell you that it fries your brain is that a lot of kinds of TV come with lots and lots of commercials that are meant to make you buy things. And so whenever you're watching TV and you're looking at commercials you have to be really careful that you're thinking about why are they trying to make me buy this thing, and how are they trying to make me buy it. And those are the kinds of things that can make you a really smart TV watcher.

And I think that if you do those things, if you're careful about what you pick and you don't watch it for too long, and you are thoughtful about, you know, why there's so many commercials in certain kinds of TV. Then you can be a good TV watcher and of course there's always stuff like public TV which doesn't have any commercials and has a lot of that stuff like about, you know, animals and an arts and interesting things and interesting parts of the world. But I think if you make all those choices carefully it doesn't have to rot your brain. As I said I don't think it rotted my brain but I've gotten more and more careful about what I pick. And I think that you should too.

[Jane] Linda Holmes writes about pop culture and entertainment for NPR. And your parents may know her from the Pop Culture Happy Hour podcast.

[Welly] Hi, my name is Welly and I'm four years old. I want to know how zipper zip stuff?

[Jane] Did you catch that? Welly wants to know how zippers zip stuff. You probably use zippers every day. But how much do you actually know about them?

[Bryon] My name is Bryan Robinson. I work for YKK, it's the largest zipper company in the world.

[Jane] Look at any of your zippers. The tabs, the part you pull up and down, chances are it says YKK. The company is based in Japan but in the United States the zippers are made in Macon, Georgia.

[Bryon] The zipper was first invented in 1891 by a gentleman called Whitcomb Judson. But it wasn't until 1913 that the zipper as we know it today was patented. It was patented by a man named Gideon Sundback and he used it for women's boots, to zip up the side of the boots, and that design and that patent today looks almost 100 percent like the zipper we use now.

Basically how a zipper works, a zipper is made up of three components: you have the textile tape, like the material and that's the part that you sew into your garment, like a jacket or your pair of jeans, or your sleeping bag, a really good example would be like your backpack. That part is what holds the zipper into that garment. You have the slider, that's the part that moves up and down, with that slider.

The most important part after that is the elements. These are the little teeth that when the slider moves up and down the elements interconnect with each other and this interconnecting is what causes the zipper to stay together.

So if you look at some examples, if you take a deck of cards and you shuffle a deck of cards like one card on top of the other. If you think about the teeth of a zipper being each card, the one on the left goes on top of the one on the right on top, and so forth and so on. And by doing that everything is locked together.

Another way to visualize it if you take your fingers and you put one finger on top of the other, on top of the other, on top of the other, and squeeze down and try to pull your hands apart. You'll find that it's very difficult to pull your hands apart because your fingers are acting like the teeth of a zipper. So once those teeth are interlocked together the zipper stays zipped like on your backpack or your pair of jeans.

Very interesting is on the first trip to the moon with NASA. In the space suits there are YKK zippers. It's a very high end zipper. It's water tight and will not let air through. So you can imagine with trip to the moon, that was very important for the space suits.

[Jane] So there you have. Something to think about the next time you are zipping up your backpack. And if you really want to see how a zipper works, have an adult help you go to www.butwhykids.org. We have a link on this episode to an animated video that shows you all about it.

I'm out at the University of Vermont outdoor track to answer our last question of today's episode.

[Dieuna] My name is Dieuna and I am eight years old. My question is who is the fastest runner in the world?

[Jane] The fastest runner in the world is Usain Bolt. He's the fastest man who's ever been timed. He's a 30-year-old Jamaican sprinter and he holds the world record for both the 100 and the 200 meter sprints. He has nine gold medals at the Olympics and 11 world championships. His record for the 100 meter sprint is 9.58 seconds. That is super-fast. That's more than 23 miles an hour.

How fast do you think you could run 100 meters? I'm going to give it a shot and try it out right now. This track is really snowy and slushy. I don't know if you can hear it. So that may slow me down. I'm going to try not to give any excuses I'm going to run as fast as I can. I put my sneakers on and we'll see how close I can come to Usain Bolt. Let me get my timer out. All right. Ready let's do it together. On my mark, get set. Go.

23 seconds. In 23 seconds Usain Bolt could have gone all the way to the end and back and started running out again in the time it took me to do just one 100 meter dash. Holy smokes that is fast!

So Usain Bolt is the fastest man alive. The fastest woman is Florence Griffith Joyner. She set the world record in the 100 meter dash for women at 10.48 seconds. And she set that record almost 30 years ago in 1988, but no one has beat it yet.

So those are the fastest runners in the world, but they're running very short distances. If you run a longer distance you're probably going to be slower, well you are going to be slower, because you have to maintain that speed over a longer distance and amount of

time. The fastest marathoners finish 26.2 miles in just over two hours which is still really fast. That's under five minutes per mile. Why don't you try running 100 meters yourself see how fast you can do it? Tell us how you do. I bet you can run faster than me.

That's it for this episode, our popcorn episode. Big thanks to Linda Holmes, Bryon Robinson and Riley Woodford. I learned a lot today and hope you found something interesting too.

If you have a question you'd like us to answer, have an adult record it on a smartphone.

Tell us your first name, where you live, and how old you are, and send your question to questions@butwhykids.org.

But Why is produced by Melody Bodette and me, Jane Lindholm, for Vermont Public Radio, where we have help from a lot of cool people including Sara Simon, Jonathan Butler and Emily Alfin Johnson. Our theme music is by Luke Reynolds.

We're working on a big episode all about our weird and wonderful bodies. So check back in a couple of weeks for that. And until then, stay curious!