

Fiona: You're listening to Brains On...

Ezra: Where we're serious about being curious.

<<Brains On is supported in part by a grant from the National Science Foundation>

<<Laughter>>

Molly: Meet Peter, Max and Noah.

<<Peter: Well, we're buddies.>>

Molly: These pals are all about the same age. They go to the same school in New Haven, Vermont. They like a lot of the same things - like reading, playing ball, and of course...

<<Peter: He likes pizza and I like pizza.

Max: Noah do you like Pizza?

Noah: Yeah, pizza.>>

Molly: Agreed. Pizza is life. Max says they have their differences too.

<<Max: Noah likes asparagus and I do not.

Voice: Do you like asparagus?

Noah: Yeah, I like asparagus.

Max: Another difference is that I do not like chicken and Noah does.>>

Molly: So.... They probably shouldn't order an asparagus, chicken pizza -- but that's not really going to get in the way of their friendship.

If we were exactly the same as our friends that would be kinda boring. Differences offer surprises and let us learn about things we might never even know existed or didn't think were that cool in the first place.

Some differences come from the place you grew up in. Like the language you speak or your favorite baseball team. Go Twins! Other differences, like your hair or eye color, are biological -- they come from your body, your cells and your chromosomes. Chromosomes are part of your cells and they hold the blueprints, the DNA, that makes you -- you.

One difference between Peter, Noah and Max -- is that Max, like most people, has 46 chromosomes in his cells. Peter and Noah's cells have 47.

<<Peter: I have an extra chromosome.>>

Molly: That extra chromosome means that Peter and Noah have Down Syndrome. For Peter, it's just another thing that makes him... *him*.

<<Peter: Yeah. And... I like Down Syndrome. I think it's cool.>>

Molly: For Max, meeting someone with Down Syndrome made him curious.

<<Max: When Noah came into the school - that made me want to know the answer to this question: What causes Down Syndrome? And so I sent the question into Brains On.>>

Molly: We'll be answering that today. Keep listening.

This is Brains On from American Public Media. I'm Molly Bloom. Here to help me answer Max's question about Down Syndrome, is 12-year-old Ezra and 10-year-old Fiona from St. Paul, Minnesota. Hello!

Fiona: Hello.

Ezra: Hi.

Molly: So, you guys are siblings...

Ezra: Yeah.

Fiona: Yes we're siblings. He's my brother.

Molly: Do you always get along?

Ezra: No.

Fiona: Yeah.

Ezra: No.

Fiona: Yeah yeah yeah yeah yeah yeah yeah yeah!

Molly: So Fiona says you always get along.

Ezra: That's not true.

Molly: Ezra begs to differ.

Fiona: It's real brother! <<laughs>>

Molly: So you both like to do sports?

Fiona and Ezra: Yeah.

Molly: So what is your favorite sport, Ezra?

Ezra: Baseball.

Molly: What is your favorite sport Fiona.

Fiona: Swimming, biking, running and horses.

Molly: And horses. And Fiona, this is a question for you: Is Ezra a good brother?

Fiona: Yeah. My brother loves playing baseball, soccer and he's handsome just like me.

Molly: And Ezra, do you think Fiona's good sister?

Ezra: Yeah, she's really creative and fun.

Molly: Well, let's get to Max's question.

<<Max: What causes Down Syndrome?>>

Fiona: People with Down Syndrome are all unique.

Ezra: But sometimes they have similar characteristics due to their extra chromosome.

Molly: For instance, they may have similar shaped eyes or they might have a larger space between their first or second toes. It's also common for people with Down Syndrome -- or DS -- to have heart issues and challenges with memory and learning. This can sometimes slow their development.

Ezra: But having Down Syndrome doesn't define who a person is.

Fiona: I'm still Fiona. I love running, swimming, biking and riding horses.

Ezra: She just happens to have Down Syndrome. Just like I happen to have brown hair.

Molly: Down Syndrome is named after John Langdon Down -- a British doctor who first described the condition way back in 1866. It wasn't until almost one hundred years later -- in the late 1950s -- that scientists figured out it was caused by an extra chromosome.

Ezra: That word has come up a lot so far... chromosome?

Fiona: What is a chromosome?

Molly: Here to fill us in -- is producer Marc Sanchez.

Marc: Let's take out our handy-dandy zoom ray here and zoom right in [[zoom sound]] -- way in [[zoom sound]] -- to our cells.

Cells are those little units that make up our bodies -- and our bodies are made up of a practically unimaginable number of them -- many many trillions of cells. In fact, there are cells in just your body than there are people on Earth. There are a lot of cells.

Now, let's take one of those cells and zoom in again [[zoom sound]]. In the middle of that cell is a nucleus. Now zoom in again [[zoom sound]] -- inside that nucleus are chromosomes, 46 to be exact, 23 from the mother and a matching 23 from the father.

Now, let's zoom in one more time [[zoom sound]] on a single chromosome. Each chromosome is made up of one DNA molecule [[robot voice: DNA -- deoxyribonucleic acid]] and a bunch of proteins called histones.

Now DNA is the blueprint for everything in your body. It tells the cells in your body what to become and what to do.

DNA molecules themselves are really cool looking. Each DNA molecule is shaped like a long, skinny double helix. Picture a ladder that twists from one end to the other. So instead of going straight up, it kind of spirals from top to bottom.

DNA strands are so long and skinny they wouldn't fit inside the cell without being part of a chromosome. In a chromosome, these DNA molecules wrap around the proteins, like a thread wraps around a spool. It's a neat space-saving trick.

Scientists are hard at work trying to figure out what all the different sections of DNA do. These sections are called genes. Right now, for example, we know that two of the genes that affect eye color are located on chromosome 15. The gene that controls if you're lactose intolerant is on chromosome 2.

Scientists still have a lot left to learn about chromosomes and DNA and genes. So for now, I think it's time to zoom back out to Fiona, Ezra and Molly in the studio. [[zoom sound]]

Molly: So, we know that people with Down Syndrome have an extra copy of the 21st chromosome, which is why it's sometimes called trisomy 21.

Ezra: Tri for three, like in a three wheeled TRI-cycle.

Fiona: Or a TRiceratops.

Molly: But how does an extra chromosome lead to Down Syndrome?

Ezra: To find out, we talked to Dr. Brian Skotko.

Molly: One of his sisters has Down Syndrome and that inspired him to work in a field where he could help people like her.

Ezra: Now he's a doctor and the Co-Director of the Down Syndrome Program at Massachusetts General Hospital.

Ezra: Is there an easy way to explain Down's Syndrome to my friends?

Skotko: I heard from one sibling who has a brother or sister with Down syndrome that she explained Down syndrome like baking a cake. If you look at the recipe for most cakes it involves two eggs. Yes, you throw the milk in there, you throw the batter in there, you mix it together and you have a great cake. But let's say we threw an extra egg in the recipe. It would still turn out to be a cake. Yes, maybe a little fluffier but it would still be a cake. People with Down syndrome have an extra ingredient. They have an extra chromosome, they have that extra egg and that turns out to be wonderful humans, wonderful brothers and sisters, wonderful sons and daughters but they also have an extra ingredient that makes the composition of who they are sometimes a little bit different.

Ezra: So my sister, she doesn't see herself different than anybody else. Do people with Down syndrome really realize they have Down syndrome?

Skotko: Many people with Down Syndrome understand what the condition is and some people don't necessarily fully grasp that. It really depends on the age of the person and also their development. But what's important is that everyone with Down syndrome realize that they're important, that they're special and that they value to their families and to their communities.

Ezra: How does having an extra chromosome lead to Down syndrome?

Skotko: By having an extra copy of chromosome 21 the body has extra genetic material and that's what causes Down syndrome. Some people might say, well isn't extra chromosomes good? Having extra genes that must be a good idea. And actually there are many advantages to having an extra copy of chromosome 21. People with Down Syndrome almost rarely get breast cancer, almost rarely get solid tumors. So having those extra genes from extra chromosome 21 helps fight cancers.

But we also know having those extra genes sometimes can confuse different parts of the body and can lead to health challenges. Chromosomes are really the blueprints for our body and when you have an extra set of instructions that could either work to your advantage or it can confuse some of the cellular biology and that really depends on every organ -- which chromosomes they tap, which blueprint they rely on and how often they rely on those throughout one's life.

Molly: So why is it that different people who have Down syndrome might have totally different medical conditions that occur with it? Some people have heart conditions, some people don't. Why is it so different?

Skotko: We know that everyone with Down syndrome has extra chromosomal material from chromosome 21, but people with Down syndrome are so varied -- not only in their personalities but in the medical conditions that they get or they don't get. Why is that? It eludes scientists right now. So researchers and scientists are trying to unravel what causes certain conditions in some people but not others. Stay tuned for good research coming down the pike.

<<music>>

Molly: So, Ezra -- did anything stand out to you from talking to Dr. Skotko?

Ezra: Yeah, like, a simple way to describe Down syndrome is it's like a cake. Like you usually use two eggs but sometimes you can use three. Like, it's still going to be a cake, but it might just be a little fluffier.

Molly: Yeah, that's a really good way to describe it.

So now we have a picture of what Down Syndrome is and how it works. But Max had another question too.

<<Max: Is there anyway to, like, fix someone who already has it?>>

Molly: To answer that we spoke with Linda Smarto from the National Association for Down Syndrome.

<<Smarto: Can you fix a chromosomal abnormality? The answer is no. They're working on that -- maybe try to discover ways to fix this when the baby is in utero, meaning within the womb. But as of now there is no way. And from a parent's perspective, since my daughter has Down syndrome. If you were to ask me 23 years later, as my daughter is 23 years old, if I would wanna change anything about my daughter, the answer would be no.

I would like to look at it more as assisting an individual with Down syndrome. So let's think about what are the best ways in which we can assist somebody with Down syndrome. Providing them with a lot of support, with a lot of friendship, helping an individual with Down syndrome and letting them soar to their full potential. Not to put any limitations on anybody especially those who have that extra chromosome.>>

<<music>>

Molly: Ok -- before we go any further, we need to do something very important. We need to hear the Mystery Sound. Here it is guys -- ready?

<<sound>>

Ezra: Sounds like a pig eating.

Molly: Ooh, a pig eating. That's a good guess. Fiona, what is your guess?

Fiona: Cow eating hay.

Molly: Cow eating hay. Those are both really good guesses. We will be back with the answer in just a little bit.

<<music>>

You listen to Brains On so that means you have something really valuable to us: your thoughts about the show. We're working with the National Science Foundation to make Brains On even better and we'd love to hear from you. How do you listen? Why do you listen? What are you taking away from the show? We want to know! You can really help us out by answering a short survey online, or by signing up to be part of family interviews. And, you'll get a cool thank you surprise for helping us out. Just go to Brains On dot org slash supernova. That's brains on dot org slash super N O V A. Thanks and high fives for the help.

Molly: Questions,

Ezra: Drawings,

Fiona: And high fives,

Molly: Are what fuels our show. We love and appreciate everything you send in. If you want to get in touch, email us at hello at brains on dot org. That's what Lilo did when she sent us this question.

<<Lilo: One morning when my mom was making me breakfast I was wondering why the eggs were turning from clear to white when they were cooked.>>

Stick around to find out the answer and hear the latest additions to the Brains Honor Roll. All at the end of the show.

<<Ad break>>

Molly: Today on Brains On, we're talking about Down Syndrome. I'm in the studio with siblings Ezra and Fiona. Hi guys!

Ezra: Hi!

Fiona: Hi!

Molly: One thing we typically see in people with Down Syndrome is something called muscle hypotonia. It means having low muscle tone. This can make it harder for some people with Down Syndrome to control their muscles and do complicated movements quickly. It can even affect mouth muscles, making it harder to speak. Which is why some people go to speech therapy. Fiona, you go to therapy, right?

Fiona: Yeah.

Molly: What is your therapist's name?

Fiona: Sarah.

<<Sarah: My name is Sarah Bowman and I am a speech pathologist. We are targeting some specific speech sounds such as the ch and shhh and consonant blends, s blends. Like in the words snake or spot or star to help her overall speech clarity.>>

Molly: So she helps you?

Fiona: Yeah.

<<Back and forth between Sarah and Fiona from therapy session>>

<<Sarah: Well, when we're working on a specific sound, first we'll work on producing that sound in isolation and then the word level in phrases and then in conversation.>>

Molly: Now that we've talked about talking -- let's switch to listening. Here's that Mystery Sound again.

<MYSTERY SOUND>

Molly: Final guesses?

Ezra: Same thing.

Molly: Same guess?

Fiona: Same thing.

Molly: You're sticking with a cow eating and you're sticking with a pig. So we have a farm theme. So here is the answer.

<<Answer: That's the sound of the mini-horses eating. They're eating a grain to make them feel healthy.

Molly: So you guys were really close. You both guessed farm animals eating and it was a mini-horse eating!

Fiona: A horse!

Molly: Yeah.

Fiona: A horsey? I didn't think that it was a horse!

Molly: Fiona, I'm guessing you've seen a horse eat before.

Fiona: Oh yeah.

Molly: Because you ride horses, right?

Fiona: Yeah! My horse's name is KC.

Molly: Your horse's name is KC?

Fiona: Yes. He's a boy. KC is a good, awesome horse.

Molly: What do you do when you ride the horse? Do you go fast, do you go slow?

Fiona: So fast.

Molly: You go really fast.

Fiona: Yeah.

Molly: So the horse from the Mystery Sound lives in Texas -- near Austin -- at a farm called the Down Home Ranch. It's a place where lots of people with Down Syndrome live and work with animals. Our producer Sanden Totten joined them for their morning chores.

<<Carl: My name is Carl. I take care of farm animals.

Travis: I'm Travis and I live at Down Home Ranch.

Sanden: What's the first chore?

Carl: We go inside and scoop their poo and after that we lay out hay.

Travis: The ranch is a working community. It's a place to live. Well, my grandfather was raised on the ranch too.

Carl: Well, my favorite thing is to ride horses but my least favorite is how heavy the hay is. That's my least favorite.

Sanden: What's next, what chore's next?

Travis: Cattle.

Naomi: I'm Naomi and I work with the ranchers here helping take care of the animals.

Sanden: They're spreading out the cow cubes for the cows to eat on the grass.

Naomi: The ranchers that we have you know they're are not interested in the city life. They love being out in the country. They like the freedom, they like the starry nights, you know, campfires and they like animals. There's a lot of people that might not want to interact with others but you get them with an animal and they'll interact with the animal or talk to them. They really open up.

<<moo>>

Travis: Oh no baby, calm down. Next step is chickens.

Sanden: Ok. Let's do it. I've been practicing my chicken call. Want to hear it? <<clucks>>

Travis: And the rooster goes: <<crows>>

Sanden: That was pretty good!

Carl: It takes patience with the animals, to stay calm and give them space if they're wild. To be a rancher, it's passion, it's love, it's a part of your blood.>>

<<music>>

Molly: Fiona, do you think you'd like to live on a ranch one day?

Fiona: Yeah.

Molly: What do you want to do when you grow up?

Fiona: I'll be a hairstylist.

Molly: Ooh, a hairstylist.

Fiona: Yes.

Molly: What should my hair be like?

Fiona: You be brownish red.

Molly: I should get brownish red hair? I like it.

Molly: What about you? What do you want to do when you grow up?

Ezra: I want to be a physical therapist.

Molly: What inspired you to want to do physical therapy, anything particular?

Ezra: When I broke my elbow I had to do occupational therapy.

Molly: How did you break your elbow?

Ezra: I fell off the monkey bars when I was like 6.

Molly: Well I'm glad to see your arm is all better now and getting your dream job can be tough for anybody. But people with conditions like Down syndrome are often told they can't do certain things, which can make chasing a dream even harder. Thankfully, there are people like Annie DeFrain out there giving lots of encouragement. She has Down syndrome too.

Annie: I'm a program aide at Wing Lake center.

Molly: Wing Lake Developmental Center is a place for people with severe developmental disabilities. Students anywhere from age three to 26 learn and practice life skills. One of her favorite parts of the job is helping students with something called Occupational Therapy, or OT. Together they practice everyday skills students might have trouble with on their own.

Annie: Like today is Wednesday, so Wednesday is occupational therapy, they do a lot of fine motor skills, which is mostly hands on. Like today, the students made pumpkins, and we made pumpkin faces. Sometimes we make brownies, I remember a time where we made jello.

Molly: Annie says a lot of the students have trouble with the activities on their own, but with a little help they get it done just fine. If they're really struggling, Annie will bust out a confidence boosting pep talk.

Annie: I'd probably will say I believe in you, you can do it, you can try it again. I think one of the skills that I teach people for getting the jobs is being positive, believing in their goals in life and being able to achieve them, and how to be kind and patient to other people. Never give up on anything, once you put your mind to it you will succeed in everything you do.

<MUSIC>

Molly: That was 30-year-old Annie De Frain. She spreads her words of wisdom in Bloomfield Hills, Michigan. She also had this advice for people meeting someone new with Down syndrome.

Annie: I wish people can be more understanding and patient, to communicate face to face. Also slow it down what you are trying to say so that I could hear them.

Molly: Being patient and slowing down your speech. That's good advice. Fiona and Ezra -- do you have any advice for when we meet someone with Down syndrome?

Ezra: Talk slow, but don't go fast. But don't talk down to them either.

Molly: I think sometimes people meet someone with Down Syndrome and notice they look or talk different then they're not quite sure what to do and instead of trying to figure it out they might just ignore them. Have you seen that happen?

Ezra: Yeah.

Molly: So what do you think they should do instead of just ignoring the person?

Ezra: Go up and say hi, I mean they're no different than anyone else.

Fiona: Say hi...

E: See if they want to play.

Molly: Having an extra chromosome is just one trait of many. You might think someone with Down Syndrome is really different from you -- but you both might like shopkins or horses. And we all know, some of the best friendships are founded on...

Fiona and Ezra: Pizza!

Molly: ... but maybe not with chicken and asparagus.

<music>

Molly: Down Syndrome is a condition where a person has an extra chromosome.

Ezra: That can result in many different characteristics. But no two people with Down syndrome are the same.

Fiona: We have different likes and dislikes. And we have our own hopes and fears.

Molly: People with Down syndrome may need extra help sometimes, but that doesn't mean they can't achieve big things.

Ezra: If you meet someone with Down syndrome -- or any difference really -- don't be afraid to reach out and get to know them.

Fiona: You might make a new friend.

Molly: That's it for this episode of Brains On.

Ezra: Brains On is produced by Molly Bloom, Marc Sanchez and Sanden Totten.

Molly: Special thanks to Shelly and Joanna Harris, Laura Goodfellow, Kristine Downey, Meaghan Rice and Beeman Elementary School in Vermont, Sandra Baker and the Down Syndrome Association of Los Angeles. Tracy Hafeman with the Down Syndrome Association of Minnesota, Travis, Kyle and everyone else at the Down Home Ranch.

Fiona: We have production help from

Molly: Jon Lambert, Emily Allen, Marcus Aarsvold, Jon Kalish and Lauren Dee.

Ezra: You can always send a question to hello at brains on dot org. Or you can follow the show on Twitter or Instagram.

Molly: Brains On is funded in part by a grant from the National Science Foundation. Before we go -- It's time for our moment of...

Fiona: Um....

<<Lilo: Hi, my name is Lilo and I was born in South Africa. One morning when my mom was making me breakfast, I was wondering why the eggs were turning from clear to white when they were cooked.>>

<<Adams: My name is Paul Adams and I am the senior research editor for Cook's Illustrated and America's Test Kitchen. One of my early childhood interests in cooking was about eggs and how visible and pleasing it is when you fry an egg. Basically an egg white is about 90 percent water with tiny little blobs of protein floating throughout it. And when it's raw the blobs stay out of each other's way and they're very small and you can see through it because it's mostly water and water is clear. When you cook it each protein blob, which is a folded up clump of long protein, unwinds and so each one becomes a long string and they all tangle together. So the whole egg white basically turns into a net and it's solid and there are tiny holes in the net but they're too small for light to really pass through. So the light bounces off and it looks white.>>

Molly: Clearly it's time for the most recent group of kids to be added to this Brains Honor Roll.

Lilia Joy from Manhattan Beach, California; Linnae and Bethany from Raleigh, North Carolina; Antea from Ithaca; Arthur from Nashville; Nathan from Mt Juliet, Tennessee; Aurora from Houston; Noah from Washington; Aaron and Daphne from Tucson, Arizona; Amelia from Champaign, Illinois; Charlie from Minneapolis; Geneva from Bellingham, Washington; Maya and Mira from Charlottesville, Virginia; Brielle from Calgary; Nic from Sydney, Australia; Nora from Tewsbury, Massachusetts; Timothy, Bethany, Rachel and AJ from Round Rock, Texas; Tyson, Cameron and Kaylee from Cedar Hills, Utah; Rowan from Juneau, Alaska; Blake from Wilmington, Massachusetts; Mae from Austin, Texas; Thomas from San Francisco; Lucian from Tampa, Florida; Sarayu from Bangalore, India; Sena and Luna from Oakland, California; Hannah from White River Junction, Vermont; Sierra from Madison, Wisconsin; Eleanor and Maxwell from Plymouth, Michigan; Aidan from Nashville; Hill from Crow-zay, Virginia; Adrienne and Ian from Santa Barbara, California; Lizzy and Emma from Oxford, Pennsylvania; Giancarlo from Liam, Peru; Ezra, Jonah and Orli from Silver Spring, Maryland; Romie from Duluth, Minnesota; Lee-luh from Carlisle, Pennsylvania; Eleanor from Charlotte, North Carolina; Cora from Sunbury, Ohio; Cammie from Oakwood, Ohio; Freja from Oakland, California; Robert from Atlanta; Thomas, Lydia and Markus from Marquette, Michigan; Jethro from San Francisco; Ivan, Allen and Clara from Silver Spring, Maryland; and Dominic from Strafford, New Hampshire.

Molly: We'll be back soon with more answers to your questions!

Fiona and Ezra: Thanks for listening!