

**Brains On! Exploratory Research:  
Impacts of Listening to a Children's  
Science Podcast**

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## STUDY OVERVIEW

The Brains On! exploratory research study is guided by three overarching research questions:

1. Who is the audience for Brains On! and what are their motivations for listening to children’s science podcasts?
2. How are Brains On! listeners using the podcast and engaging with its content?
3. What kinds of impacts does Brains On! have on its audiences?

These questions were answered through a three-phase mixed-methods research design. Each phase informed the next, providing additional insights into answering the research questions. Phase 1 was a review of a sample of secondary data in the form of audience comments and feedback gathered by the Brains On! team and posted by listeners online. Phase 2 was an online survey of Brains On! listeners, with a focus on understanding Brains On!’s core audience of kids ages 5 to 12. Phase 3 was group interviews with listener family groups that included members of the core audience and is the focus of this report. Table 1 illustrates the focus of each phase of the research.

Table 1. Alignment between the phases of the research and the research questions

Research Question	Phase 1	Phase 2	Phase 3
1. Who is the audience for Brains On! and what are their motivations for listening to children’s science podcasts?	X	X	
2. How are Brains On! listeners using the podcast and engaging with its content?	X	X	
3. What kinds of impacts does Brains On! have on its audiences?	X		X

Phase 3 was focused on understanding the breadth of impacts Brains On! might have on child listeners and identifying the features of the podcast that may play a role in leading to those impacts. Since research and evaluation are lacking on the impacts associated with listening to children’s science podcasts, the Phase 3 study provides an important first step in documenting the types of impacts these experiences can have. It is important to note that the purpose of this study was not to quantify impact for Brains On! listeners or make generalizable claims about impact based on particular demographic characteristics or listening habits, but to explore and describe the wide range of impacts Brains On!, and possibly similar types of science podcasts, has on its listeners.

We hope what we have uncovered through our exploratory research will begin to provide insight into an area of science learning where little was previously known as well as provide a foundation for future researchers to examine a particular impact area more deeply.

# METHODOLOGY

## Family Interviews

In April 2019, we conducted in-depth interviews with adult/child family groups to gather qualitative insight into the potential impacts that listening to Brains On! could have on children, as well as understand what aspects of the podcast may have influenced those impacts (Research Question 3). The interview protocol was developed to explore the full range of impacts Brains On! might have on its listeners. Phases 1 and 2 brought to light some potential impact areas to explore. We also looked to two key publications in the informal science education field, *Learning Science in Informal Environments* (National Research Council, 2009) and the National Science Foundation's *Framework for Evaluating Impacts of Informal Science Education Experiences* (Friedman, 2008), for additional impact areas to pay attention to in our interviews. These impact areas are outlined below. Appendix A includes a table which shows the alignment between our interview questions and the impact areas from these two publications. The interview protocol can be found in Appendix C.

### Strands of Informal Science Learning (National Research Council, 2009, p. 43)

Learners who engage with science in informal environments...

- Strand 1: Experience excitement, interest, and motivation to learn about phenomena in the natural and physical world.
- Strand 2: Come to generate, understand, remember, and use concepts, explanations, arguments, models, and facts related to science.
- Strand 3: Manipulate, test, explore, predict, question, observe, and make sense of the natural and physical world.
- Strand 4: Reflect on science as a way of knowing; on processes, concepts, and institutions of science; and on their own process of learning about phenomena.
- Strand 5: Participate in scientific activities and learning practices with others, using scientific language and tools.
- Strand 6: Think about themselves as science learners and develop an identity as someone who knows about, uses, and sometimes contributes to science.

### Impacts of Informal Science Education Experiences (Friedman, 2008)

Impact categories...

- Awareness, knowledge, or understanding
- Engagement or interest
- Attitude
- Behavior
- Skills
- Other

The interview was structured so that both children and parents/guardians were involved in answering the questions. Interviews started with a general open-ended question for the parent/guardian to talk about impacts they had seen in their child as a result of listening. Families were then presented with a series of questions related to 12 potential impacts Brains On! could have on children. As previously described, these

interview questions were based on Phase 1 and 2 findings as well as common impact areas of informal science education experiences. The 12 impact questions were asked as yes/no questions. Ten questions were first asked directly to each child in the family group, while two questions were first asked directly to each parent/guardian in the group; however, both children and parents/guardians were able to provide input for each question. To make the interviews more interactive and engaging for children, they were given a small brain eraser to use to respond to the question, placing their “brain” on a sheet of paper with yes and no responses printed on it (see Figure 1). After the child(ren) responded, the interviewer asked each child to explain their reason for placing their “brain” where they did. Parents/guardians were also encouraged to chime in and provide additional insight about their child. If a child and/or parent/guardian responded yes to an impact question, they were then asked to describe what feature(s) of the podcast they felt may have influenced that impact. To help respond to this question, they were provided with a handout that listed features of the Brains On! podcast. The list of features was developed based on Phase 1 and 2 research findings and a discussion with the Brains On! producers (see Appendix D). Families were also provided with a list of the most recent 102 Brains On! episodes that they could refer to throughout the interview (see Appendix E).

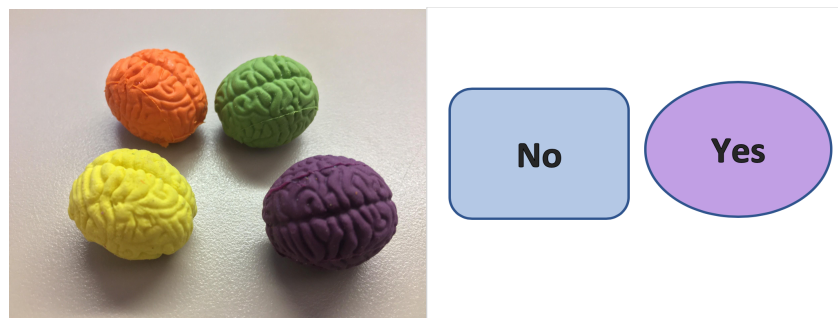


Figure 1. Brain erasers and response sheet

The initial interviews served as pilot tests to refine the interview questions and ensure the interview was no more than 30 minutes long given the attention span of the children during the interview process. Interviews were audio recorded and transcribed for purposes of analysis. Interview transcripts were uploaded into the qualitative analysis software Dedoose. Interview data were analyzed and coded based on the coding framework that was developed in Phases 1 and 2 and was revised as new codes emerged from the interview data. The coding framework was also informed by the six strands of science learning from *Learning Science in Informal Environments* (National Research Council, 2009) and the impact areas discussed in the *Framework for Evaluating Impacts of Informal Science Education Projects* (Friedman, 2008). When an impact was identified for a child, it was also coded based on the features of the Brains On! podcast that seemed to influence that impact, using the features list in Appendix D as a starting point for coding as well as additional features that emerged from the interview data.

Interviews were held at three locations: 1) the Science Museum of Minnesota, in St. Paul, Minnesota, 2) Natural History Museum of Los Angeles, and 3) National Public Radio affiliate station KPCC in Pasadena, California. All families were provided with a \$25 Visa pre-paid card in appreciation for their time.

## Recruitment and Sample

A challenge faced when gathering data from podcast audiences is that the population of podcast listeners is unknown, so we didn't have a list of listeners from which to recruit interview respondents. For this reason, we used multiple methods to try to recruit child/adult groups. We started with inviting people who had signed up to participate in our Phase 2 survey if they lived in the Los Angeles or Twin Cities metro areas. We also used the same recruitment website created in Phase 2 to encourage adults 18 and above with child listeners in the household to sign up to participate in a family interview. Invitations to sign up through the recruitment website were posted on Brains On! social media (Twitter, Facebook, Instagram), included in the Brains On! newsletter, and posted on the Brains On! website. A total of 47 Minnesota families and 28 Los Angeles area families expressed an interest in being interviewed. Originally, we hoped to have a larger pool of families to select from so that we could purposefully select 50 families to ensure maximum variation in our sample across various demographic characteristics. However, we ended up inviting all of the families who expressed interest as some families ended up being unable to participate, especially in Los Angeles where we were only in the area for a limited number of days.

We ended up interviewing 46 families (34 Minnesota families and 12 Los Angeles area families) with a total of 63 children. Family groups included between 1 to 3 child listeners and 1 to 2 accompanying adults/guardians. For the interviews, we initially focused on families with child listeners ages 5 to 12 since Phase 1 and 2 data revealed that the Brains On! audience included a large group of five-year-old listeners. However, pilot interviews showed it was going to be difficult to look at impact for five-year-olds since children this age had difficulty staying engaged in interviews and parents/guardians found it more difficult to describe potential impacts for this age level. As a result, we decided to remove this age group from our sample and instead focused on listeners ages 6 to 12. The demographic characteristics of the children who participated in the interviews and the households they came from can be found in Appendix F. Overall, the interview sample included an even split of male and female children, a majority of the children identified as white only (68%) and none of the children identified as African-American/Black, over half (55%) came from households where someone had a job in a STEM field, over half (56%) were from households where the highest level of education in the household was a graduate degree, and none of the children were from a household that had anyone with less than a college degree. Even though the interview sample is slightly more diverse than the Phase 2 survey sample (see Appendix F for a comparison of the Phase 3 interview and Phase 2 survey demographics), the interview sample is still more white, more highly educated, and has more STEM-employed households than the general United States population (United States Bureau of Labor Statistics, 2019; United States Census Bureau, 2018).

Families were asked to indicate how long their child(ren) had been listening to Brains On! and how many episodes they have listened to over time. As illustrated in Figure 2, most children (81%) in the interview sample have been listening to Brains On! for a long period of time (2 years or more). Most of these children had also listened to multiple episodes of Brains On! (see Figure 3), with more than half (57%) having listened to over 50 episodes. As previously mentioned, the focus of this study was to explore and describe impacts as a result of listening to Brains On!, not to categorize findings based on demographic or listening characteristics. While not intentional, an advantage of the interview sample being heavily composed of children who have listened multiple years and to numerous episodes is that it allows for better understanding of possible impacts since these children have had more time to engage with Brains On!.

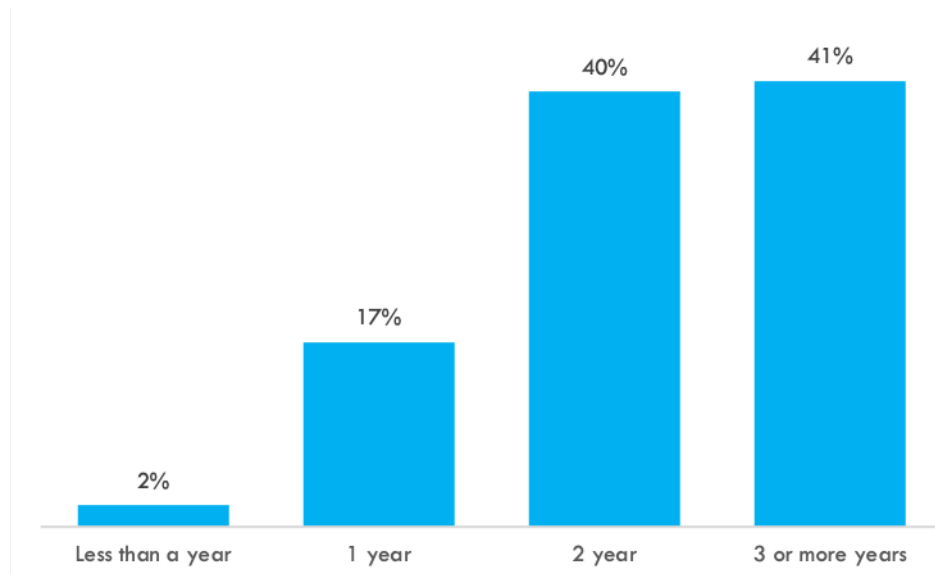


Figure 2. Length of time child has listened to Brains On! ( $n = 63$ )

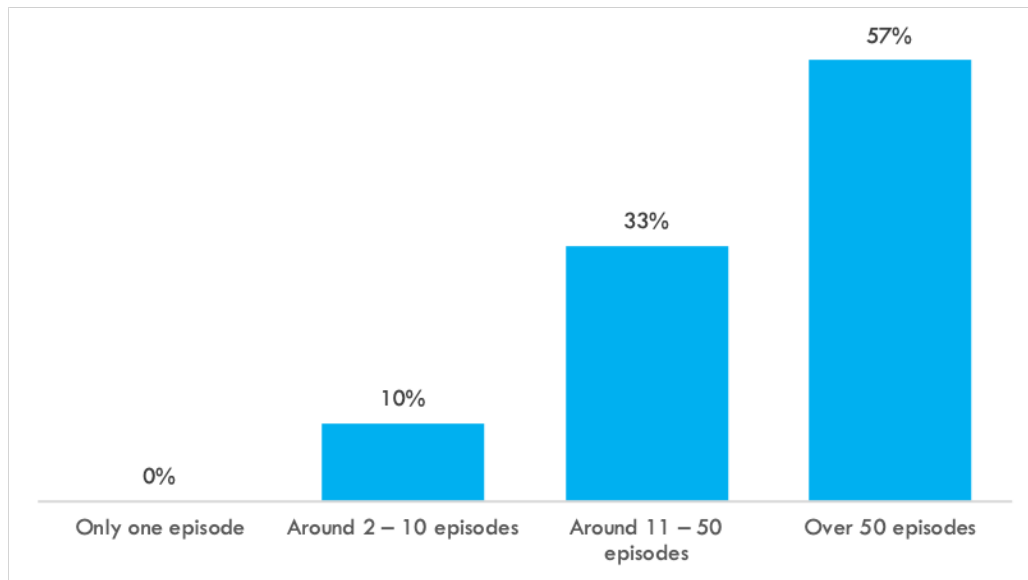


Figure 3. Number of Brains On! episodes listened to by child ( $n = 63$ )



## OVERVIEW OF FINDINGS

### Impact Areas Addressed by Brains On!

Brains On! has a wide range of impacts on listeners ages 6 to 12, with all of the children we interviewed experiencing some kind of impact as a result of listening. As illustrated below, all children learned something new from listening to Brains On!, while the rest of the impact areas were mentioned by a majority of the children (additional details of the impact areas are included in the Results & Discussion). The impacts of listening to Brains On! align closely with many of the impact categories outlined in the informal science education publications *Learning Science in Informal Environments* (National Research Council, 2009) and *Framework for Evaluating Impacts of Informal Science Education Projects* (Friedman, 2008) (see Appendix B for alignment of the impact areas to these documents). The evidence of multiple impact areas that align with these key frameworks for informal science learning points to the value of Brains On!, and similar children's science podcasts, as informal science educational media experiences for children.

We recognize that Brains On! is not the only experience influencing a variety of these science-related impact areas and, as a few parents mentioned, it can be difficult to parse out impacts based on listening versus children's natural development (e.g. asking more questions or being more curious). Even so, it is clear from our research that Brains On! is contributing to the changes some children experience after listening.

#### Impacts of Brains On! on Child Listeners (n = 63)

##### All interviewees

- Learn something new.

##### Around three-quarters of interviewees

- Engage in science-based conversations.<sup>1</sup>

##### Around two-thirds of interviewees

- Increase their interest in science.
- Increase their interest in learning about science.
- Increase their curiosity about the world.
- Ask more questions about the world.
- Listen more closely to the sounds they hear in the world.
- Increase their awareness about the kinds of jobs people can have in science.
- See themselves as someone who does or can do science (science identity).

##### Around half of interviewees

- Do a project or activity based on something they heard on Brains On!.

##### Slightly less than half of interviewees

- Notice changes in the types of questions asked.
- Increase their awareness of the different types of people that have science jobs.

<sup>1</sup> We did not ask parents/guardians and children directly about science-based conversations in the interviews, this impact just came up naturally. This means the number of interviewees that experienced this impact could be higher since we don't know if conversations based on Brains On! happened in families that didn't mention it.

### **Brains On! increases children's science knowledge.**

Brains On! succeeds in impacting children's science knowledge, as all children in our study **learned something new** from listening to Brains On!. Children may gain awareness of an entirely new area of science or add to their existing knowledge. Brains On! provides opportunities for children to learn about science topics they maybe wouldn't have learned or thought about otherwise. This helps to broaden children's knowledge and understanding about the world around them. The explanation of science terms in kid-friendly ways also helps children expand their science vocabulary.

### **Brains On! encourages and supports children's science interest and curiosity.**

Brains On! plays an important role is fostering, supporting, and sustaining children's **interest in science**. For some children, Brains On! can spark a general interest in science or an interest in a specific science topic that they didn't have before listening. However, many listeners already have an interest in science when they start listening, which means Brains On! can help to sustain and deepen a child's science interest. For some children, this increased interest in science leads to an increased **interest in wanting to learn more about the science** topics they encounter on Brains On!. This might lead to children seeking out more information about the topic of interest by searching online, checking out a book at the library, listening to a different Brains On! episode, or listening to a different podcast altogether.

Brains On! not only sparks children's interest, but **heightens their curiosity**. Curiosity is at the core of the Brains On! podcast. Brains On!'s mission is "to encourage kids' natural curiosity and wonder using science and history," using the tag line "stay curious" on some of their marketing materials. Brains On! supports children's curiosity and their tendency to ask questions about their world by using children's questions as the backbone of each episode. Brains On! places value on the questions children have and encourages them to contribute their own questions, encouraging them to engage their natural curiosity.

### **Brains On! helps children practice and strengthen their science reasoning skills.**

Curiosity and an interest in learning more about the world can lead to children **asking more questions** about the world around them and engaging in scientific reasoning (National Research Council, 2009). Brains On! models the scientific inquiry process for children and can lead to children asking more science-based questions as a result of listening to Brains On!. Questioning might occur directly after listening to an episode or children may come across something in their daily life which allows them to apply what they learned from an episode and want to pursue additional inquiry into the topic.

Brains On! places value on the questions children have by asking children to send in their questions and then uses those questions as the topics of episodes and Moment of Um segments. Even if children never submit their questions, our research found that the possibility of doing so can help motivate children to ask science questions and think about what they would possibly submit.

Brains On! not only promotes scientific inquiry in relation to episode topics, but leads some children to shift how they encounter the world, asking not only more questions, but **more sophisticated science questions** about the world around them. For some children, this means asking deeper or more targeted science questions than what their parents/guardians might expect from a child at that age.

Brains On!, specifically the podcast's Mystery Sound segments, encourages children to **pay more attention and listen more closely to their world**, an important part of scientifically observing the world around them. Not only while listening to an episode, but later when encountering their world, some Brains On! listeners ask questions about the sounds they are hearing, try to figure out what might be making the sound based on the features of the sound, and try to figure out why a sound might be occurring.

### **Brains On! is a catalyst for engaging in science practices.**

Brains On! can be a catalyst for engagement with a range of science practices, such as conversations and engaging in science activities. Brains On! serves as a prompt for **science-based conversations** between adults and children. These discussions can be around various aspects of a Brains On! episode such as the questions in the episode, episode topics, and Mystery Sounds. These conversations can provide opportunities for children to demonstrate what they have learned from listening to Brains On!, apply what they learned from Brains On! to a real world situation, ask questions that lead to deeper inquiry into an episode topic, and to jointly engage with family members to discuss what they are hearing during a shared media experience.

Many children may **do a project or activity based on something they heard on Brains On!**. Children may engage in their own scientific-inquiry based on Brains On! episode topics. Some episodes may inspire families to visit somewhere science-related that was featured on an episode. Some children may do activities or projects that emulate the Brains On! podcast. This includes activities such as pretending to be a Brains On! host, recreating segments they hear on the show such as Mystery Sounds and interviewing adults, or even creating their own science podcast inspired by Brains On!. Since Brains On! is an auditory experience, some children use their creativity and imagination to visualize something they hear about in an episode through drawing or building.

### **Brains On! increases children's' awareness of science role models and careers.**

Brains On! provides opportunities to **increase children's awareness of the kinds of jobs people can have in science**. Brains On! features a scientist on each of its episodes, providing opportunities for children to be exposed to a broad range of science careers, the different types of work people do in science, where scientists might work, and who might be a scientist. Many times, episodes introduce children to areas of science they were not aware of before hearing about it on Brains On!. Brains On! also helps to dispel common stereotypes of who a scientist might be or where they may work, as well as humanize scientists. For some children, the introduction to various science careers can increase their interest in a possible science career when they get older.

One of the goals of Brains On! is to **increase children's awareness of the diverse range of people that have jobs in science**. This diversity can include various aspects of someone's identity such as gender, race/ethnicity, or age. Brains On! is most effective in increasing children's awareness of women in science by hearing gender diversity represented on the show, not only coming from adults (hosts, scientists) but also from children featured on the show. Other aspects of the identity of Brains On! guests, such as race/ethnicity, age, or where episode guests are from, may also be noticed. Like gender, voice differences are used by some families as a way to notice these aspects of identity, giving them additional awareness of different people involved in the sciences.

## Brains On! fosters and supports the development of children’s science identity.

Brains On! helps to support and develop children’s identity of **being someone who knows about, uses, and can contribute to science**. The representation of kid co-hosts as “kid scientists” on each episode is important for helping some listeners shape their identity as kids who do or are able to do science. This is important in the construction of science identity, since knowing about other kids who are doing science allows children to consider it as a possibility for themselves (National Research Council, 2009). It also touches on how identity formation can be a process, often thought of as “identity work,” so as children listen to Brains On!, they might negotiate how they relate to the kid co-hosts with how they perceive their own engagement and identification with science over time (Bell et al., 2018; National Research Council, 2009). Hearing a range of scientists on the show also supports children’s identity development by helping them envision a possible future self who has a career in science.

## Brains On! Features Contributing to Impacts

Brains On! episodes have many characteristics which play a role in positively impacting child listeners. Specific features that were mentioned during interviews are described in Table 2 and the following pages.

Table 2. Descriptions of Brains On! features.

Feature	Description of the feature
Episode topics	Each Brains On! episode highlights a specific topic based on questions children send in to Brains On!.
Ability for kids to contribute to the show	Children are able to contribute to the show by submitting their questions for episode topics and Moments of Um, recordings of Mystery Sounds, answering callouts by the show, and submitting their own materials such as drawings.
Kids’ questions featured in the episodes	Questions submitted to Brains On! by children form the basis of episode topics and content.
Moment of Um	Moment of Um is a short segment during each episode that answers a question sent in by children that is unrelated to the episode topic or content.
Mystery Sound	The Mystery Sound is short, interactive segment in each episode that asks listeners to guess an unknown sound that is usually submitted by a listener.
Kids featured on the show	Children are featured on every Brains On! episode as co-hosts, interviewing scientists, asking their science questions, or talking about the mystery sound they submitted. Their name may also be read as part of the Honor Roll.
Brains On! hosts	Brains On! has four hosts: Molly Bloom, Sanden Totten, Marc Sanchez, and Menaka Wilhelm. Molly Bloom is the primary host.
Scientists featured on the show	Scientists are featured on each episode to share their science expertise in a kid-friendly manner. Scientists are chosen based on the episode topic and content, and intentionally come from diverse backgrounds.
Kid-friendly	Episode topics and content are age-appropriate and child-centered. Ideas are presented with the assumption that children are on par with adults in the show.
Use of humor/funny	Brains On! uses humor in their episodes through silly characters, jokes, songs, sound effects, voices, and in some cases silly topics.
Debate episodes	Debate episodes are a particular type of episode which use a debate format to highlight two different episode topics.

Children and their parents/guardians saw a number of connections between each of the impact areas and particular features of the Brains On! podcast (see all of these connections laid out in Table 3). As illustrated in Table 3, the features that seem to have the greatest impact are the “episode topics” and “kids’ questions featured in the episodes.” The impact areas with the most connections to Brains On! features were the impacts of “learn something new” and “engage in science-based conversations.” A high level summary of the role each of the features are included below. For extensive details on how each of these features helps to support the development of the individual impact areas, see the Results and Discussion section of this paper.

### **The benefit of covering a variety of episode topics**

Brains On! episodes cover a wide variety of topics. The **variety of episode topics** appeal to a broad range of children’s interests and provide various opportunities for children to learn something new and/or build on existing knowledge. Episode topics sometimes introduce children to topics they may not have considered before or had an opportunity to learn about. This exposure can lead to increased interest in science generally or a specific science topic. More than any other feature, parents/guardians and children pointed to the variety of episode topics as a contributing factor in kids asking more questions about the world around them. Exposure to new and interesting topics provide curious kids with new things to consider, which can translate into children asking more questions or wanting to learn more about a topic. The range of topics and questions stemming from those topics also help support science-based conversations. In some instances, Brains On! introduces families to topics that they otherwise wouldn’t talk about.

### **The importance of children’s ability to contribute to the show**

The participatory nature of Brains On! plays an important role in extending science learning beyond listening to the podcast. **Children are encouraged to contribute** to the development of future episodes by submitting questions and mystery sounds. The fact that episode topics and **Moments of Um** are based on children’s questions and **Mystery Sound** segments are sounds children send in appears to influence children’s curiosity and interaction with the world around them. We see this evidenced in both how children are asking more questions of their world and are listening more closely to sounds around them. Even though many children may never submit a question or sound to Brains On!, the fact that it is a possibility has led to some children and families asking more questions, listening more closely, engaging in conversations around questions and sounds, and saying things like *“that would be a good question to send to Brains On!”* or *“that would make a good Mystery Sound.”* For some, then, it is the mere possibility of submitting something to Brains On! that is enough to engage.

### **The value of basing episode topics on children’s questions**

Featuring **children’s questions in each episode** helps to validate the questions children might have about the world around them. This places value on the things children are curious about and encourages them to explore their own curiosity. The relevance of the questions to children’s lives and hearing questions they might also wonder about helps to keep kids engaged in the episode, enhances their opportunities to learn new knowledge, and increase their interest in science. In some cases, the content of the questions can spark children’s interest in a new science topic as the questions may be about an area a child listener had not thought about before. Additionally, Brains On! helps to build children’s questioning skills by modeling how children can ask their own, and more sophisticated, science questions about the world.

## The importance of hearing children's voices

Every Brains On! episode **features multiple children on the show** including a child co-host, children reading questions they submitted, and children explaining the Mystery Sound they sent in. Hearing other children involved in science helps to engage children and increase their interest in listening to the show as well as model what it sounds like to be curious and ask questions. Children can hear kid co-hosts having science conversations with adults on the show (Brains On! hosts and guest scientists) and participating in the scientific inquiry process in meaningful ways. As described earlier, when children hear and relate to the kid co-hosts, it can also help them reflect on their own engagement with science and see themselves as someone who can do science (impacting their science identity).

## The role of adults featured on the show

Every Brains On! episode features an adult **Brains On! host** as well as a **scientist or other science-based expert**. The adults on the show provide opportunities for children to learn about the different types of people who work in science and the wide range of science jobs people can have. This knowledge can help to fuel adult-child conversations about possible science careers. Brains On! also provides opportunities for children to see themselves in the guest scientists on the show and recognize that anyone can be a scientist. Brains On! is particularly successful in helping children learn about the roles of women in science as the show's primary host is female and the show features many female scientists.

## The importance of a kid-friendly format

The **kid-friendly format** supports children's engagement, interest, and science learning. The format of the show is broken into short elements which helps to hold children's attention, keep them engaged with the content, and reinforce learning. Complex science topics are explained at a kid's level and presented in a fun, entertaining way that makes science interesting for children. The Brains On! hosts also message to children that their science questions and contributions are valued, encouraging science engagement and supporting children's identities as someone who can do science.

## The influence of humor

Brains On! incorporates **humor** into its episodes, which helps to make science learning fun and entertaining for children. The humor keeps children engaged in the content, helping to enhance opportunities for children to learn something new from the show and become more interested in science. The silly characters, songs, and skits also help children remember content and can serve as topics of family science conversations.

Table 3. Connections between features of Brains On! and various impact areas.

Feature of Brains On! →	Episode topics	Kids can contribute to the show	Kids' questions in the episodes	Moment of Um	Mystery sound	Kids featured on the show	Brains On! hosts	Scientists featured on the show	Kid - friendly	Use of humor/funny	Debate episodes	Total Number of Features
Learn something new	●		●	●	●			●	●	●	●	8
Increase interest in science	●		●		●	●				●		5
Increase interest in learning about science	●		●	●								3
Increase curiosity about the world	●		●	●		●						4
Ask more questions about the world	●	●	●	●								4
Notice changes in the types of questions asked	●	●	●									3
Listen more closely to the sounds they hear in the world		●			●							2
Engage in science-based conversations	●	●	●	●	●			●		●		7
Do a project or activity based on something they heard on Brains On!	●	●			●	●	●					5
Increase awareness about the kinds of jobs people can have in science	●							●				2
Increase awareness of the different types of people who have science jobs						●	●	●				3
See themselves as someone who does or can do science						●	●	●	●			4
<b>Total number of impacts</b>	<b>9</b>	<b>5</b>	<b>7</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>3</b>	<b>5</b>	<b>2</b>	<b>3</b>	<b>1</b>	

## RESULTS & DISCUSSION

This section of the report goes into detail describing each of these impact areas and the features that relate to that impact. Quotes in this section are identified using MN for Minnesota interviews and LA for Los Angeles area interviews, followed by an identifying case number (e.g. LA01 represents Los Angeles interview case #01). Children are identified using “C” followed by gender notation and age (e.g. CF10 represents a 10-year-old female child). Note, gender was identified by the parent/guardian when they signed their child up to participate in the interview.

### Learn Something New

Brains On! succeeds in impacting children’s science knowledge. Overwhelmingly, children learn something new from listening to Brains On!. As one child stated, “*Brains On! is a learning podcast, and I do love it*” (LA17, CM07). Children may gain awareness of an entirely new area of science or add to their existing knowledge of the science explored in an episode. For some children, they may learn something new from every episode they listen to.

- *Every time I listen to Brains On!, I learn something new. No matter how much I know, I always learn something new when I listen to it.* (MN24, CF09)
- *[CF10]: In all of the more than 150 episodes I have definitely, definitely, definitely learned a lot. In every single episode I learn at least five things. [CM08]: Obviously. [Interviewer: Obviously. Tell me why obviously.] [CM08]: Because like it says something new that you won’t learn in your everyday life.* (LA16, CM08/CF10)
- *In like almost every episode I learn a new fact or something new about how the world works or how just people in general work.* (LA09, CF12)
- *Because Brains On! has so many things, in their episodes, that I didn’t know about, or knew about but didn’t know what they did.* (MN10, CF08)

Children retain various types of information from listening, such as facts about a specific topic or describing scientific phenomenon (e.g. facts about Mars or describing lucid dreaming).

- *One time, there was this girl on the show, and she said that she lived somewhere, and there was lead in her water, so she couldn’t drink it, because it’s poisonous.* (LA03, CM08)
- *I put yes, because I had no idea that caves could breathe in and out.* (MN09, CM11)
- *The one about different animals seeing different colors and I just never knew a lot of that before. I’m like, this is really interesting and so now, say, I see my dog or another animal and I’m trying to imagine the world how they see it and, yeah, for example did you know that dogs aren’t actually color blind? They just can’t see certain colors like red and green or see them in a different way?* (MN06, CM09)

For some children, listening to Brains On! may have an impact on their science vocabulary.

- *It’s definitely increased their vocabulary, not only science vocabulary but just vocabulary in general. We were listening to the one about cell phones and he was asking what dopamine was on the ride over to the metro stop so we were discussing what dopamine was and how dopamine affects your body. So, it definitely sparks conversations and it connects to things that they – we try to listen to ones that connect with stuff that we’re already doing in life or something that’s coming up so that we can give some background or follow-up.* (LA12, Mother of CF07)



- *[Interviewer: Oh. So, when you listen to Brains On! episodes, do you usually have questions after?]*  
*[CF07]: Yeah. Mainly about what the words they're saying, 'cause I don't know all the words yet.*  
*[Mother of CF07]: Sometimes, vocabulary is a – it's an awesome lesson. (MN36 CF07)*

Brains On! also provides opportunities for children to learn information about science that they maybe wouldn't have learned or thought about otherwise, including at school. This helps to broaden children's knowledge and understanding about science and the world around them.

- *Well, I think that I mean a lot of the stuff that I think about from listening to Brains On!, it's learning about something new. So, it's learning information about something new that maybe we wouldn't come across on our own. Like – I'm trying to think. One of the ones we listened to recently on dirt, like we play in dirt all the time, we- Yeah, we listened to it again on the way here. We have gardens, but we never have really talked about dirt and the different kinds of soil and things like that. (MN02, Mother of CM08)*
- *I put yes because before I thought I knew a lot about the world, but the facts that they included in some episodes, they gave me more information that I didn't know. (LA02, CF08)*
- *Because there's lots of things that I don't learn in school. [Interviewer: That you learn somewhere else?]*  
*Mm-hmm, that I learn from Brains On! (MN29, CF06)*
- *I mean I definitely think there's all these weird topics, weird like just think – I mean they have a much broader knowledge of science because of the variety of Brains On! episodes. (LA10, Mother of CM06/CF10/CM12)*
- *I think that it has definitely expanded their knowledge on stuff and definitely given more extensive answers than I can on certain topics as well as topics that we haven't had a chance to talk about that we can explore. (LA16, Mother of CM08/CM09)*
- *I put yes, because I wasn't always that – I'm not that balanced in the types of science I know. Like I do geology and I do archeology and I do some plants, but I don't learn about different types of science. And Brains On! has helped me ... because they put the information there, where it's easy to get, so it's not as hard to get information about things that I probably wouldn't learn about otherwise. (LA10, CF10)*
- *Well, he loves science and facts and Brains On! has been a really great way for him to learn new facts about everything...It's presented in such a great format that it's entertaining but has so much content that he just is – files away answers to questions that I can't really adequately answer so they're great. (MN06, Mother of CM09)*

Some children recall and share content from episodes at will, usually when they are going about their daily lives or doing activities that prompt them to make connections between what they learned on Brains On! and what they are experiencing in their everyday life.

- *This is really a big part of his science learning. Because we do home school so this would be one of the main ways he learns about different science things. But I mean I can tell when we go out in public that he has picked up on things. Like we were just recently at the eye doctors and then he was diagnosed with an eye condition. And like, "Yeah, I know about it." Like Brains On!, like all sorts of things I kind of know that I wasn't, that I didn't teach him. (MN04, Mother of CM08)*
- *So, she's definitely learned many things from Brains On! The other day, after we listened to that one about smartphones and how dopamine, it activates the reward center in our brain, we were playing a game or doing something, and you were, like, "Oh, I have so much dopamine, right now." We never talk about – otherwise, you wouldn't have known about dopamine. (MN28, Mother of CF06)*

- *I can't think of anything else specific except that they frequently will reference, you know, in daily life when a show topic comes up and then they'll be like, "Oh, we learned about that on Brains On!." (LA10, Mother of CM06/CF10/CM12)*
- *We were at the aquarium... in Duluth this last weekend. And CM07 and I were together and he was telling me that, "Oh, I learned that at Brains On!" So, I mean, they're just learning a lot of different things and they're – and it's great because we're seeing them actually apply it and kind of realize what they're, what they've learned. (MN03, Mother of CM07/CM12)*

Brains On! can help some children, such as children with dyslexia, learn science in ways that other mediums may not be able to.

- *[Mother of CF10]: For CF10 it definitely made it easier for her to learn about science, I think, because she's dyslexic and she couldn't read science – like science books a lot of the time don't pay attention to- [CF10]: Like I struggle with Magic Tree House type things. Reading a textbook is also hard. [Mother of CF10]: Well, but even an encyclopedia, things with small print. [CF10]: I can't do that. [Mother of CF10]: -you know, she couldn't read them. [CF10]: Science podcasts probably make up most of my learning about science. [Mother of CF10]: Yeah. So, she got a lot of science information from Brains On!. (LA10, CF10 and Mother of CF10)*

## Features connected to this impact area

The range of **episode topics** appeal to a wide variety of children's interests and provide various opportunities for children to learn something new and/or build on existing knowledge. Episode topics sometimes introduce children to topics they may not have considered before or had an opportunity to learn about.

- *The fact that there's a variety of topics makes a difference, because it's constantly feeding curiosity and he might not ever have thought to think about hair. Now, two weeks from now, he's going to say some really random thing about hair because it was there. I think the variety keeps him engaged. So, it builds knowledge better. (MN21, Mother of CM06)*
- *And I think that it really does open up things that you've never thought about, like, you know, what happens when your waste goes down the toilet? Like, where is it going?...I think it opens up vistas that wouldn't otherwise be opened at this point. There are such a myriad of topics that I don't imagine you would cover at school or that we would necessarily come up, you know, just circumstantially. (MN32, Mother of CM06/CF10)*
- *I would say it just makes him think about things he might not have thought of. The wide variety of topics that you guys cover and then, just sometimes, the detail about them – it's just stuff he hasn't thought about. So, I like that. (MN33, Mother of CM12)*

The **debate episodes** expose children to two topics using a debate format. Not only do these episodes teach children more about the two topics up for debate, but they provide children an opportunity to learn more about how to debate an issue or topic.

- *The debate episodes have definitely become impactful. He has become more aware of the give and take of conversation and the ability to persuade, which is something that we, in our household, also do is the idea of negotiation and discussion. So, Brains On! has amplified that, I think. (MN21, CM06)*
- *Every debate episode they'd talk about a lot of facts of their side of the debate. (LA02, CF08)*

**Scientists featured on the show** allow children to hear multiple perspectives and learn from experts working in various areas of science.

- *Probably the different scientists around the world. Because, you can really like there's like from different point-of-views and stuff like that. (MN11, CF11)*
- *Because I learn more about every topic that it has in every episode, because they have – what's the word? Connections with scientists. I wouldn't have that. So, I learn new things. (MN08, CF11)*
- *And then they bring in a bunch of scientists so they give you lots of crazy information. Mystery Sound when it's done by a scientist like on the volcano one. Yeah, you learn something. I will think to myself when that happens, mind blown. (MN18, CF10)*
- *And then, a lot of times, there's a subject matter expert on there that explains things. And so – especially just the vocabulary that gets used sometimes by a subject matter expert is good just in broadening their horizon, thinking about things. (MN33, CM12)*

**Children's questions** are both the basis of the episode topic and the **Moment of Um**. These questions are things children may be interested in and have questions about themselves, helping to keep them engaged in the content and enhance their opportunities to learn new knowledge.

- *[Mother of CF09]: I think having kids asking questions and then having that be kind of driving it. [CF09]: Yeah. [Mother of CF09]: Because they think of really interesting things. And so, yeah. Or it helps it relate to them better. (MN35, CF09 and Mother of CF09)*
- *I think when it's that conversational style, like when Molly's talking with the kid host, that's generally what she's really kind of grabbing onto, I think. Like when Molly is talking to the kid who's the host and they're talking about the topic and kind of asking questions and learning about it in different ways... it's actually surprising to me because she is a very visual learner. But when we're in the car, I'm zoning out half the time and she's hearing it all. So, I think that conversational piece is helpful. (MN23, Mother of CF06)*
- *I think the format, so the format of asking that question at the outset, and then setting off on a way to get to the answer, right, is – teaches the kids to ask that question and follow that pattern, and I'm sure that they're – at the end of it, we're all learning something new. (MN17, Father of CM06/CM08)*
- *Like the Moment of Um is just random thing that's just super cool. (MN18, CF10)*

The episodes have a variety of features that help to make learning fun and entertaining for children. The **use of humor** keeps children engaged with the content and helps to enhance opportunities for learning new things from the show.

- *[CF10]: I like that they kind of make learning playful and like – [CF08]: Funny. [CF10]: Yeah, funny. But yet... they also get down to the facts. Like what's really happening and stuff other than just making a bunch of – I don't know. (MN34, CF08/CF10)*
- *It's kind of educational and wholesome and fun, and it's kind of – it's silly, you know, and so I think he picks up facts a little bit better when they're not from a book or from something a little bit dryer. So, I think it's – you know, I think it's been great for kind of getting him curious about why do things happen... they have the skits, right? I mean, we always talk about kind of the silly characters. (LA03, Father of CM08)*
- *As I said before, I love like the little skits that they do. Like two atoms are talking. One gives the other some electrons and makes him happy. [Interviewer: And so, do you think – do the skits help you learn the science better or –] Yeah, I think so because they make it hilarious and at the same time actually show you a little bit more about how it works. Like with the electron transferring, they make it – they*

succeed and make it absolutely hilarious as they – also, it's a molecule party. I like that one. It's funny. (MN18, CF10)

The **Mystery Sound** provides an opportunity for children to learn more about the world around them through the sounds they hear on the episodes.

- *What I like about the Mystery Sound is that, like, that not only is it a sound, but I like when they explain it.... The blackhole one I think was, like, it was a worm eating some type of plant, and, "Oh, so this worm eats this type of plant." Yeah, so, you're not just learning sounds, you're learning other stuff that's not based on what's in the episode. (MN22, CM09)*
- *The Mystery Sounds. I mean they're not passive participants. They're active participants in what's going on. (MN38, Father of CM07)*

The **kid-friendly nature** of the podcast helps to make the podcast age-appropriate and support children's learning. The format of the show is broken into short elements which helps to hold children's attention, keep them engaged with the content, and reinforce learning. The topics are also explained at a kid's level and presented in a way that makes them interesting for children.

- *Brains On! I think does a good job of... taking a topic that my kids would maybe not be interested in and finding a way to make it interesting. (LA10, Mother of CF10)*
- *Molly does a really good job explaining things at a child's level. (MN36, CF07 and Mother of CF07)*
- *I think I would go back to the formatting, right? 'Cause, like, it's broken up just enough that, like, it keeps their attention but they don't get bored, right? And there's very interesting things. (MN22, Mother of CM07/CM09)*
- *I think that, kind of like I said before, there's many different, like, elements of the show. And so, using different elements to present content in different ways, some of which may resonate with the kid and some of which may not, really helps to reinforce and expand their understanding. You know, maybe they're more interested in the sound, maybe they're more interested in a joke about it, maybe they're more interested in what the experts have to say or what the kids think about it. So, I think that the variety of ways the content is presented helps to reinforce the content. (MN28, Mother of CF06)*

## Increase Interest in Science

Informal science education experiences, such as children's science podcasts, play an important role in fostering, supporting, and sustaining an interest in science (National Research Council, 2009). Many children who listen to Brains On! already have some level of interest in science. Brains On! can help to support and increase this interest for children. In some cases, this interest can expand to areas of science children may not have been interested in before listening to Brains On!.

- *I was pretty much already interested with it. I mean, I'm probably in the middle, because I was like interested, but I wasn't like super, super engaged. But Brains On! made me like more close to science or something like that. (MN11, CF11)*
- *[Mother of CM07]: I think it's been a wonderful part of our lives. He liked science beforehand – but he loves it now... [CM07]: Because of Brains On!.... (Later in interview) I used to like science, and now it made me want to be a scientist. (LA17, CM07 and Mother of CM07)*
- *I was already really interested in science, but Brains On! has – it's helped me – I'm already interested in it, but it's helped me to figure out more, which makes me more interested in specific types of science, just learning a little bit about them. (LA10, CF10)*
- *Before Brains On! I was really only interested in like the chemistry branch of science. But since listening*

*to it, it really made me thinking of like the other things that make science, science. (MN34, CF10)*

- *Really, the only passion I had in science was animal science. And now it's the mind blown, so many awesome and hilarious things about science. (MN18, CF10)*

Brains On! can also help to develop an interest in science for children who may not have been interested when they first started listening. In this way, Brains On! can help to trigger an initial interest in science as well as help to maintain that interest (Hidi & Renninger, 2006).

- *I think that it has definitely gotten me more interested in science because before I started listening to Brains On! I was like "Oh, science is boring. Like I don't want to have anything to do with it. Like it's just boring stuff that just like doesn't even have to do with me in any way at all." But then once I started listening to Brains On! I got a lot more interested in like scientific discoveries and why things happen and physics. And now I'm like science, science, science. When before I was just like, eh. (LA16, CF10)*
- *Because before I started listening to Brains On! I kind of liked playing Legos and drawing more. And then, when I was listening to Brains On! I found out how cool science could be and started liking it more. (LA07, CM07)*
- *I'd say yes, because like when I first started listening to it, like I really wasn't that interested in science. (LA06, CM09)*
- *Because I became more interested in science because I used to do math instead, and I didn't really like it, because there was lots of steps. But then now that I listen to Brains On, it's more fun to do science. (LA03, CM08)*

Some children develop higher levels of science interest from listening to Brains On!, which can lead to deeper engagement in science learning activities and impact how they see themselves in relation to science. For example, children who have higher levels of science interest may be interested in learning more about a Brains On! science topic, ask more questions about the world around them, become interested in science careers, and/or do a project or activity based on an episode topic (these four examples are all impact areas reported separately in this report). Below are just a few examples of this higher level of individual interest as a result of listening to Brains On! See the other impact areas previously mentioned for more examples of how this higher level of interest manifests itself.

- *Ever since I started listening, I've been asking my mom if we can go to the science museum. And, like, I've been wanting to do science in school, a lot.... And after I listened to Brains On!, I kind of, I wanted to become a scientist. (MN24, CF09)*
- *It's definitely expanded her interest in science, and she actually even decided to make her own podcast about the history and science of cheese. It's not published, it's just on my phone. But we have guests that come on the show, we have different parts of the show, and that was definitely inspired by Brains On! So, I would say it's definitely increased her interest in science and also in podcasts. (MN28, CF06)*
- *And I really feel like he's extremely engaged, but it's also a wonderful way to – quite frankly, we'll do a car trip, and he'll listen to episode after episode and be totally enthralled. (LA17, CM07)*
- *When I was already interested in science, I was only liking it for 12 minutes, and then wouldn't be really interested until somebody asked me about it. And now that I listen to Brains On!, I wanna listen to two episodes in a row. (MN28, CF06)*

For some children, Brains On! may impact their interest in science in a way that a formal classroom experience is unable to.

- *I thought at first that science was just, like, super descriptive and it didn't really make sense to me.*

*And then, when I found out Brains On! I discovered that it could be translated in a more fun way than at school. (LA07, CF10)*

- *In science classes before Brains On!, I was always like, “Do we have to do the weather thing today?” But in Brains On! they make it more fun. And that – I don’t know. It made me more interested. (MN34, CF08)*
- *I put yes because I learn way more stuff in science on Brains On! than at school. Because we’re in like a grade that we don’t, that we barely learn anything interesting in science. (LA16, CM08)*

## Features connected to this impact area

**Kids’ questions** form the basis of Brains On! episode topics and content. In some cases, the content of the questions themselves spark children’s interest in a science topic as they may be questions child listeners also have or questions they may not have thought about before. The fact that the questions are coming from children, not adults, also helps to engage child listeners.

- *I think that because they are the questions that kids ask, it’s really engaging that way. (MN01, Mother of CF09)*
- *I like that kids are asking the questions. And it’s just really interesting. (MN35, CF09)*
- *Just all of the questions – and I like that you – the kids actually get to take part in it... That just makes it a little bit more interesting. And knowing that these are questions coming from kids makes it like you know that Brains On! is a helpful resource and stuff like that. (MN11, CF11)*
- *Brains On! has introduced me to more questions that I never thought about myself, that other kids have come up with, or the makers came up with. (MN08, CF11)*

Not only are children’s questions the basis of Brains On! episodes, **children are featured** as co-hosts or read off questions they submitted. The involvement of children in the podcast helps to engage children and increase their interest in not only listening to the podcast, but their interest in science.

- *I like the fact that in a good amount of the episodes, that it’s kind of cool that you kind of bring kids for your experiments, because I’ve never – that’s one of the – it’s probably the only podcast I’ve ever listened to where kids are involved in most of the experiments. (MN12, CM10)*
- *Yeah, I think that it’s really cool that they incorporate, like, kids into it, ‘cause it’s more, like, if it were just adults, then it would be, like – then all the kids would be, like, “Oh, this is an adult thing, like, we don’t need to worry about this until we’re, like, 25.” So, not just an adult thing, we can do this at home and stuff. It’s really cool. (MN32, CF10)*
- *I definitely think that being able to send in things and having kids on the show makes it much more – makes science more approachable. (MN01, Mother of CF09)*

The **use of humor** in the episodes helps to make learning science fun and entertaining for children, which in turn can help children become more interested in science.

- *Because when we did some science projects in a science book I wasn’t really interested in it. I was like yeah, ok. But then when I started listening to Brains On! I just started to like science more because it talked about all of these different things and explained it with little like little voices, like those little cute voices. I like that. And I also get to learn new things and I like the science now. (LA08, CF07)*
- *And I love how you do all those little voices like molecules, the spiders and news network. (LA16, CM08)*
- *The fun things that they add to it, like the voices and the – like a little bit of story, and do it, too. (MN31, CF10)*

The **Mystery Sound** segment in each episode is a popular feature of the Brains On! podcast, as evidenced in Phase 2 survey findings. This interactive feature is engaging to children and helps to increase children's interest in science and listening to the world around them.

- *I am more interested in science because of the Mystery Sounds. (MN32, CM06)*
- *I love how it's like it's so interactive with the kids, with us, with trying to guess the Mystery Sounds. (LA16, CF10)*

As mentioned earlier, the **episode topics** are based on questions children submit to Brains On! The variety of topics, the inclusion of topics children might not learn about elsewhere, and the relevance of the questions to children's lives and things they might wonder about all help to keep kids engaged in the episode and increase their interest in science.

- *Because I like the science of paleontology, but then, listening to Brains On! just showed me a lot of other types of sciences. Now, I know a lot more about everything.... It just helps you, like, figure out how much science there is in something, and if there's science in. (MN22, CM09)*
- *I would agree with CF09, too. I think there was definitely some interest more in, like, astrology and space and things like that, when we listened to that. So, it's just been a really good fit for the age range they're in and their interests, and this is a great entry into some subjects that we wouldn't necessarily talk about at home without it. (MN24, Mother of CF09)*
- *I really like it – I like Brains On!, because every time there's a new science thing, every time. (MN17, CM06)*

## Increase Interest in Learning About Science

As a child's interest in science develops and they move through the phases of interest development, they may begin to develop an individual interest in particular science topics or science in general (Hidi & Renninger, 2006). This individual interest can lead to an increase in motivation to want to learn more about science (National Research Council, 2009). Brains On! episodes cover a wide variety of topics that provide multiple opportunities for children to find something they are interested in learning more about.

- *Yeah, I would say they're probably all yes, because there's things we deep dive into after we listen to an episode... Not every episode, but quite often. (MN09, Mother of CF07/CM10)*
- *Because I just really – I started to like science and be more interested in learning about it from Brains On!, especially like plants. Before that I just didn't care about plants, and now I really care about plants. (LA10, CM06)*
- *It's also made me really interested in learning about new facts, about – I love listening to podcasts about things where people have conducted experiments to see what the outcome of something could be, because that – it's – for me, it's really interesting. (MN12, CM10)*
- *I'd say yes, because I was definitely more interested in other subjects. But, since listening to Brains On!, it's made me a little bit more interested in how science works and stuff like that. [Interviewer: Have you gone out to look for more information or to learn more about things you hear on Brains On!?] Yeah, I've asked my teacher a lot. (MN11, CF11)*
- *[CF10]: Like, it's kind of like chips, like, once you eat one, you can't stop. [Interviewer: [Laughs] And so, from listening, have you – are there particular things that you've been interested in learning more about after you've listened to Brains On!?] I think that carnivorous plants are really cool, 'cause, like, it's a plant and an animal. Like, when I first heard about that, I was, like, "Plants eating other plants?" like, that's very weird, but, like, it's really cool. [Mother of CF10]: I think that these guys are more*

*interested in learning about science, given a show on any given subject. I think that then going forward, they're more interested to relate things back to how that, you know, like, "Oh, yeah, it's carnivorous plants. They eat flies. They eat animals. Like, what other things could be like that? Or have I ever seen anything like that?" I think it makes you just more excited to apply the new knowledge that you're gaining to knowledge that you already have, and then build on that knowledge. (MN32, CF10 and Mother of CF10)*

In some cases, Brains On! provides children with an introduction to topical areas or questions they never thought about before. This can lead to children becoming interested in learning more about specific episode topics, which results in children continuing to expand their knowledge and understanding of science.

- *I think kind of like what Mom said about the opening new topics, new doors for me to learn about. Like say, for example, before I started listening to Brains On!, I never really wondered like too much about why allergies happen and stuff. And then I listened to one episode about allergies.... I'm like hey, that was really interesting and I think I want to learn more about that. A couple years later like now, we learned about that in school and I'm like yeah, I know this. This is awesome, yeah, and so I'd definitely say yes. (MN06, CM09)*
- *And I think that it really does open up things that you've never thought about, like, what happens when your waste goes down the toilet? Like, where is it going?... I think it opens up vistas that wouldn't otherwise be opened at this point. There are such a myriad of topics that I don't imagine you would cover at school or that we would necessarily come up, just circumstantially. (MN32, Mother of CF10)*

When children become interested in learning more about a topic they hear about on Brains On! they fulfill their desire to learn more in various ways. Children may look up information about a topic, read a book about the topic, have a conversation with someone, do a science activity, or even listen to other science podcasts.

- *[CM08]: When I listen to Brains On! they say lots of facts, and I wanted to learn even more. [Father of CM08]: Usually, there's a list of questions we have to go on the internet for, because usually, we're listening to it while we're driving, and so... we'll have a list of questions that we'll follow up on back home. (LA03, CM08 and Father of CM08)*
- *[CF11]: The topics that they talked about, I wanted to explore more. [Mother of CF11]: I would just agree, I guess. Sometimes we find books on the topics ... or we just end up talking about them a lot. So yeah, I think she's definitely become more interested in science ... In learning about it. (MN08, CF11)*
- *Because it's giving me a fact about that. Then I want to learn more about that thing. So, for example scabs, it talks about scabs. I want to see what the molecules actually look like. It's just a podcast. (LA16, CM08)*
- *Since Brains On!, I have gotten a couple of science podcasts. Yeah, I've gotten a lot of science podcasts. (MN35, CF09)*

## Features connected to this impact area

The variety of **episode topics** provide a wide range of science areas for children to become interested in and want to learn more about. The individual episodes answer kids' questions about the topic and provide content focused on it, which as one parent/guardian mentioned is then a "jumping off point" for children to



find opportunities to learn more about a topic.

- *I'd say yes, although the only thing that you've really kind of been most interested in science lately has been engineering, so I wouldn't say like we definitely go out and get books about every topic that he hears, but anything that's about like how do airplanes fly, or how do you make a bridge, that kind of like engineering stuff, he kind of pursues. [Interviewer: So certain kinds of topics?] Certain topics. Yeah. (LA06, Mother of CM09)*
- *The episodes are fabulous, but they're a jumping off point. And so he's been – what I find is whatever the topic is, in the weeks afterwards, he's much more likely to sort of want to dive into it, like find a book in the library, or look more stuff up online, or try an experiment that he hears about. So, he's much more – it feels more hands – like it feels more something that he can be part of, even though he's a kid. (LA17, Mother of CM07)*

**Children's questions** are both the basis of the episode topic and the **Moment of Um**. Both of these features of the podcast provide children with information to answer the questions posed on the episodes, but also engage children enough for them to want to further their learning of the topic after they finish listening to the podcast. The questions and Moment of Um can spark more questions and an interest in answering those questions by learning more about the topic.

- *[CF07]: It actually made its own questions, instead of just answering ours. [Mother of CF07]: It made its own questions instead of just answering ours? So, brought up new questions you might not have thought about? (MN16, CF07 and Mother of CF07)*
- *It made me more curious about the questions. (LA02, CF10)*
- *I put yes because during like when I listen to Brains On! it really is interesting to see how they gather their facts and how they explain it. And it does make me want to learn more and ask more questions about how the way the world works in science. (LA09, CM12)*
- *Yes, so with the Moments of Um, so they'll give you a little bit about it and then think like – with the Mystery Sound Extravaganza which we just listened to in the car on the way here - why is air invisible? So, we know why you can't see it, why can't you touch it, why can't you smell it, why can't you hear it most of the time. (MN18, CF10)*

## Increase Curiosity About the World

Curiosity is at the core of the Brains On! podcast. Brains On!'s mission is “to encourage kids' natural curiosity and wonder using science and history,” using the tag line “stay curious” on some of their marketing materials. Brains On! supports children's natural curiosity and their tendency to ask questions about their world, which in turn can help to support and/or increase children's curiosity.

- *I was already curious but then Brains On!, mega curious. (MN18, CF10)*
- *So, before I started listening to Brains On!, I was curious. But not super curious. But now that I have been listening to Brains On!, more ideas have been popping in my head.... There's a lot more questions that I've thought about that I can like, think about and wonder. (MN33, CM12)*
- *I think they're very curious kids, and I think in some ways helps them satisfy that curiosity. 'Cause a lot of times, we'll be listening to Brains On!, and they'll be, like, "I forgot I had a question about that." (MN22, Mother of CM07)*
- *He started listening when he was probably four... He's always been very curious and engaged with the world. So, Brains On! was a – we picked it as a first podcast on purpose. I think, though, that his – I think he has become much more aware and awareness feeds curiosity. (MN21, Mother of CM06)*

- You (CF10) seem to be curious, and this kind of helps grow the direction your curiosity goes in. (MN31, Mother of CF10)

Children's increased curiosity can be around aspects of their world that they already have some familiarity with. Brains On! provides new information about those topics that can then lead to increased interest, curiosity, and wonder.

- They opened up new reasons for me – things for me to look at and the things I've already looked at they showed me different angles of it and I find that – I just think it's really amazing. And every time I, yeah, just a lot of times I wonder like how's that made? How can I improve that? Like how is that awesome? Yeah. (MN06, CM09)
- [CM08]: Aren't there Brains On! about bees? [Father of CM08]: Mm-hmm. [CM08]: Like I've got a lot, like since we've talked a lot about we – I'm just getting really curious about how they make the honey and stuff. (MN02, CM08 and Father of CM08)
- Well so I think I heard of a Brains On! interview about ... about rocks. And I started getting interested into rocks because they're kind of really cool and I want to know which types of rocks like have a name and don't have a name. [Interviewer: Okay so that was how you listened to an episode and it made you more curious?] Yeah. (LA12, CF07)
- I think it's made her or at least encouraged her curiosity about how things work. The sciences have been really interesting for her. So, it's just kind of expanded that world. (MN23, Mother of CF06)
- I feel like there's more to the world than there was. Like, I'm more aware of everything that's going on around me. I'm more observant, I guess. 'Cause, like, one of the shows about bugs and stuff, and now, every time I see a bug, instead of being, like, more, like, "Oh, it's a bug, it doesn't have a brain"...It's more, like, "It has a job, and it needs to get that job done." (MN32, CF10)

Brains On! also introduces children to science topics that they may not have thought about or had an interest in otherwise, sparking their curiosity about new subjects.

- I became more curious because I wasn't really thinking about the other stuff that they mentioned. [Interviewer: What kind of stuff do you think about now?] I think of the gross things and where do poo and pee go when they go down the toilet. (LA02, CF08)
- It's made me think, like, oh, here are kind of things to think about that I haven't before, and then I'm more curious. (MN08, CF11)
- It has piqued curiosity in subjects that we might not have touched on without listening to it. (MN24, Mother of CM06/CM09)
- [CF09]: It's just like been boosting my idea – like there was this one episode that was talking about how the world was made and what was the first living thing on earth. I want to know what the earth looked like before there was any animals or anything living. [Interviewer: So, after listening to Brains On!, you became – you wanted to know more about something? You were more curious about it?] [CF09]: Mm-hmm. [Mother of CF09]: Yes, I would say it's more. Kind of like what I was saying, just the different topics that she might not have thought about and then it kind of sparks that curiosity into those different topics. (MN01, CF09 and Mother of CF09)

Brains On! episodes provide an introduction to a topic which can then be a jumping off point for curious kids to pursue additional inquiry into a topic. For some children, their increased curiosity about a topic they hear about on Brains On! leads to asking additional questions and an interest in wanting to learn even more about the topic. (See the "Ask more questions" and "Increase interest in learning about science"

impact areas for more information about how this curiosity can manifest itself through increased questioning and wanting to learn more).

- *There are some questions, like there are some episodes on the show that even once they're done, they spark other questions in my brain, and then I just like to try to figure out how those things are possible, and – yeah.... Sometimes I'll listen to other podcasts like this and see if I can find episodes about that, or I'll just try to – try to find books about that subject. (MN12, CM10)*
- *I think it's certainly fostered what's already a lot of curiosity, so I think either in the course of listening to Brains On! or following it, we certainly have discussions that are triggered from the content, and the kids are the ones asking the questions, typically.... It gave them the opportunity to ask questions they didn't know they had. So, I don't know if they wouldn't have asked them otherwise, but they ... they started thinking about it, and you know a kid is thinking if they're asking questions, right? So, I don't know that it – I think it's the topic.... So, I think that's where I see it playing a part in fostering their curiosity or giving them – making them more curious by virtue of giving them a thing to ask a question about. (MN17, Father of CM06)*
- *I think that what it does is it kind of sparks her thinking, especially of what if sort of thing. Like if they're talking about black holes or wormholes, and if it's theoretical sort of science, she'll ask a lot more, well, "What if this happened?" or "What if that happened?" or "What if you went through a wormhole? What do you think would...?" That sort of thing is what it tends to spark in her. (MN31, Mother of CF10)*
- *I think that definitely since I started listening to Brains On! I have definitely become more curious about learning about the world around me. I have gotten very interested in environmental science like pollution and all that stuff and also just discovering how everything works and like – yeah, just how everything works. (LA16, CF10)*
- *[CF12]: Well, listening to them makes me more curious about the same topic and wanting to learn more about it, because a lot of the topics that they have are really fun.... [Father of CM07/CF12]: And they've both shown more curiosity in some of the episodes.... I think they give kids just enough to get started, which is a great point to leave it, because then they have to figure out how to find out more on their own. (MN03, CF12 and Father of CM07/CF12)*

## Features connected to this impact area

Every Brains On! episode has **children featured on the show**. The kids model what it sounds like to be curious and how to ask questions. Having kid co-hosts and featuring kids' **questions in the episodes** places value on the things children are curious about and encourages them to explore their curiosity.

- *I think the fact that it features kids so heavily is really what helps, because it's modeling the curiosity. Like these are kids' questions, and kids are interviewing the scientists or whatever, so it really feels like it's from a kid place, which is usually from a curious place. So, I think that's part of it. (MN08, Mother of CF11)*
- *I think that they have modeled curiosity in the questioning format and the asking experts to share details. I think in hearing all the different kids ask questions, that encourages him to follow his own curiosity, to let his own curiosity have more voice. So, I think that's a big piece. (MN21, Mother of CM06)*
- *I think the fact that it has kids on the show asking questions allows a child to think that they can ask those questions as opposed to always listening to adults speak about science and the world around you. When kids get involved, it encourages other kids to be allowed to get involved in that way. (MN36, Mother of CF07)*

- *I think what it does is show the kids who are super curious that it's cool to be curious and ask questions. No question is not worth asking. (LA04, Mother of CF09)*
- *I mean they're both very curious, but I think that it has made them more like specific in how they can ask questions, because there are so many good examples about how kids ask questions on the podcast. Yeah, just like how it's worded. (MN02, Mother of CM08)*

The variety of **episode topics** helps to increase children's interest in a topic and spark their curiosity, sometimes leading them to ask more questions or want to learn more about the topic.

- *Just the different topics that she might not have thought about and then it kind of sparks that curiosity into those different topics. (MN01, Mother of CF09)*
- *I think it's the topic...So I think that's where I see it playing a part in fostering their curiosity or giving them – making them more curious by virtue of giving them a thing to ask a question about. (MN17, Father of CM06)*
- *Well, listening to them makes me more curious about the same topic and wanting to learn more about it, because a lot of the topics that they have are really fun. (MN03, CF12)*
- *It's just bringing up a topic that you're like, "Oh, I hadn't considered how that works before or why those things happen before." (MN25, Mother of CF09)*
- *Whenever we listen to an episode, she is taking it all in, and then has more questions and makes comments like, "Oh, that kid that just said that, I had that same question," that sort of thing. So, I think it's just the information that they're – the topic that they're talking about, just she really absorbs it all and wants to know more. (MN23, Mother of CF06)*
- *None of them are so in depth that they get confusing or boring. So, it's, "Here's a little bite of this topic." And they've both shown more curiosity in some of the episodes, and others it's like, "Okay, I've found out enough about that topic. I don't need to go any further." But I think they give kids just enough to get started, which is a great point to leave it, because then they have to figure out how to find out more on their own. (MN03, Father of CM07/CF12)*

The **Moment of Um** is a short segment that answers a question sent in by children that is unrelated to the episode topic. This helps to increase some children's curiosity on the subject and leaves them wanting to know more.

- *The Moment of Um it tells you a little to get the rest. What is the rest? What is the rest? What is the rest? What is the rest? What is the rest? So, it's kind of thinking like what is the rest? (MN18, CF10).*
- *It's (Moment of Um) kind of like a jumpstart to, like, think about more things. (MN32, CF10)*

## Ask More Questions About the World

Curiosity and an interest in learning more about the world can lead to children asking more questions about the world around them and engaging in scientific reasoning (National Research Council, 2009). Brains On! places value on the questions children have by asking children to send in their questions and using those questions as the topics of episodes and Moment of Um segments. This models the scientific inquiry process for children and can lead to children asking more science-based questions, including questions they may want to submit to Brains On!

Listening to Brains On! can lead to children asking more questions about the world around them, with some of these questions based on topics children learn about in a Brains On! episode. In some cases, questioning might occur directly after listening to an episode, while in other instances children may come across

something in their daily life which allows them to apply what they learned from an episode and pursue additional inquiry into the topic.

- *When I listen to Brains On! they have – they tell us lots of things about science. And then I'm like well, they tell about this something and I want to learn more about that something. So, I'm asking more questions. (LA08, CF07)*
- *I think one of the things that Brains On! has helped with is open up more questions, is to kind of help think about things that we haven't thought about before, that we haven't thought to think about. (MN25, Mother of CF09)*
- *[Mother of CF07]: She started listening so early that – but I know that it started her having just a cavalcade of questions as soon as we started listening to the show when it first came out, which when we did go to the first live show, poor Molly had to face this child at three, babbling questions at her for the show. So – about, you know, how about the healing? And how about this? And can you do a show about that? So yeah, it definitely – [Father of CF07]: She would come home from the ride from school, and one of the first things would be I'd get to hear about what the podcast was, and [Mother of CF07]: Can we look something up? If there was something more that she wanted to look at about it. (MN16, Mother and Father of CF07)*
- *Depending on what the topic is that we've been, that when we listen to it he does ask some questions right away afterwards or kind of a conversation starter as far as that goes. (MN13, Father of CM10)*
- *I would say I definitely think so because after every episode there's two or three things and even sometimes a week later a topic will be revisited and I sometimes forget a detail of an episode and she'll bring it up and it's like clicking back in. Oh okay, well, something stuck. It's nice. (MN05, Mother of CF06)*
- *I'm noticing the Heat, Chill, Chop, Mix episodes – do you remember those, the cooking episodes from the summer? You don't remember those? When we listened to those four, the science of cooking, Heat, Chill, Chop, Mix, you were – you kept asking questions when we were cooking, and you kept asking about which things were happening. (MN21, Mother of CM06)*
- *She has kind of a photographic memory, actually, so she'll remember things from different episodes, or sounds, or tidbits. And then, when they are in context and we observe them in the world, she'll bring up these things and apply them. And then, we'll wanna talk and ask more questions about – well, when we see it. You know, we hear it, and then we apply it, and then we talk more about it and ask questions. (MN28, Mother of CF06)*

Brains On! not only promotes scientific inquiry in relation to episode topics, but leads some children to shift how they encounter the world, asking not only more questions, but more sophisticated science questions about the world around them (this also relates to the impact area “Notice changes in the types of questions asked”).

- *It's made me a lot more curious, I think. 'Cause instead of like, if I see something, I'm not just, "Oh, there's that thing," I'm like, "How does that work?" (MN32, CF10)*
- *I have been asking way more questions just about everything. At school when I was, before I started listening I used to ask questions that were like – questions that weren't really important that I already knew the answer to but I just wanted to ask them for the sake of it. Like do plants sneeze? Like stuff like that. But now I'm asking questions that actually make sense. Like the other day at school my teacher and I had a big discussion about cloning. And I was asking questions that were actually important. (LA16, CF10)*
- *Well, you know, every question leads you down – I don't know the right expression – not like a rabbit hole – in a good way. Like, there's always more questions and always more answers, and they kind of*

lay the foundation for why things work. But then we're, like, "Well, what is this exception? Why would this happen if this happens?" So, I think it gives us, like, a foundation then to ask more questions. Yeah, and sometimes we look up stuff to further our knowledge 'cause we have more questions after an episode. I think we were just listening to this one about, like, carnivores, plants and animals that bite back, and we were really interested in the Venus flytrap, right? Because – and then we looked up more about it online – it makes us – it really does, I think, promote scientific inquiry. (MN28, Mother of CF06)

## Features connected to this impact area

More than any other feature, parents/guardians and children pointed to the variety of **episode topics** as a contributing factor in kids asking more questions about the world around them. Exposure to new and interesting topics provide curious kids with new things to consider, translating into children asking more questions. Some of this can be sparked by an episode only covering so much about a topic.

- *But because of the new topics being brought up, they do ask more questions, because it introduces new topics. (LA10, Mother of CM06/CF10/CM12)*
- *Well, again, it would just be the variety of the things they talk about. And so, it's not just adults' input, it's like, anything. I mean, I think about my work and it's – the times you get asked questions that you don't know the answer to, it always comes from a kid. Right? So, it's those random questions that you just don't think of all the time. So, those questions come up in Brains On!. [Interviewer: Okay. So, do you see that happening with CM12 then?] Yeah. He would have more – he would have questions about more things now because it's things he hasn't thought about before? (MN33, Mother of CM12)*
- *I think it goes back to the – that you get just enough information to get started. And so, they kind of get this trail and they get led partway down it by hand. And then, now there's all these possibilities. And so, with him especially, he's dug deeper into some of those things. But I see him going different directions. Like, we'll listen to an episode about – I'm trying to think of a specific example. But he's been so on the biology track, we'll listen to an episode about one kind of animal and he'll start asking questions about another animal that are related.... He had a lot of insight questions after the one with ants. (MN03, Father of CM07)*

The **questions in the episodes** provide a model for children to ask their own questions about the world.

- *Throughout the actual episodes, there is a lot of asking of questions in the dialogue that I've picked up on and that I think is a good example, just by example showing asking questions. (MN25, Mother of CF09)*
- *She and her sister, her sister is almost five, like when we're listening to this in the car or something on a drive, the Brains On!, we'll pause and talk about the questions and that kind of thing. It's clear they're curious about the answers that come up on the episodes, and they ask questions all the time like that about other things, and so it makes me think that they are asking more questions and they're asking questions the way the show does it. (MN15, Father of CF07)*
- *A lot of the episodes start with a question, so just knowing that you can start with a question and talk to experts or talk to people who are knowledgeable about a specific topic and you can start to gain knowledge yourself. And it may lead to future questions. (MN03, Mother of CM07)*
- *It's probably the kids asking so many questions and everybody guessing about a Mystery Sound even. Like, that allowance to ask questions in such a non-scary way. (MN36, Mother of CF07)*

Brains On! episode topics are based on questions submitted by children. The ability for **kids to contribute** questions to the show encourages kids to ask questions about their world and for some children to ask more questions than they had before listening. Even if children don't submit their questions, the possibility of doing so can help motivate them to ask science questions and think about what they would possibly submit.

- *I would say more but I would also say that she gets really excited about sending questions in. So, she's asking a lot more questions, but then she wants to send them in. [Interviewer: So, asking – so being able to send in questions gets you [CF09] excited to ask more questions? Is that what I'm hearing?] Yes. (MN01, Mother of CF09)*
- *[CF11]: I'll ask my mom a bunch of questions about – more about it. And she'll say, "I don't know. [Laughter]. Go ask someone else." But, then she'll like help me... [Mother of CF11]: There have been times where I said, "That would be a great question to ask the Brains On! crew." And I think you submitted one – was it a question or – [CF11:] I submitted one or two questions. (MN11, CF11 and Mother of CF11)*
- *[CF10:] Yeah, like, we finish an episode, and then, like, we spend the next 20 minutes in the car talking about, like, what we would ask, or, like, what we think was cool about it, or something. [Mother of CF10]: And even though we have yet to send in pictures or sounds or whatever, like, sometimes I think we talk about, like, what would be [crosstalk]. [CF10]: What would we do if we were going to do it? (MN32, CF10 and Mother of CF10)*
- *She asks a lot more questions when we're not even listening to Brains On!. Outside of listening to it, she still asks a lot of questions and thinks about, "Let's send it to Brains On! and see if they can answer it for us." (MN36, Mother of CF07)*

The **Moment of Um** gives Brains On! the opportunity to feature and answer additional questions submitted by listeners. It also provides just enough information for children to get interested in the topic, spark their curiosity (as mentioned in the "Increase curiosity about the world" impact area), and then ask questions about the Moment of Um's topic.

- *The Moment of Um. They only give you a little bit of information about one topic and then you're – you start wondering about a lot of other stuff. (MN03, CM07)*
- *Moment of Um. They always have questions and then spin-off questions and then more questions. But I don't know how much of that is Brains On! and how much of that is childhood. (LA10, Mother of CF10/CM12)*

## Notice Changes in the Types of Questions Asked

As children develop scientific questioning skills, the types of questions they ask about the world may also change. As a result of listening to Brains On!, some children expand the range of topics they encounter and ask about. This leads to parents/guardians hearing questions about science topics their children would not have generally been exposed to.

- *[Mother of CF09]: She just asks a lot more questions and they're not just about the things that she was naturally interested in. Definitely brought in the different categories, because we never were wondering how elevators work or why – [CF09]: Or how – [Mother of CF09]: That's one of the ones that I listened to. So, I knew that, that episode. But yeah, she will hear so many things and then ask follow-up questions about the topic that she never would have been exposed to otherwise. (MN01, CF09 and Mother of CF09)*
- *[Mother of CF10]: I think the scope of what she's asking "what if" about has widened, because she's learning about things that she wouldn't normally run into day to day. And with kids, you know, they*

tend to ask questions about things that they know. And so, in this sense, I think it just broadens the scope of what she's asking "what if" about. Do you agree with that? [Father of CF10]: Yeah. (MN31, Mother and Father of CF10)

- *Brains On! isn't the only science show they listen to or watch. But they've definitely asked a lot more about science. They're both really interested in biology in particular. But they'll ask questions about the world and that's definitely increased. (MN18, Father of CF10)*

Brains On! helps some children develop more sophisticated ways of questioning. For some children, this means asking deeper or more targeted science questions than what their parents/guardians might expect from a child at that age.

- *I feel like they ask – she asks – they ask different questions than – you know, like you hear people saying, "Why is the sky blue?" and those kinds of questions. But, like I think they go – they go deeper. (MN35, Mother of CF09)*
- *She was very little when she started so, I think, yeah, her questions were a four-year-old's questions and then, again, became very – much more interesting and specific to episodes we had listened to... But I also think that without listening to Brains On!, she wouldn't be thinking so much about that specific stuff and, you know, talking about molecules. That age, I feel like, is slightly more grown-up than I'd expect from most small children. Not grown up, but you know what I mean. (MN36, Mother of CF07)*
- *What kind of questions have they been asking lately? Hmm... that's a good one. Because the – I don't know, I feel like a lot of it is the curiosity that he would have anyway, but this is directing him to ask questions in better ways. So, he'll – what did we – we just did something. I don't remember what it was, though, but I feel like it was with bugs... But instead of just, "Why does the animal do that?" I keep going back to the biology because he's asked me a lot of animal questions – "Why does it do that?" he'll ask a question and sometimes even make a statement. "Well, I know this, so is it doing this for a reason? For this reason? This reason that I might think?" He's actually drawing an inference and adding that to the question to try to prove it out instead of just asking a question that's really, really general and I may or may not go in the correct direction for him. So, he's doing a better job at being more pointed, I guess. (MN03, Father of CM07)*
- *I think they've become more sophisticated... Okay. I'm having a hard time pulling an example, but they've been more specific. (MN19, Father of CF06)*
- *I'd tell you it's definitely a little bit more on the focused questions. So, it's not just kind of like – not so much on the general side of things. But they're definitely a little bit more pointed. Like it was something that has either helped him probably focus his question a little bit more or if he's already got a little bit of a background if it's more of a conversation starter, it's definitely more of a targeted question. (MN13, Father of CM10)*
- *I think that the way that they word questions is very different from other kids, just like in how it's added. They like word it in a way that asks for like a specific piece of information, and not just like general information. And they ask to look together a lot of times, like, "Can we call someone or can we look for this book at the library?" And I think – I mean, again, we've been listening to it for a while, but definitely never happened like that before. (MN02, Mother of CM08)*
- *The questions that he does get are like they're more kind of thoughtful. So, he's definitely asking better questions, and he'd kind of researching them, and it's been pretty positive... And it's usually like can we find more about this, or why is this, and then, so, when we get home, we'll say, "Okay, let's go research this." (LA03, Father of CM08)*



In some instances, parents/guardians may see more sophisticated questions immediately after their child listens to an episode and a decrease in sophistication the longer it has been since they have listened.

- *Sometimes. If we're more consistent about listening to it, their questions will be a little more on the intellectual side. If we've gone a long time without listening to it, they tend to not formulate the questions in the same... it's more of like the why, why, why, why. (LA12, Mother of CF07)*
- *[Mother of CM06/CM08]: I think it's – it piques their curiosity, and so I think they know how to structure or like at least...I can tell they're listening. It's quiet in the car when we're listening, and they're like absorbing it, and I think that it's sinking in, and the types of questions they ask is – yes, I think – yes. [Father of CM06/CM08]: Yeah, the types of questions, I mean, yes, but I don't know how much that is correlative versus cause – you know, I don't know. I think definitely, again, like from my experience, it's within a certain time frame of having listened to it, there's a decay there, like from maybe within hours, through the end of that day, having listened to that, that that curiosity and the types of questions change. I think there's a – until you listen to another episode. I don't think the types – like a more probing question necessarily comes out of it, until you listen to it again, and they have that experience to [Mother of CM06/CM08]: Exposure. Yeah. [Father of CM06/CM08]: Yeah, to refer back to in order to ask a different type of question, because I think most of their questions are pretty [Mother of CM06/CM08]: General – rudimentary format. (MN17, Mother and Father of CM06/CM08)*

Since Brains On! listeners may start listening at a young age, when children are naturally curious and developing their questioning skills, it can at times be difficult to parse out if the change in the types of questions parents/guardians are hearing are influenced by Brains On!, their child's natural development, or a mix of both.

- *[Mother of CM09]: Probably. Yeah. I mean, it's hard to separate that out from him just growing older, but definitely like we – like I said, he listens to them when he's kind of building blocks and kind of can just sort of think, and then we listen to them in the car sometimes. And yeah, I think that's probably the best thing, is that he's able to ask more sophisticated things about the things he's listening to, and then we can talk about them, and I usually don't have an answer for him, but – [CM09]: Then we both want to have a – [Mother of CM09]: Then we both want to have an answer. (LA06, CM09 and Mother of CM09)*
- *I would say yes. I would say that part is probably Brains On! and part is probably maturity in age, right, and just, like, natural development. But I think the questions are more specific, you know, not, like, "Why does the sun shine in the morning?" You know, they're more about, like, specific phenomenon, sometimes reflecting on an episode we've listened to, but also maybe something she sees. But they're more – they're higher-level – it's demonstrating higher-level thinking. That things are not necessarily, like, binomial; it's not, like, yes or no, black and white. But that there is, like, there's a spectrum, there's a continuum of ways things can be, and so, she's asking more nuanced questions. But that could also be maturity in age, too. 'Cause she's been listening over a long period of time. (MN28, Mother of CF06)*
- *I'll say yes, with a but. I think her questions have gotten more complex or more specific in many ways, but that's also because I think we – I think she was six when we first started listening, or – six or seven, and so she's also grown a lot in that time, so that might have happened anyway. (MN08, Mother of CF11)*
- *That's hard to separate out just him getting older and asking more complex questions so I can't say because of Brains On!. His questions get more complex, though, the more he learns. (MN06, Mother of CM09)*

## Features connected to this impact area

The **questions featured in an episode** provide models for children of how to ask questions and what a “good” science question might sound like. This can be bolstered for some by a child’s **ability to contribute** their own questions to Brains On!.

- *[Interviewer: In terms of that complexity of questions, are there – what about Brains On! do you think might have contributed to that? Any aspects of it, or –] Well, they feature the kids' questions, so it's like she – it's like knowing what a question sounds like. Oh, that's a possibility of a question. Like, all right, now we're on to something. I think it's inspiring. (MN08, Mother of CF11)*
- *I mean I think they're asking – they ask questions that they feel like we should have an answer to. That somebody has an answer to and we just don't. So, I think that's kind of – where sometimes people ask questions about why did somebody do that versus CF08's question about why does rain water turn into sea water... Like I feel like that type of thinking is prompted after we listen to other kids asking those questions. The kids asking the questions piece is, we like that. (MN34, Mother of CF08/CF10)*
- *He maybe has been influenced by it. 'Cause especially when his brother had a chance to ask a question on the radio, then all of a sudden, he came up with, "What are some questions I could ask?" And a bunch of them it's, like, "Well, that's not a very good science question," and he just kept trying and trying and trying, until he came up with, "How do we get vitamins from the sun?" Right? And that was the one, like, he was finally able to send in. So, I would actually say he did have a change. (MN22, Mother of CM07)*
- *I think the kid engagement has been good, because sometimes you're like thinking of questions that you want to send, or he thinks of like ways to participate, which might make him think about something. (LA05, Mother of CM08)*

Hearing new and varied **episode topics** provide fodder for a child’s inquiry into new topical areas.

- *She will hear so many things and then ask follow-up questions about the topic that she never would have been exposed to otherwise. (MN01, CF09)*
- *I think that we already kind of, you know, would ask questions like these, let's say. But I would say that, again, for me, it's that introducing a new area or topic gives them either something to talk about that they wouldn't otherwise have thought of, you know, in many cases, like, just to think about something more critically. So, in that way, I would say maybe some of the questions are a little bit more specific than they would otherwise have been, just because you kind of have a sense of how to go about thinking about it? (MN32, CM06/CF10)*
- *The variety of episode topics. (LA05, Mother of CM08)*

## Listen More Closely to the Sounds They Hear in the World

Earlier phases of our research suggested that some children may improve their listening skills from listening to Brains On! Some of this may come from children simply having to focus on listening to a podcast episode, however we were interested in knowing if listening to Brains On! had any kind of impact on how children paid attention to the world around them. Each Brains On! episode includes a Mystery Sound for children to listen to closely and then try to guess what it might be, finding out the answer later in the episode. As we know from Phase 2, the Mystery Sound is popular and many children try to find their own Mystery Sounds, with some even submitting sounds to Brains On! The act of children listening to sounds around them, questioning what they might be, observing to see where the sound may be coming from, and

trying to figure out who or what might be making a sound and why are all part of the skill of engaging in scientific reasoning (National Research Council, 2009).

Brains On! helps children pay more attention and listen more closely to their world. Some of the sounds they listen closely to may be things they didn't pay attention to before, but because of Brains On! they are more aware of the sounds in their surroundings.

- *Now that I think about it, yes. That probably has. 'Cause like, if you hear sounds that, in some places, you hear all the time – like waves rushing by – you don't really think about them. You just hear them, and it's like, an ordinary thing that you always hear. So, yes, I have been changing to those. (MN33, CM12)*
- *There's a lot of times when CF06 hears a sound and says, "That would be interesting. Let's tape that for Brains On!" So, I think that, like, in our everyday lives, there's so many sounds, and we often tune them out. Because it becomes, like, we become fatigued; it becomes background noise. But I do think now we're listening for sounds that are interesting... Brains On! has heightened our awareness to sounds that might've just been in our background, or we've become fatigued to or desensitized to, and brought them, kind of back to life. (MN28, Mother of CF06)*
- *I usually hear lots of birds in the morning, and sometimes, very rarely, at night... I have my blinds down all the time, so, like, I can't really see outside, so, like, it's kind of like a Mystery Sound, 'cause you can't see what's making the sound. (MN29, CF06)*
- *I just like the sounds of things that I hear every day. And like sometimes I'm drinking the water. I was drinking the water in the car and then a little funny sound trying to get it off my lips. Then finding an everyday thing, drinking water made a sound. And I thought sounds can be just awesome to listen to. (LA08, CF07)*
- *Before, I was always hearing bird sounds, but now I'm paying more attention to the sounds and how they make the noises. (LA02, CF08)*

Because of Brains On!, some children not only listen more closely to the sounds around them but engage in higher levels of scientific reasoning by paying close attention to the features of the sounds they hear to try to figure out what might be happening or what might be making the sound.

- *After I listened, I started listening more for, like, birds and different sounds I haven't heard before, to try to, like, investigate the world around me. [Interviewer: Why do you think that Brains On! made you start listening to those sounds more closely?] Like, just, like, the Mystery Sound, because it helped me learn how – it made me think more about what I'm hearing and what the sounds around me are. (MN24, CF09)*
- *It (Mystery Sounds) increases my analysis of sounds. (LA16, CM12)*
- *Because there's a lot of noises when I'm sleeping in my room, and I'm really curious about which noise goes to which thing it's coming from. [Interviewer: Oh, okay. Did Brains On! help you – give you some of that curiosity about those noises?] The Mystery Sounds did. (MN17, CM08)*
- *Sometimes when I listen to... the Mystery Sound episodes... I never would have guessed that it would have been something that was the answer to it, because I never knew it could make it – it made that sound. So now I listen a little more closely to things in the world around me, try to figure out what sounds they are, and what they're coming from. (MN12, CM10)*
- *[Mother of CF06]: Like when we're outside and we might hear an animal making noises. We guess – we try to think about what the animal might be doing. [CF06]: Mm-hmm, because yesterday when we were playing outside, I heard like a bird squawking but I didn't know what the bird was. [Mother of CF06]: Mm-hmm. There were two birds in the tree and we were talking about what they might be*

doing up there when they were making those loud noises. [CF06]: Uh-huh. I thought they were laying an egg. Maybe they make that noise when they would lay an egg. [Mother of CF06]: I don't know. Maybe. [CF06]: Maybe one of them was a daddy and one of them was a mommy. [Mother of CF06]: Maybe. (MN23, CF06 and Mother of CF06)

## Features connected to this impact area

The **Mystery Sound** makes some children more interested in listening more closely to the sounds they hear in the world around them.

- *Because it's asking them a question as the listener, and they respond to that immediately, like, ooh, what's the Mystery Sound, and they're spouting off all kinds of possibilities. And I think that changes how they listen when they're anywhere. (MN17, Mother of CM06/CM08)*
- *Sometimes I'll hear something really close to another Mystery Sound and it'll be like, "Huh. I remember that from somewhere." And then I'll try to detect what it is. (MN11, CF11)*
- *I like learning about how I can hear better, like on the Mystery Sounds, and it helps me improve my hearing. (MN35, CF09)*

The **ability for kids to contribute** Mystery Sounds to the show results in some children listening more closely to sounds in their world to try to find a potential Mystery Sound they can submit to Brains On!. Even if families don't end up recording a Mystery Sound and/or sending one in, having the option to submit a Mystery Sound can keep kids engaged and listening to the world around them.

- *Because I am always listening for a possible Mystery Sound. So, like every sound I hear I'm like, "Oh, maybe I could use it for something." Or a lot of the time I make connections like, "Oh, I've heard this sound before. It reminds me of something." (LA16, CF10)*
- *I think a lot of it for whatever reason because we listen in the car, it's a car sound. So, if she's playing with something in the car, she'll say, "Well, we should send this in" like sticking tape on the door and pulling it up and off. (MN05, Mother of CF06)*
- *[Mother of CM11]: We do talk about what would make a good Mystery Sound. [CM11]: Yes, we do. [Mother of CM11]: We have a new hamster, and the hamster was talking in his sleep. [CM11]: And oh, like hamster drinking water. [Mother of CM11]: And we're like – [CM11]: Oh, my gosh. [Mother of CM11]: – this needs to be a Mystery Sound, and we need to record this as a Mystery Sound, because no one's going to guess this is a hamster talking in its sleep. (LA01, CM11 and Mother of CM11)*
- *There's been some cases where he's like, "We should send that in for a Mystery Sound." That's always our – never can record anything quick enough or anything. But yeah. There's been sometimes where he's like, "Yeah, that would be a good one." So yeah. I think he does pay attention a little bit more sound wise out there. (MN13, Father of CM10)*
- *I think it's mostly that if she hears something unusual, she wants to know if she can record it to send it in, and we haven't been able to pick one out. But she listens. (MN16, Mother of CF07)*

## Engage in Science-Based Conversations

Adult-child science conversations are common during informal science education experiences and research has shown that interactions children have with adults and other children while interacting with media can positively affect a child's science learning outcomes (National Research Council, 2009). We know from the Phase 2 survey that listening to Brains On! sparks adult-child conversations in most families. Since we

already knew this was an impact of listening, we did not ask an interview question directly about science-based conversations. However, references to science-based conversations came up naturally in a majority of the interviews. These conversations help to provide opportunities for children to demonstrate what they have learned from listening to Brains On!, apply what they learned from Brains On! to a real world situation, ask questions that lead to deeper inquiry into an episode topic, and to jointly engage with their family members to listen and discuss what they are hearing during a shared media experience.

Some science-based conversations involve a child sharing information they heard from Brains On! with others. This also provides an opportunity for parents/guardians to hear what children are learning and what information they are retaining from listening to Brains On!

- *[Father of CF06]: Yeah, you definitely enjoy it, and I'm always surprised by how many very specific things that you remember.... And retain them, and you can bring them up in conversation later. [Interviewer: Yeah. So, you learn new things from Brains On!?] [CF06]: Yeah. Sometimes at my locker, I talk to my friends about Brains On!. [Interviewer: Oh, do you? When you talk to your friends about Brains On!, what do you talk about?] [CF06]: It's – I talk about how it's really cool. [Interviewer: And do you tell them things that you learn from it?] [CF06]: Yeah. (MN19, CF06 and Father of CF06)*
- *[Mother of CM07]: We were walking down the street. We happened to bump into a neighbor. We noticed that the moon was – sort of where the moon – how the moon looked, and the neighbor said, you know, I've always wondered why it is that it looks like that. And CM07 had a really good answer, which I'm pretty sure is correct, and also, he could articulate to a man in his seventies. [CM07]: Yeah, it's probably correct. Yeah, because when it was evening, it was daylight, it was like morning at the other side of the world, and the other side of the world was on the other side of the moon. [Mother of CM07]: Okay, so anyway, but my – so I think that kind of interaction is way beyond what I would have expected. He just turned seven, and I don't think when I was seven I was able to articulate science theories. (LA17, CM07 and Mother of CM07)*
- *She definitely references some of the science in their episodes – specifically that she's smarter than me because she's young and her brain works faster than mine. She likes to point that out a lot. (MN36, Mother of CF07)*
- *I hear him sharing information that we've heard on Brains On! with other people. My parents – or his grandparents – so, I think it does increase his curiosity about what's going on. (MN27, Mother of CM08)*
- *Sometimes you'll say things when we're listening to other podcasts, you'll say things that you learned on Brains On!. (MN18, Father of C10)*
- *She always likes to talk about the subjects of the show, and she's brought those to school with her, so teachers have dealt with hearing about stuff maybe ahead of what they expected. But she is always super interested in stuff she hears... she's always bringing up new things that she's heard on the show that – both to us and at school. (MN16, Mother of CF07)*
- *Or in things that I've observed, where they're answering – the kids are answering questions from other kids with answers that they've gotten from Brains On!. So if we've listened to an episode about, I don't know, let's say dolphins, the dolphin/octopus episode, right? If they're in school or if we're – typically, we're not there with them in those circumstances, but sometimes we are, like Science Night at school, and there'll be a question from an expert, "Hey, does anyone know how XYZ works?" And when the kids are able to answer that question because of the knowledge that they have from there, I know from – firsthand from the looks on CM06's face, especially, when he – the confidence that he's gaining from that. I can see it in his face. (MN17, Mother of CM06/CM08)*

For some families, the new knowledge children learn from Brains On! helps to spark science conversations that provide children with an opportunity to apply what they learned from Brains On! to a real life situation.

- *So, I know that they'll – if we go to the science museum, they'll bring up stuff. "Oh, I learned that." We were at the aquarium...in Duluth this last weekend. And CM07 and I were together and he was telling me that, "Oh, I learned that at Brains On!" So, I mean, they're just learning a lot of different things and they're – and it's great because we're seeing them actually apply it and kind of realize what they're, what they've learned. (MN03, Mother of CM07)*
- *I was looking through here and I mean we talk – like the one on the four things about cooking, I remember like we talked about chopping and we talked about mixing and it's like, remember, when we were making batter for something and you're like, "No. If you mix it this way it will mix better." It's just funny how some of those things really stick with you. (LA09, Mother of CM12)*
- *I'm noticing the Heat, Chill, Chop, Mix episodes – do you remember those, the cooking episodes from the summer? You don't remember those? When we listened to those four, the science of cooking, Heat, Chill, Chop, Mix, you were – you kept asking questions when we were cooking, and you kept asking about which things were happening. Then you were telling people about how carrots were full of molecules. I remember that. (MN21, Mother of CM06)*
- *She has kind of a photographic memory, actually, so she'll remember things from different episodes, or sounds, or tidbits. And then, when they are in context and we observe them in the world, she'll bring up these things and apply them. And then, we'll wanna talk and ask more questions about – well, when we see it. You know, we hear it, and then we apply it, and then we talk more about it and ask questions. (MN28, Mother of CF06)*

Some parent/guardian-child conversations are sparked by questions children have about something they hear on Brains On!, where the parent/guardian helps the child find the answers to their questions.

- *[CF07]: I think it's like when I listen to it, I get just a bunch of like, stuff popping up in my head and I start asking questions and my mommy tells me what - [Mother of CF07]: The answers. I just answer everything. All the questions. (MN36, CF07 and Mother of CF07)*
- *[Father of CF07]: We would get the follow-ups to Brains On!. Since she's listening in the car, the initial ask is my wife, who's driving. And then if there's follow-on at home, it's whoever is around. So we would get – I don't remember – I'm trying to remember any specific episodes. But it would be – [CF07]: Dreams. [Father of CF07]: Yeah, there would be a question around dreams or there would be a question around – they talked about this in the episode today. Why? And she would extend it to something else and ask me – which was great. I didn't always have a good answer, but it was a good challenge. (MN16, CF07 and Father of CF07)*
- *And I know when we listen to them in the car together if we're traveling somewhere we'll sometimes even talk about it (the episode topic) and questions will come up and it's like, "Okay, well, let's go figure it out." (MN03, Mother of CM07/CF12)*
- *[Mother of CM09]: I think that's probably the best thing, is that he's able to ask more sophisticated things about the things he's listening to, and then we can talk about them, and I usually don't have an answer for him, but – [CM09:] Then we both want to have a – [Mother of CM09]: Then we both want to have an answer. (LA06, CM09 and Mother of CM09)*

Brains On! serves as a catalyst for science-based conversations between family members, often while they listen together in a vehicle. This unique listening environment provides an opportunity for families to have a

shared learning experience where they are listening and discussing the podcast content together. These discussions can be around various aspects of a Brains On! episode including the questions in the episodes, episode topics, and Mystery Sounds.

- *A lot of times after we listen to an episode there'll be follow-up questions and discussions that happen in the car. So that's where we're listening to it on our morning commute. And it's just nice to – it passes the time and it gives us something interesting to talk about that normally I wouldn't have broached that topic. (MN05, Mother of CF06)*
- *Well, in the car we can read or we can play games or we can sit in silence or listen to music. But when we listen to a podcast – and really the only one we have for them is Brains On! – then it's more conversation. Around what we're listening to, which is kind of fun. I mean we usually discuss the subject. We always do a guess on the Mystery Sound. We like pause it and we make our own guesses. (MN34, Mother of CF08/CF10)*
- *We have talked about the episodes in the car. It's just kind of been an addition to what we normally do as a family. So, we just kind of use it as just one more thing to add in, something interesting that we can all participate in together... It helps us connect as a family, especially on car rides... I mean for me and the conversations I've had with my daughter, it's more of the topics and just stuff that – you know, the overall content. (MN25, Mother of CF09)*
- *I think it's definitely something we listen to almost entirely in the car and gets us talking about science, gets us talking about reasoning. (MN18, Father of CF10)*
- *[Mother of CF10]: I think she talks about science a lot more. [Father of CF10]: Yeah. [Mother of CF10]: Asks questions. What do you think, CF10? [Father of CF10]: We have a lot of discussions around the episodes. We're usually listening on long car trips, and so we'll pause and talk about things, and - [Mother of CF10]: And sometimes CF10 will have a question, and we'll say, well, we could look it up on Brains On!, see if they had an episode on that, and sometimes we'll listen. (MN31, Mother and Father of CF10)*
- *I think it gives us something to talk about together, about science, like kind of a common – like just in the car, we were listening – we both learned that there's something the world that's called fatbergs... I think the biggest impact it's had on us is our just ability to be able to talk about – because I can't – I think they do reasonably interesting science stuff at school, but he doesn't bring it home. You know, so I can't talk to him about it. So when we listen to an episode, then we're talking about it together. So I think that's a big impact. (LA06, Mother of CM09)*

## Features connected to this impact area

Brains On! episodes cover a wide variety of **topics** that help to spark conversations. The topics include ones that are of interest and relevance to both children and adults. In some instances, Brains On! introduces families to topics that they otherwise wouldn't talk about.

- *I know in Soil, Can You Dig It we were talking about the worms a bit... The dreams we talked about quite a bit and we actually shared with some friends, too. Dogs because we have a dog that was very interesting for her. Animals breathing underwater. We talked about fish. (MN05, Mother of CF06)*
- *But I also think the fact that there's a variety of topics makes a difference, because it's constantly feeding curiosity and he might not ever have thought to think about hair. Now, two weeks from now, he's going to say some really random thing about hair because it was there. I think the variety keeps him engaged. So, it builds knowledge better. (MN21, Mother of CM06)*
- *I know, like, there's certainly been conversations that have started from episodes like the evolving ones. And, of course, the fart episode was the favorite. Oh, yeah, the yawns, hiccups, and*

goosebumps... And it's also, like, it's just started fun conversations in the car, when we listen to it, 'cause we use it for when we're driving around.... and this is a great entry into some subjects that we wouldn't necessarily talk about at home without it. (MN24, Mother of CM06/CF09)

- So a lot of times we'll listen to Brains On! like in the car, on like a family road trip, and so it gives us something to talk about after. Like we were all amazed by the spider episode, I remember. 'Cause just being like I used to be afraid of spiders and now I'm not anymore. And just learning about why they move the way they move and that being something that we – I mean just an example of something that, you know, a topic that we all find really interesting, like as a family. That's something that we come back to a lot. (MN02, Mother of CM08)
- It's given us a lot of good platforms to talk about how the world works and, you know, how things work around, like, work in the world around us, like electricity, like the science of food, like, you know, where does our waste go when we go to the bathroom. Right? (MN28, Mother of CF06)
- Like one of the ones we listened to recently on dirt, like we play in dirt all the time... We listened to it again on the way here. We have gardens, but we never have really talked about dirt and the different kinds of soil and things like that. I think that it's given us like a shared thing that we talk about too. (MN2, Mother of CM08)
- Well, I would say that maybe it has encouraged us to have more discussions about science-related topics, even though already we were a science-loving family. So, in that regard, it's helped us to have some focus for some topics.... so, you know, the Where Do our Poo and Pee Go, like, that one, we had discussion about that, you know, like, we talked specifically about that topic, and took it further and things like that. So I think it gives us a – let's say it gives us a jumping-off point for some different science topics that we might not have come across otherwise. (MN32, Mother of CM06)

The interactive nature of the **Mystery Sound** segment in Brains On! episodes provides opportunities for families to guess and discuss what is making the sound.

- We have a good time guessing what it could be in the car because usually we listen to it in the car and usually we used to regularly listen to it on the drive to school, which is about a 20-minute drive which is kind of a perfect amount of time for a Brains On! episode. (MN06, Mother CM09)
- You know, we were listening to the one about the gecko glove, which we were all, like, "What on earth sound is that?" It's, like, "Okay, we were never gonna guess that," but it's fun to talk about, right? So, like, it's the – yeah, I really like the formatting. (MN22, Mother of CM07/CM09)

The ability for kids to **contribute to the show** through sending in questions and Mystery Sounds has helped to foster conversations, even if families don't end up submitting anything to Brains On!

- I know that CF07 has tried to think up additional questions for the show, and that has led to discussions around various aspects of the world around us. (MN16, Father of CF07)
- There's ways for it to be interactive, and we always like to guess the Mystery Sound. And they encourage asking questions, which she has written to them, and posed her own questions. So it's – the interactivity of it, both talking to them on the show, but also getting us to talk...I think maybe right after we listen to a Mystery Sound, we like start kind of brainstorming, like what if we record this or that, and we wonder if other people would be able to guess it, but that's about it. I don't know that we necessarily think about it in regular life. (MN08, Mother of CF11)
- We do talk about what would make a good Mystery Sound. (LA01, Mother of CM11)

The episode topics and **Moment of Um** are based on **questions children submit** to Brains On!. These questions and the surrounding content in the episodes are topics of conversation for some families.



- *I mean she and her sister, her sister is almost five, like when we're listening to this in the car or something on a drive, the Brains On!, we'll pause and talk about the questions and that kind of thing. It's clear they're curious about the answers that come up on the episodes, and they ask questions all the time like that about other things, and so it makes me think that they are asking more questions and they're asking questions the way the show does it. (MN15, Father of CF07)*
- *The questions that they ask and subsequently answer might spur some – you know, some ancillary questions about that too. That sparks into discussion. (MN11, Mother of CF11)*
- *There was, like, short little bits like the Moments of Um, that's a more interesting – well, that was a quirky little thing, not necessarily worthy of a whole show, but that was a cool snippet. I find them talking about the Moments of Um later on. (MN29, Mother of CF06/CM10)*

The **scientists** featured in each episode have helped to fuel conversations about people who work in science.

- *It's opened up conversations about who we know who does science, things like that. So, I think there's a definite sense of, "I could do that." (MN21, Mother of CM06)*
- *[Father of CM06/CM08]: We have a lot of conversations around what it means to be a scientist, and like that it – like kids think that a doctor is a medical doctor, and having a lot of conversations of if you're a professor, you are a doctor by – you are. You have to be, right? So we've had a lot of conversations about what research means, what education means, what it means to be an expert in your field, and what a – I think that helps them understand the trajectory that they would be on if they wanted to do – pursue those studies. Because science is like – I can't think – apart from public speaking for the little one, like I can't think of a better – something that they're more engaged in than science. [Interviewer: Does Brains On! play a role in these conversations you have?] Absolutely. (MN17, Father of CM06/CM08)*

**Humor** in the episodes helps to keep children engaged and learn the content. The humor can be the topic of conversation, as well as help children remember the information in the episode so they talk about it later.

- *Oh, yeah. They have the skits, right? I mean, we always talk about kind of the silly characters. Yeah, silly characters. (LA03, Father of CM08)*
- *The funniness and the silliness and all that makes you remember them better, so then you bring – you know, we can bring it up later, because we're like, oh, yeah, remember on Brains On!, duh duh duh, and I don't know if we would have remembered that if it wasn't funny or memorable. I think we were talking about those – it was like the monsters. Anyway, yeah, so it just brings it up, makes it memorable. (LA05, Mother of CM08)*

## Do a Project or Activity Based on Something They Heard on Brains On!

Although Brains On! is an audio experience, Phases 1 and 2 findings provided evidence that children's engagement with what they hear on Brains On! may continue after listening concludes. This extended engagement may lead to children doing a project or activity based on something they hear on Brains On!.

Children may engage in their own scientific-inquiry based on Brains On! episode topics.

- *One time I measured how big the rain drops on my window were on one rainy day. And then on another rainy day I measure them again and one was bigger than the other... The one about rain*

inspired me to do that. (MN34, CF08)

- [Mother of CM11]: Well, particularly the episode on sleep he thought was so interesting that he made a project in the house and had us all trying to track our dreams for a little while. [CM11]: And it failed. [Laughter] Almost every time, it didn't relate at all, but one time – [Mother of CM11]: Lucid dreaming is very hard. [CM11]: Very hard. [Mother of CM11]: So, I think it's captured his attention. I think it's captured his imagination. I think it's sparked some curiosity... There's Post-Its all over our house... There's Post-Its everywhere. We did not successfully lucid dream in the house. [CM11]: It was almost there, and it was a really good dream. And it ended just at the right point, ended just at the right point. (LA01, CM11 and Mother of CM11)

Brains On! can also be a source of inspiration for children's school science projects or scout projects.

- [CM07]: So, we put a dot of colored pen on a stripped-up paper towel and we put it in the water and we put it on different, we put different colors on pieces and then figured out which one runs faster... Based on, I got it based on an episode. [Interviewer: And you did that for school, for a school project?] Mm-hmm. [Father of CM07]: Yeah. They have sort of like an optional science fair in the evenings. (MN38, CM07 and Father of CM07)
- [CF12]: I have, did like a science project on memory. [Mother of CF12/CM12]: After we listened to the memory episode, huh? [CF12]: Yeah. That was fun. And it was for like a school science fair... [CM12]: I also did a science project and it was from one of the episodes. And I just remember when I was thinking of trying to do a science project I remember one of the Brains On! episodes. (LA09, CF12/CM12 and Mother of CF12/CM12)
- He was just doing a project for science for school, and it was a passion project. He needed to pick a topic he was interested in and do a presentation about it. We had a very active conversation about whether he could get *Mystery Sounds* into his project. It was all about becoming a vet, and he went on a clinic visit and recorded some sounds. We didn't quite get enough to get in his presentation, but I thought it was kind of a cool idea. (MN30, Mother of CM10)
- [CM10]: I did water testing... [Mother of CM10]: So, I'm the Cub Scout leader, and there's this award that's a science award called a Nova Award. And one of the first things you do for it is you engage with media, for an hour. And they suggest, you know, like, a Nova TV show episode, or a book or something. But in this case, we'd actually used the *Keeping Water Healthy* and the *Burning Rivers of Fire* episodes, as the one hour of media engagement of learning about stream and water health. And then, used the water testing kit advertised through Brains On!, to do the water testing experiments on Lake Harriet and the creek, so. (MN29, CM10 and Mother of CM10)

As described in the impact area "Increase interest in learning more about science," children's increased interest in learning more about science often leads to searching out more information about the topic of interest. Children might seek out more information by searching online, checking out a book at the library, listening to a different Brains On! episode, or listening to a different podcast altogether.

- Usually, there's a list of questions we have to go on the internet for, because usually, we're listening to it while we're driving... We'll have a list of questions that we'll follow up on back home. (LA03, Father of CM08)
- [Mother of CM09]: I'd say yes, although the only thing that you've really kind of been – most interested in science lately has been engineering, so I wouldn't say we definitely go out and get books about every topic that he hears, but anything that's about like how do airplanes fly, or how do you make a bridge, that kind of like engineering stuff, he kind of pursues. [Interviewer: So certain kinds of topics?] Certain topics. Yeah. (LA06, Mother of CM09)

- *There are some questions, like there are some episodes on the show that even once they're done, they spark other questions in my brain, and then I just like to try to figure out how those things are possible, and... [Interviewer: So, when you – when it sparks these other questions, do you then go look for answers to those questions?] Sometimes I'll listen to other podcasts like this and see if I can find episodes about that, or I'll just try to – try to find books about that subject. (MN12, CM10)*

Some episodes may inspire families to visit somewhere science-related that was featured on an episode.

- *I mean, we are going to be going to visit the Great Sand Dunes because of when they did the national parks. And I have a brother-in-law that lives near them. So okay, after we heard about that episode, we [have] got to get down there and visit that. (MN09, Mother of CF07/CM10/CM11)*
- *I guess going to the Bakken Museum was an activity, right? (MN20, Father of CF09)*
- *The national park programs encouraged him to become a junior ranger. [CM07]: A junior ranger? [Mother of CM07]: Yeah, remember, you signed up in Joshua Tree for junior ranger? [CM07]: Yeah. [Mother of CM07]: And it was after the Brains On! episode. (LA17, Mother of CM07)*

Some children may do activities or projects that emulate the Brains On! podcast. This includes activities such as pretending to be a Brains On! host, recreating segments they hear modeled on the show such as Mystery Sounds and interviewing adults, or even creating a podcast inspired by Brains On!

- *[CF06]: Sometimes I actually pretend I'm Molly Bloom on Brains On!... [Father of F06]: Yep. I have heard you in your room doing that...I've heard you pretending to do new episodes on new topics. [CF06]: Yeah. (MN19, CF06 and Father of CF06)*
- *[Father of CF06]: We've actually played Mystery Sounds at home. [Interviewer: Oh, have you? Like your own sounds?] [CF06]: Yeah. [Father of CF06]: One of us closes our eyes, and the other makes a sound. [CF06]: Yeah. Mine to daddy was me eating cucumbers. Yeah, my daddy guessed it actually right away, because he looked at the plate and saw less cucumbers. (MN19, CF06 and Father of CF06)*
- *[Mother of CM08]: Do you ever have questions about stuff that you think, 'Oh, I could ask somebody that does that for a living?' Like can you remember times when you called Uncle Jack... to ask them questions like the kids do on Brains On!? About stuff that they know about. Or even like Baba Brown, wanting to ask him about, like the Vietnam War? [CM08]: Mm-hmm. [Mother of CM08]: Yeah. It's like, "Hey, we could call Baba Brown." And that's something that they do on Brains On! too. (MN02, CM08 and Mother of CM08)*
- *She actually even decided to make her own podcast about the history and science of cheese. It's not published, it's just on my phone. But we have guests that come on the show. We have different parts of the show, and that was definitely inspired by Brains On! (MN28, Mother of CF06)*

Since Brains On! is an auditory experience, some children use their creativity and imagination to visualize something they hear about in an episode through drawing or building.

- *[CM06]: I mean there was one time after an episode where I decided to build something out of Legos that resembled what they talked about in one of the episodes. [Mother of CM06]: Yeah. He frequently does projects based on – like he'll draw or he'll make Legos. [CM06]: Yeah. After the Venus – after the carnivorous plants episode I drew a picture of a Venus Flytrap. [Mother of CM06]: Yeah, but he'll build things off of subjects too out of Legos and stuff. [CM06]: Yeah, there was this episode on a jungle and I built a jungle. (LA10, CM06 and Mother of CM06)*

- *Like we make roller coasters with our Legos and stuff. (MN35, CF09)*

In some cases, the show sponsors may serve as a source of extended science learning to supplement what children are hearing on Brains On!

- *[CF06]: In one episode, you know, like, that commercial thingy before they start, they sometimes talk about Kiwi Crate. [Mother of CF06]: We subscribe to Kiwi Crate... It's a monthly subscription box that comes, and each box is focused on a particular science topic or experiment. And then they send you, like, monthly experiments with, like, a book about it, and so, it's very tied-in to, like, what you would hear on Brains On! And Brains On! promotes Kiwi Crate, so we subscribe to Kiwi Crate and we do the activities. (MN28, CF06 and Mother of CF06)*

For some families who listen in vehicles, their listening location may influence if children do some kind of activity or project after listening. Although this isn't the case for all families that listen in cars, it may limit extended engagement for some.

- *I don't know that we have specifically done something that was a direct result from listening and then going, "Okay, let's do that at home," probably partly because we listen in the car, so it makes it harder to. (MN32, Mother of CF10)*

## Features connected to this impact area

**Episode topics** provide the basis for seeking out additional information about something learned on Brains On! or provide ideas for science activities and projects.

- *I just remember like I think we did one of flush, where does poo and pee go. And then I went on to a computer website and searched more about that subject. (MN34, CF10)*
- *We did that science of slime thing or we're going to do that. (LA04, CF09)*
- *Like all the activities related to solar eclipse... We kind of made the pin box together. (MNO4, Mother of CF09)*
- *[Mother of CF06]: We ordered the water kit. And we took that to Girl Scouts and we did a – [CF06:] A run test to see. [Mother of CF06]: A water test. [CF06:] Like there was a bottle like a bottle that you would drink out of that we tested... [Mother of CF06]: Yup, it was based off an episode and then you could go online and they'd mail the kit to you and that was really nice because it brought the activity home, with like a specific task and showed you how to do it. (MNO5, CF06 and Mother of CF06)*

The show is structured based on children's questions and submissions of Mystery Sounds. In some cases, Brains On! also creates videos or other media that features children's drawings. The **ability to contribute** to the show by submitting drawings, questions, and Mystery Sounds encourages children to engage in activities outside of listening.

- *I did send a Mystery Sound last year. They didn't put it on Brains On! It was the sound of a squeaky balloon. I put water on it and then I rubbed it with my hands. So, like, it made this squeaky sound. (MN29, CF06)*
- *We've done one like draw, write a letter to Earth. We did one drawing activity. (LA08, Mother of CF07)*
- *We constantly send in things to the show – we send in pictures, we send in ideas, we send in comments – yeah, we do that a lot. (MN28, Mother of CM06)*

As described earlier, some children do activities based on features of the podcast, such as pretending to be one of the **co-hosts**, playing their own **Mystery Sounds** game, and interviewing others similar to the way **kids featured on the show** interview scientists.

## Increase Awareness About the Kinds of Jobs People Can Have in Science

Brains On! features a scientist on each of its episodes, providing opportunities for children to be exposed to a broad range of science careers. Many times, episodes introduce children to areas of science they were not aware of before hearing about it on Brains On!. While few children may recall the exact roles/titles of the scientists highlighted in the episodes, most are able to describe details they learn about the scientists, such as what they do in their line of work, where they work, or the kind of science they focus on in their job. This awareness that a job exists, even if children can't remember the exact name of it, is important in opening children's eyes to the broad range of work happening in the sciences. For some, it may even help to increase their interest in pursuing a possible science career in the future.

- *I didn't even know that an astrophysicist was a thing... before I started listening. (LA16, CF10)*
- *I don't really know if this was real, but what I'm talking about is like if they interviewed a scientist that specializes in like – they just study like the way dogs think about a certain thing, I'm like, what? That seems crazy. I didn't know that could be a job. (MN08, CF11)*
- *I did not know there was a scientist that studied sound before. (MN09, CM11)*

Through the range of scientists and content featured on Brains On!, children become aware of the wide variety of jobs in science and the different types of work people do in science.

- *Before that, I just like – I just thought there was like three types or like two or three types of scientists. And then I heard Brains On! and there's so many more types of scientists. And it's interesting the way they do their jobs, and what makes them different. (MN11, CF11)*
- *I think he knows more about particular kinds of jobs that people have. Like there's more diversity in his understanding of the types of science that's available to people... (LA17, Mother of CM07)*
- *It has helped her to diversify her understanding of what types of scientists you can be, right? I mean, yeah, you can definitely be a physician, you can be a nurse. But you can also be an astronomer, you can also be someone – I don't know all the names – who has expertise in soil, who has expertise in bugs, who – you can be an engineer. We talked a lot about engineering. So, I think it's diversified her understanding of what types of things people can do in science. (MN28, Mother of CF06)*

Brains On! also expands children's awareness of where people in science work, helping to dispel common stereotypes of a scientist being someone who works in a lab conducting experiments.

- *The benefit is she gets to hear from people that do work on all different things, as opposed to just thinking of a scientist as being in a lab, in a white coat, pouring chemicals in beakers to sort of draw a scientist kind of thing. Like recognizing that what an oceanographer does is different, or a marine biologist is different from what a medical doctor, or medical researcher, rather, would do. (MN15, Father of CF07)*
- *Like I said I only really – when I thought of science I always thought of like a lab with a bunch of chemistry stuff. But Brains On! made me realize that there were other things to science and that those are equally even and may even be more so like cool and interesting. (MN34, CF10)*

Brains On! also helps to change children's perception of a scientist from being someone beyond reach to being more of a regular person, humanizing who a scientist is.

- *Before I started listening I didn't know that like – I just thought scientists were like people that were honored like kings and queens. But now I realize that they are more like – like they're just regular people... It's like how you might like be somewhere like in the mall. So, you're with your shopping cart. You're walking and then you pass by a scientist and you wouldn't even know it and you would just be like oh, there's a normal person that probably won't be a scientist. Surprise. They are. (LA16, CF10)*

Learning about new jobs can also have an impact on children's science identity (also see the impact area "See them self as someone who does or can do science"). As children learn about new careers, they may become interested in pursuing a particular science career they heard about on Brains On! when they get older.

- *[CF09]: I put yes, because now I'm more interested in, like, cooking and baking and chemistry and – ... Like, what I heard on the show, and then I started looking up more stuff about that at school, and stuff, and then I just learned about the jobs you can have. [Mother of CF09]: I do think when they talk to different experts, they've – it's definitely piqued their interest and led to more questions and more realization of, like, "I could do that, in the future." (MN24, CF09 and Mother of CF09)*
- *A lot of jobs that they had I didn't even know were a thing and I'm like that is awesome and I don't know. A lot of times I'm like, "I want to do that when I grow up" and I'm like yeah, this is awesome. And the things I already knew about they really go into detail about it and I learn new stuff that I never would've dreamed up like imagining and it's awesome. (MN06, CF09)*
- *Sometimes on the episodes, the kids talk about the different kinds of science jobs that they'd like to have someday. (MN23, Mother of CF06)*
- *And it also opened up more jobs for me to think about doing. (LA01, CM11)*
- *I think ever since the elevator episode, she said she wanted to be someone who, like, designs buildings. I keep telling her it's an architect, but she keeps calling it someone who designs buildings. [Laughs] But, yeah, like I said, it was kind of surprising, I just never thought she saw herself that way, but I'm glad she does. (MN20, Father of CF09)*

## Features connected to this impact area

Children expand their ideas of what can be considered science work and who does science by hearing **scientists featured on the show** talk about what they do in their profession and share what's unique about the science that they do.

- *There is some scientists mentioned on – well, like interviewed on the show, and I'm like, I didn't even know you could have a job like that. (MN08, CF11)*
- *Because you listen to a lot of scientists that have different jobs. (MN27, CM08)*
- *When the people (scientists) like answer the questions and they'll tell you – sometimes, they'll like tell you a little bit about what they do. And you can kind of – and when they don't, you can kind of like – you can kind of detect some things that they would do, and it's really interesting. (MN11, CF11)*
- *All the people that they've brought in from – that do those jobs, that work... it kind of teaches me how people have jobs and like how they conduct experiments within those jobs. (MN12, CM10)*

The **episode topic** is what determines the type of expert or scientist that might be on the show. As children listen to the episode, they learn about different jobs related to the topic. The variety of episode topics also provides opportunities to expose children to a wide variety of jobs in science.

- *I mean it's just like what the topic is... Like if it's on like, for example, the extinction one, they talk about a lot of different kinds of animals and like what we're studying – like what people are doing with them and stuff. (MNO2, CM08)*
- *But there was some things like – there's some things about like, the ground soil – stuff about the world and there's stuff about space and then, there's stuff about, I don't know, certain things – so, animals and like – I don't fully remember, but there was like, I think an episode a while back about something about like, bees. I don't remember if that was actually one, but that there was a scientist that did stuff about them and then, it's just a lot of variety about it. (MN33, CM12)*

## Increase Awareness of the Different Types of People That Have Science Jobs

One of the goals of Brains On! is to increase children's awareness of the diverse range of people that have jobs in science. This diversity can include various aspects of someone's identity such as gender, racial/ethnic, age, etc. Note, for families that said their child increased their awareness, they didn't always talk about awareness of various differences in identities, but may have only talked about one difference they noticed (i.e. gender identity).

Brains On! is most effective in increasing children's awareness of women in science. Families attribute this to one of the Brains On! hosts (Molly) being a woman as well as being able to distinguish voice differences in scientists featured on the show. By hearing gender diversity represented through both male and female voices, not only coming from adults but also from children, families are further exposed to the various types of people doing science.

- *Yeah. I can – they'll say like where they're from and stuff like that. And you can kind of tell by their voice, you can tell if they're male or a female and stuff like that. So, yeah. And it's fun to hear a lot more diversity. So, like even if it's an audio, you can just kind of – because you think of like scientists – usually, you think of scientists as boys and – but, it's fun hearing a bunch of girls answer these questions and it's very inspiring. (MN11, CF11)*
- *Just that it's – they seem to make a real effort to have a diverse pool of people, especially – because it's important to have girls in STEM, but I'm raising a boy, so it's – you know, we're still trying to raise a little feminist. So, I think it's been good to have – because we don't know any scientists personally, except for the one we have in our family, so I think it's good for CM11 to have female role models. (LA01, Mother of CM11)*
- *Definitely there's – you can tell there's a conscious emphasis on women in science, and I think that comes through really well. (LA06, Mother of CM09)*
- *So, genders yes... like when there's a female scientist on it's really nice to hear. (MN05, Mother of CF06)*

Other aspects of the identity of Brains On! guests, such as race/ethnicity, age, or where episode guests are from, may also be noticed by some of the families. Like gender, voice differences are used by some families as a way to notice these aspects of identity, giving them additional awareness of different people involved in the sciences. Sometimes, for these families, the various accents of whoever was featured on the show indicate something different to pay attention to and recognize. For some families, guests' names provide an indication of the diversity of people in science.

- *I think it more builds his awareness of the world broadly, rather than – which is a kind of learning. So, I guess, yes. That's a roundabout way of saying, "yes." It's building his awareness of the world as a*

very diverse place. In the world of jobs in science, that diversity is there, as well. [Interviewer: Again, what about Brains On! do you think helped him learn more about the different kinds of people?] I think because it's a podcast he's hearing, so he's hearing voices that have different cadences, different dialects, different cultural patterns to them. He's hearing little kid voices and they talk about, "Oh, this is a high-schooler who's won a science prize and she's going to tell us this information she learned about water filtration." So, I think it's exposure and just being immersed in it in a space where he hears the variety of humans as experts in science. (MN21, Mother of CM06)

- [Mother of CF08/CF10]: I feel like there are a lot of female adults [featured on the show], a lot of woman who are consultants, experts. [Father of CF08/CF10]: And I would add that it tends to be younger people involved in science and part of your programming too. So, I think that – we explain to the kids that when people come out of – when boys and girls come out of college they have these opportunities ahead of them to get involved in science, and I think it inspires them. (LA02, Mother and Father of CF08/CF10)
- You can tell by accents that people are from different places. Either around the world or around the US, too. (MN09, Mother of CF07/CM10/CM11)
- I was just noticing, today, that some of the scientists they were interviewing, whatever one we were listening...some of the scientists were not native English speakers. We are a bi-ethnic and bicultural family, so they're around a lot of people who are not native English speakers. So, they might not have noticed, but I noticed. (MN22, Mother of CM07/CM09)
- Yes, absolutely, both from just the sound of people's voices and their names. And I also appreciate that that's definitely true of the kids who are on the show, that they're from different ethnicities and backgrounds, you know, and the Brains On! Honor Roll also reflects that. So again, I just think it's, like, it's great, it's really good. (MN32, Mother of CM06/CF10)
- Yeah. I do think it has maybe without her actually even realizing. And I noticed when I listen to it that it's not – it's very diverse meaning it's kids all over the world, different nationalities, all over the country. Different ages. And then I do like that it has scientists from all over and you're actually speaking to experts. So, they think, "Oh, there's a real person who does this." Yeah. And from a science family, I love that. (LA04, Mother of CF09)

For some families, Brains On! reinforces existing family values and beliefs around the importance of diversity in science and supports what parents/guardians are already communicating to their children.

- I think it's a good example of the diversity in science. I definitely have picked up on that from Brains On!. But it seems like they're a little more fair in representing diversity. That's one thing I do try to expose her to. That's one avenue, at home, through books and whatnot that I have – so I don't know – I mean anything that's presented on Brains On! is not going to be different than what I present at home anyway, because I try to really focus on diversity and all avenues of life and expose her to that. (MN25, Mother of CF09)
- [Mother of CF07]: Yeah. I'm not sure if it's been directly Brains On! or as part of the variety of things that she gets exposed to, but I know that she has an understanding that there is no specific you can only be a scientist if you are X. You can be any kind of scientist from any kind of background. [Father of CF07]: But we've also worked hard to make sure she understands that there is no specific pathway to becoming a scientist. It can be any race, any gender, any age. (MN16, Mother and Father of CF07)
- I mean, we're the kind of family that is very much interested in representation and exposing kids to difference – and so one of the things we like is that it actually is consistent with that perspective, and so it's not just men talking about science, right? There are women a lot on the show, but we also are



friends with a lot of women scientists that she knows, so – like if this show didn't do these things, then we probably would be less likely to listen to it... yeah, it's sort of like I think she already knows, or knew that, as a girl, she can do anything, or as a person of color, she can do whatever, that kind of stuff, so I would say probably no, that this has helped her learn that. (MN15, Father of CF07)

- [Mother of CF07]: I don't know if Brains On! has helped her realize any of that or if that's just something that we have tried to very much instill in her.... anybody can be a scientist, right? [ CF07]: Basically. [Mother of CF07]: Anybody. Kids. Yeah. Grownups. Black people. White people. (MN36, CF07 and Mother of CF07)

## Features connected to this impact area

The **show's female host** and the **scientists featured on the show** are key features for exposing children to the different types of people who work in science. By having a host that identifies as a woman, more attention is paid to gender. In addition, having various women in science involved in episodes also increases awareness of gender and who is participating in science. For other aspects of identity, the scientists and **children featured on the show** increase awareness of the types of people in science.

- Probably gender is the one that's most obvious because the voices are either male or female and so you realize there are a lot of both men and women. Like Brains On! does a really good job having men and women both as experts, so something I appreciate. Definitely yes for gender. (LA09, Mother of CF12/CM12)
- It used to be, and this probably doesn't seem so funny to you, because it just seems normal to you, that there are girl scientists, but it used to be that it was really hard to hear from girl scientists. And so, I think it's cool that there's all the – all the access to female scientists in particular. (MN12, CM10)
- I have always been impressed that Brains On! brings on a variety of different experts from different countries, different backgrounds, different genders certainly. And I think that's been a really great example for her. (MN18, Father of CF10)
- I do notice the diversity in the children. You know, like the ages, where they're from – that sort of thing.... just to see that there's a wide variety of scientists. Like it's not just people from the U of M, you know? They're from all over the country in all different fields. And so, that's kind of nice too. (MN11, Mother of CF11)

## See Themselves as Someone Who Does or Can Do Science

The activities and content of Brains On! have the potential to support or help develop children's self-perception of being someone who knows about, uses, and can contribute to science both as a child and as they consider the career they may be interested in pursuing as an adult (Bell et al., 2018). Many parents/guardians note that Brains On! contributes to their children seeing themselves as someone who does or can do science, with a few children going so far as to consider themselves a scientist or engineer/creator.

- And so, I think listening to podcasts like this make you think, like I can do an experiment to try to figure out if something's possible or not. (MN12, Mother of CM10)
- It's definitely given him the exposure to say you can do science, and you can do engineering, right? Now whether or not that's what he wants to do is a different question, but definitely helped him, I think. (LA03, Father of CM08)

- *[CF11]: It helped me more think into like science and how I can like – and how I'd be more comfortable with doing science and further – or even now. But, definitely. [Mother of CF11]: Yeah, I would agree. I think because of the diversity of the different fields that are presented, that it's been easier to see different tracks that might be appealing. [CF11]: Pretty much – well, again, where the people from all around the world, that really just helps you get into mind that there's so many scientists out there and that you could be one too. (MN11, CF11 and Mother of CF11)*
- *Yeah, I would say so. I think – I've heard her say, I'm a scientist. Like she'll collect rocks and things like that, talk about them. But I think the fact that there are kids on the show asking scientific questions, and even if they might be not based on great science, you know, the questions, but they bring up a discussion based on good science. So, I think that it probably has helped her think more of herself as a scientist. (MN31, Mother of CF10)*
- *CM07 is very adamant that he is a kid scientist now, and one day he will be a grown-up scientist. The only thing that has changed in the last couple of years is maybe what kind of scientist, or whether he wants to be a scientist and an astronaut, which is the same – you know, it's kind of the same thing. But there's been – he has – since listening to the show, he is definitely on a path of being a scientist. (LA17, Mother of CM07)*
- *Yeah, I wouldn't say she identifies herself as a scientist. I would say maybe even more as, like, an engineer. She's more of a creator, per se. I mean, I know there's, like, overlap, of course, between these things. But, yeah, I mean, she definitely is very interested in ... I think she recognizes her ability in science. (MN28, Mother of CF06)*

In some cases, children may not feel like a scientist now, but Brains On! can help to develop children's identities in terms of identifying as someone who could have a science-related job when they grow up.

- *Because I used to like science, and now, it made me want to – I just wanted – made me want to be a scientist. (LA17, CM07)*
- *And it shows that – it doesn't tell you, only parents can be – it – it tells you that like anybody can be a scientist. (MN16, CF07)*
- *Having children on the show and talking so much about science with children and to children specifically – I think that really helps them see themselves in those positions and that it's possible that they could grow up to be a scientist in a way that I didn't have as a child... you know, you have to see reflections of yourself in the roles that you could have or else you wouldn't think it as a possibility. (MN36, Mother of CF07)*
- *I think he's definitely – it's opened up conversations about who we know who does science, things like that. So, I think there's a definite sense of, "I could do that." I think that he hears adults whose job are to engage in science, which says they were kids once. He hears kids, middle-aged kids, middle school, high school, who are already doing science, which helps with that. So, who they interview is definitely a factor. That would probably be the big one. And that that happens in every episode, that someone is interviewed who's an expert and does it professionally. (MN21, Mother of CM06)*

## Features connected to this impact area

The representation of **kid co-hosts** as “kid scientists” is important for helping some child listeners shape their science identity as kids who do science or are able to do science. Children can hear kid co-hosts having science conversations and participating in the scientific inquiry process in meaningful ways. This is important in the construction of science identity, since knowing about other kids who are doing science allows for children to consider it for themselves and how they might think of themselves when it comes to

science (National Research Council, 2009). It also touches on how identity formation can be a process, often thought of as “identity work” so as children listen to the podcast, they might negotiate how they relate to the various kid co-hosts and then how they perceive their own engagement and identification with science (Bell et al., 2018; National Research Council, 2009).

- *[CF10]: It's definitely made me more curious, and... I feel like I can do things more. Like, it's kind of inspiring... they have kids on the show that are, like, actually up there doing it with them. And, it's kind of like, "Well, they did it, so I think I can do it, 'cause, like, how are they that much different from me?" Yeah, it's really cool. [Mother of CF10]: All the kids who are on the show, it sounds like you could, like, "Oh, we could get together and talk about science with those guys. They're really fun and cool." And I think that makes science more accessible and, you know, more engaging. Even if we're already people who are excited by science or enjoy science, it still makes it more, you know. (MN32, CF10 and Mother of CF10)*
- *[CM10]: Sort of like with the co-hosts. Like since they're kids like they kind of feel like scientists like gathering the information... [Father of CM10]: That's definitely good to hear about kids not too far off from his age doing actual out there doing the science type items versus just kind of waiting around and waiting for the degree and everything before they go out. (MN13, CM10 and Father of CM10)*
- *[Mother of CM06/CM08]: Having a child, a kid on the radio, I think is intriguing to them, or like kind of gives them that like, oh, kids do this, too. [Father of CM06/CM08]: Yeah. Or in things that I've observed, where they're answering – the kids are answering questions from other kids with answers that they've gotten from Brains On!. (MN17, Mother and Father of CM06/CM08)*
- *They [CF08 & CF10] brainstorm a lot of experiments that they want to do. Sometimes mom is anti-experiment due to the mess. So, I might be the limiting factor on how many experiments. [Interviewer: Do you think Brains On! has contributed to that?] I do. Yeah. They hear other kids doing experiments. (MN34, Mother of CF08/CF10)*

Brains On!'s content is directed at children and makes it about them. This **kid-friendly approach** gives positive messaging to children that encourages them to believe that science is possible for them, that they can do science and contribute to science, and they have the capacity to do science even if they aren't sure if they want to pursue a science career. The **show hosts** (especially Molly) and how they interact with kids, also connects back to the kid-centered format of the show and the positive messaging it sends to children that adults see children as valued voices and contributors to science.

- *I think part of it is the way that whatever kid is kind of hosting that week, I feel like that kid is spoken to in a way that makes all their thoughts – make them feel that all their thoughts are valid and that they have the equipment they need just with their brains to be able to explore and to think about things in different ways. It's not like they're talking to a little kid. It's talking to somebody with valid thoughts and who is kind of treated like a scientist on the show. So, I think that's probably... a part of it. Just not treating them like they're little kids who don't know anything. (MN23, Mother of CF06)*
- *Just having content out there that sort of is presented in a fun way for his age and specifically for him I just think he's able to see himself in it and it's speaking to him and I think in a way that a lot of content doesn't speak to children who are already informed about science. (MN06, Mother of CM09)*
- *That the host really seems to value the kids' opinions. I think that's really a key about it. She's not lecturing. She's having a mature, equal conversation with the kids on the show. And isn't that what – kids want to be seen and heard as people, right? Like not just a little kid, you don't know anything. And I love – I really like the way that Molly interacts, all of them interact with the kids. Don't you think that's true? You feel like oh, they're talking to me like I have something of value to say. (LA04, Mother of CF09)*

Brains On! provides opportunities for children to see themselves in the guest **scientists on the show** and recognize that anyone can be a scientist, including them.

- *[Mother of CF11]: She's certainly added astronomer, I think, to her list of things she might want to be. So – and that's been – that's been recent, so – I think – I think it's helped. But I like to think that it's actually meeting – virtually meeting scientists like this makes it a possibility. [CF11:] Like, oh, that's actually possible. (MN08, CF11 and Mother of CF11)*
- *... showing kids and scientists, and showing science as a field that you could have a career in. (LA01, Mother of CM11)*

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## APPENDIX A: INTERVIEW QUESTIONS ALIGNED WITH THE LITERATURE

Interview Questions	Learning Science in Informal Environments (LSIE) & National Science Foundation's (NSF) Impact Areas
Since you started listening to Brains On!, have you become <b>more interested in science</b> ?	LSIE Strand 1: Excitement, interest, motivation NSF Impact Category: Engagement or interest
Since you started listening to Brains On!, have you become <b>more interested in learning about science</b> ?	
Since you started listening to Brains On!, have you become <b>more curious</b> about the world around you?	
Has Brains On! helped you <b>learn more about the kinds of jobs</b> people can have in science?	LSIE Strand 2: Knowledge and understanding NSF Impact Category: Awareness, knowledge, and understanding
(For parents) Do you think Brains On! has helped your child(ren) <b>learn more about the different kinds of people that have jobs in science</b> (such as people of different race/ethnicities, ages, genders, etc.)?	
Have you <b>learned something new</b> from listening to Brains On!?	
Since you started listening to Brains On!, do you think you are <b>asking more questions</b> about the world around you?	LSIE Strand 1: Excitement, interest, motivation NSF Impact Category: Engagement or interest  LSIE Strand 3: Engage in scientific reasoning NSF Impact Category: Skills
(For parents) Since your child(ren) started listening to Brains On!, have you heard a <b>change in the types of questions</b> your child is asking about the world around them?	LSIE Strand 3: Engage in scientific reasoning NSF Impact Category: Skills
Since you started listening to Brains On!, do you <b>listen more closely</b> to sounds you hear in the world around you?	LSIE Strand 3: Engage in scientific reasoning NSF Impact Category: Skills
(For parents) Has Brains On! helped your child(ren) <b>see them self</b> as someone who does or can do science (possibly even calling them self a scientist)?	LSIE Strand 6: Identity NSF Impact Category: Other
Have you <b>done some kind of project or activity</b> based on something you heard on Brains On!?	LSIE Strand 5: Engaging in scientific practices NSF Impact Category: Behavior

## APPENDIX B: IMPACT AREAS ALIGNED WITH THE LITERATURE

Brains On! Impact Areas	Learning Science in Informal Environments (LSIE) & National Science Foundation's (NSF) Impact Areas
<ul style="list-style-type: none"> <li>• Increase interest in science.</li> <li>• Increase interest in learning about science.</li> <li>• Increase curiosity about the world.</li> <li>• Ask more questions about the world.</li> </ul>	LSIE Strand 1: Excitement, interest, motivation NSF Impact Category: Engagement or interest
<ul style="list-style-type: none"> <li>• Learn something new.</li> <li>• Increase awareness about the kinds of jobs people can have in science.</li> <li>• Increase awareness of the different types of people that have science jobs.</li> </ul>	LSIE Strand 2: Knowledge and understanding NSF Impact Category: Awareness, knowledge, and understanding
<ul style="list-style-type: none"> <li>• Ask more questions about the world.</li> <li>• Notice changes in the types of questions asked.</li> <li>• Listen more closely to the sounds they hear in the world.</li> </ul>	LSIE Strand 3: Engage in scientific reasoning NSF Impact Category: Skills
<ul style="list-style-type: none"> <li>• Do a project or activity based on something they heard on Brains On!</li> <li>• Engage in science-based conversations.</li> </ul>	LSIE Strand 5: Engaging in scientific practices NSF Impact Category: Behavior
<ul style="list-style-type: none"> <li>• See them self as someone who does or can do science.</li> </ul>	LSIE Strand 6: Identity NSF Impact Category: Other

## APPENDIX C: BRAINS ON! PHASE 3 INTERVIEW PROTOCOL

### 1. Consent Forms & Interactive Survey Questions (5 minutes)

(At the beginning of the interview, children and parents fill out the consent forms. Give parents the demographic sheet and tell them they can fill it out and give to you at the end of the interview.)

Raise your hand if you have listened to Brains On! before - adults too! (We need to keep track if the parent has listened). Great! Because we are going to talk about Brains On! today. We aren't going to talk about Smash, Boom, Best or Forever Ago, just the Brains On! podcast episodes. **Here is a list of episodes and features of the Brains On! podcast that you can refer to if needed during the interview** (hand over list).

First, I want to get some information about how you have listened to Brains On!. Each of you (to the children) get a brain eraser. This is what you will use to answer questions during the interview today. (Keep track of children's responses on the Child Information Sheet).

How many episodes do you think you have listened to? Brains On! has over 150 episodes. Which option would you choose? It is your best guess.

- Only one episode
- Around 2 - 10 episodes
- Around 11 - 50 episodes
- Over 50 episodes

For each child, how long have you been listening to Brains On!? For reference, Brains On! started in 2015.

- Less than a year
- 1 year
- 2 years
- 3 or more years

### 2: Impact Statement Activity - 25 minutes

The focus of today's family interview is to learn about the kinds of impacts listening to Brains On! might have on kids. Parents, we recognize that there are other things happening in your child's life that could also impact some of the things we are going to ask about, but we would like to know if Brains On! has any type of influence, that's what we mean by impacts. It could be that Brains On! didn't have an influence on any of the things we talk about today and that is completely okay.

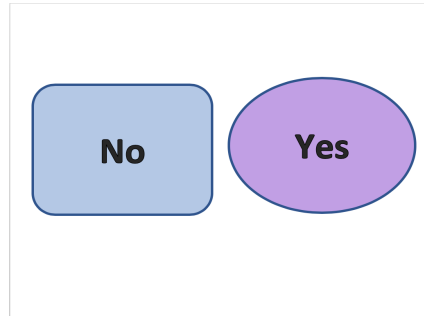
Parents/guardians, this first question is for you.

- How do you think listening to Brains On! has impacted your child/children, if at all?
  - (Alternate wording) Have you noticed any kinds of changes in your child/children since they started listening to Brains On!?
- **For each thing they talk about**, what about Brains On! do you think made you more [insert statement]? Are there particular things or features about the show that you think made you more [insert statement]? (Refer them to the features sheet)



### Yes/No Statements

Now, I'm going to read you some questions and for each one you will answer it as either Yes or No. If your answer is "Yes," put your brain eraser on this piece of paper. If "No" put it on this piece of paper. There is not a right or wrong answer to these questions. It is okay to answer "No" to some or even all of these questions. If you aren't sure how to answer, that is okay too. After you answer, I'll ask you to explain why you placed your brain where you did and ask your parent(s) to chime in as well.



(Provide an example first) I'll do an example with the first question. Since you started listening to Brains On!, have you become more interested in science? I'm going to say No because I was already really interested in science when I started listening to Brains On! and so I just stayed really interested in science as I listened. Brains On! didn't really make me any more interested. Or I could have also said Yes because I kind of liked science when I started listening to Brains On! but Brains On! made me super interested in science and now I love science. **There isn't a right or wrong answer. If you aren't sure how to answer, that is okay.**

### Follow up after each Yes response to the questions below:

- Why did you place your brain where you did? (Probe if needed: Can you give me an example of this?)
- What about Brains On! do you think helped you [insert statement]? Are there particular things or features about the show that you think made you more [insert statement]?)

(If parents talked about any of these questions sufficiently already, skip the question(s).)

1. Since you started listening to Brains On!, have you become more interested in science?
2. Since you started listening to Brains On!, have you become more interested in learning about science?
3. Since you started listening to Brains On!, have you become more curious about the world around you?
4. Has Brains On! helped you learn more about the kinds of jobs people can have in science?
5. (For parents) Do you think Brains On! has helped your child/children learn more about the different kinds of people that have jobs in science (such as people of different race/ethnicities, ages, genders, etc.)?
6. Since you started listening to Brains On!, do you think you are asking more questions about the world around you?

7. Have you learned more about how to answer questions you have about science or the world around you from listening to Brains On!?<sup>2</sup>
8. (For parents) Since your child/children started listening to Brains On!, have you heard a change in the types of questions your child is asking about the world around them? (If Yes) What does that change sound like? Can you provide an example of the changes in types of questions?
8. Since you started listening to Brains On!, do you listen more closely to sounds you hear in the world around you?
9. Have you learned something new from listening to Brains On!?
10. Have you done some kind of project or activity based on something you heard on Brains On!?
11. (Ask of parents only): Has Brains On! helped your child/children see them self/selves as someone who does or can do science (possibly even calling them self/selves a scientist)?

(To the parents - only ask if there is time left in the interview. Skip if you are over time.) Are there any other impacts Brains On! has had on your child/children that we haven't talked about yet that you would like to mention?

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<sup>2</sup> We ended up removing this question from our research study because it ended up being difficult for children to answer and Brains On! doesn't exactly teach kids how to answer questions in their episodes so ultimately the interview question didn't make sense to include in our analysis.

## **APPENDIX D: FEATURES OF BRAINS ON! FOR INTERVIEW**

### **Show elements**

- The Mystery Sound
- The Moment of Um
- Call outs and honor roll
- Debate episodes
- Songs or music
- Skits
- Silly characters
- Kid-cohosts
- The Brains On! hosts – Molly, Marc, Sanden
- Scientists are featured on the show
- The show is funny. It uses humor.
- Variety of episode topics

### **Kid-focused features**

- Episodes are based on kids' questions.
- Kids are featured on the show – kid co-hosts and kids reading questions.
- Kids can contribute to the show (sending in Mystery Sounds, questions, answers to questions, drawings, debate ideas, etc.).
- The show encourages kids to look for Mystery Sounds, their own questions, or answer questions posed by Brains On!.
- The content is presented in a way that is easy for kids to understand.

### **Other Brains On! Features**

- The newsletter (Hands On, Read On, Talk On, Listen On) includes hands on activities, other things to read, questions to spark discussion, other things to listen to.
- Brains On! Fan Club
- Brains On! website

## APPENDIX E: BRAINS ON! EPISODES TO DATE

(As of April 19, 2019)

Title	Date
The how's and why's of hair	Apr 16, 2019
Why are smartphones so hard to put down?	Apr 09, 2019
Mystery Sound Extravaganza 2019	Apr 02, 2019
Carnivores: Plants and animals that bite back	Mar 26, 2019
Flush! Where does our poo and pee go?	Mar 20, 2019
Black Holes, Wormholes and Donut Holes	Mar 12, 2019
Walking on walls: How ants and spiders do it	Mar 05, 2019
My air came from where?! How oxygen gets around	Feb 26, 2019
How do airplanes fly?	Feb 19, 2019
Memory and deja vu	Feb 12, 2019
Are we still evolving?	Feb 05, 2019
Brains On!: Behind the scenes	Jan 30, 2019
Earthrise: The picture of our planet that changed the world	Dec 25, 2018
Soil: Can you dig it?	Dec 18, 2018
Dreams: The science of a sleeping brain	Dec 11, 2018
Voices: How do we make sound?	Dec 04, 2018
Roller coasters: from dream to extreme	Nov 27, 2018
Finding your way without a map	Nov 20, 2018
Video Games: A Tale of Two Pongs	Nov 13, 2018
Do dogs know they're dogs?	Nov 06, 2018
Body Bonanza: Yawns, hiccups, goosebumps and more!	Oct 30, 2018
How to find the facts (Prove It: Part 4)	Oct 23, 2018
The scoop on journalism (Prove It: Part 3)	Oct 16, 2018
Science under the microscope (Prove It: Part 2)	Oct 09, 2018

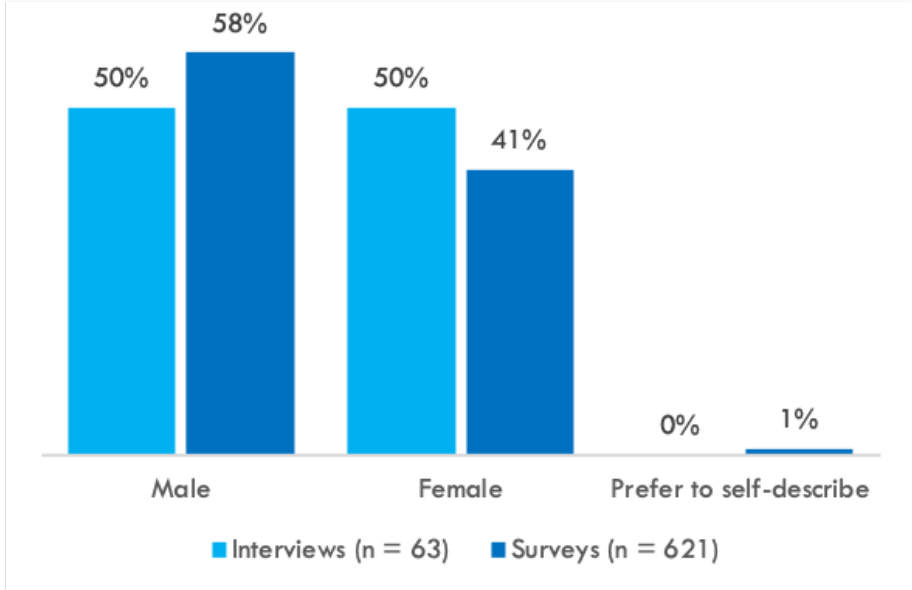
A Brief History of Facts (Prove It: Part 1)	Oct 02, 2018
Brains On! + The Story Pirates: What makes fun things fun?	Aug 28, 2018
What makes gross things gross?	Aug 21, 2018
Keeping water healthy, one clue at a time	Aug 14, 2018
Burning rivers of fire	Aug 07, 2018
How does GPS know where you are?	Jul 31, 2018
Salty snack science: Popcorn, nachos and the origins of salt	Jul 24, 2018
Wanna see Mars' close approach? Just look up!	Jul 17, 2018
Smash Boom Best: Books vs Movies	Jul 10, 2018
How to cook for an alien	Jul 03, 2018
Mix: The science cooking, pt. 4	Jun 26, 2018
Chop: The science of cooking, pt. 3	Jun 19, 2018
Chill: The science of cooking, pt. 2	Jun 12, 2018
Heat: The science of cooking pt. 1	Jun 06, 2018
Boogers and sun sneezes: Know your nose	May 29, 2018
The wonderful weirdness of water	May 22, 2018
Smash Boom Best: Bats vs. Owls (new show alert!)	May 15, 2018
What was the first robot? And more from Robotstravaganza	May 08, 2018
What's in your water?	May 01, 2018
What makes paint stick?	Apr 24, 2018
Allergy Attack: How our bodies can overreact	Apr 09, 2018
Mystery Sound Extravaganza 2018	Apr 03, 2018
How do animals breathe underwater?	Mar 26, 2018
'The Rice Cakes and the Oni': A story from Circle Round	Mar 20, 2018
Circadian rhythm pt. 2: Beyond human	Mar 13, 2018
From 8-bit to orchestras: How does video game music affect you?	Mar 05, 2018

The tick-tock of our circadian clock	Feb 27, 2018
'Is it opposite day?' and other mind-bending paradoxes	Feb 20, 2018
Our 100th episode! What's the big deal?	Feb 13, 2018
Meet Sandy, the left-handed mutant snail	Feb 06, 2018
Dolphins vs. Octopuses: Showdown in the sea!	Jan 30, 2018
Dogs: What's the secret of their sense of smell?	Jan 23, 2018
Mary Shelley and the science of Frankenstein	Jan 16, 2018
Super-size-asaurus: How did dinosaurs get so big?	Jan 09, 2018
Mysteries of the universe: Expansion and gravity	Jan 02, 2018
The nerve! Electricity in our bodies	Dec 26, 2017
Charged up! The science of batteries	Dec 19, 2017
High voltage! How electric power reaches your outlet	Dec 12, 2017
Shocking! The science of static (Electricity series pt. 1)	Dec 05, 2017
Where did language come from?	Nov 27, 2017
Smash: When continents collide!	Nov 21, 2017
Curio: Flies on the bus	Nov 14, 2017
What's smaller than an electron?	Nov 07, 2017
Healing skin and regrowing limbs: The science of regeneration	Oct 30, 2017
What is Down syndrome?	Oct 24, 2017
Bonus: Kidcast sampler	Oct 22, 2017
Curio: Vampire of the Great Lakes	Oct 17, 2017
Narwhals: Unicorns of the sea?	Oct 10, 2017
How do volcanoes erupt?	Oct 02, 2017
For crying out loud: All about tears	Sep 26, 2017
Curio: Quindar tones and talking in space	Sep 19, 2017
Mars: Our next home planet?	Sep 12, 2017

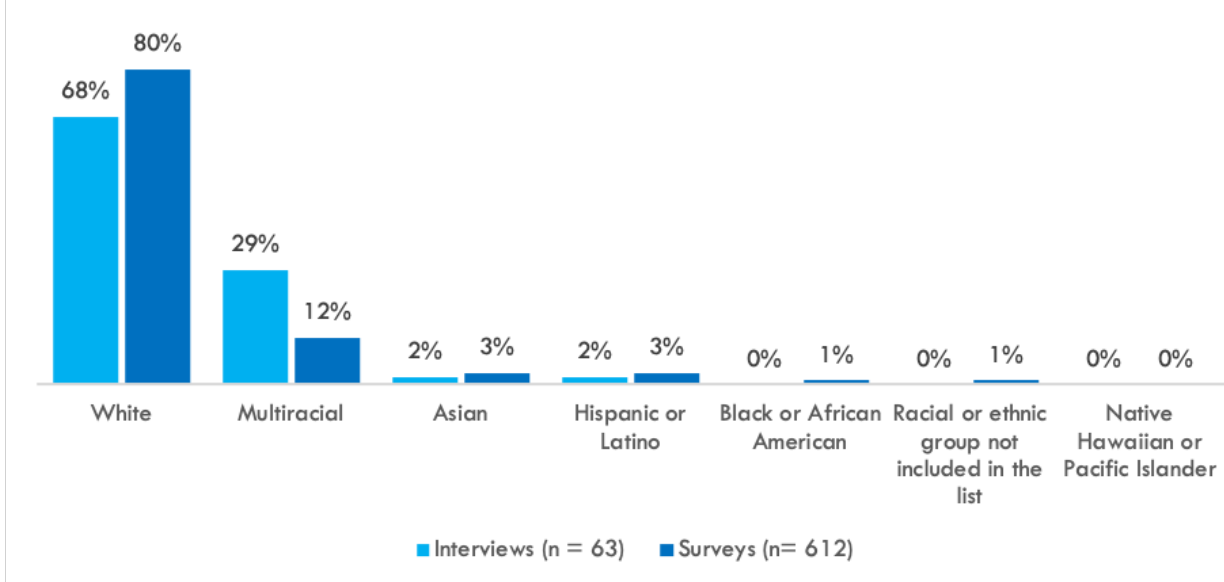
Thunder, lightning and tornadoes: Where do they come from?	Sep 04, 2017
Animal farts: A mighty wind	Aug 29, 2017
Sunburns: The why behind the ouch (and how to avoid them)	Aug 15, 2017
Everything you need to know before the solar eclipse	Aug 01, 2017
Deep Sea vs. Outer Space	Jul 18, 2017
Fart Smarts: Understanding the gas we pass	Jul 04, 2017
Riding in the car: Motion sickness and optical illusions (Road trip pt. 5)	Jun 30, 2017
Traffic: Phantom jams and chicken soup (Road trip pt. 4)	Jun 23, 2017
Monster trucks and car design (Road trip pt. 3)	Jun 20, 2017
The future of fuel, and the problem with exhaust (Road trip pt. 2)	Jun 16, 2017
How do engines work? (Road trip pt. 1)	Jun 09, 2017
Mystery sound extravaganza!	Jun 06, 2017
Books: How they're made and how your brain reads them	May 23, 2017
The science of slime: What is it and why are we so obsessed	May 09, 2017
What was the first life on earth?	Apr 25, 2017
How do pianos work?	Apr 11, 2017
How do elevators work?	Mar 28, 2017
Why is the ocean salty?	Mar 14, 2017
Ants: Who's in charge here?	Feb 28, 2017
Do we all see the same colors?	Feb 14, 2017
Cats: Glowing eyes, puffy tails and secret purrs	Jan 31, 2017
Dinosaur bones: How do we know their age?	Jan 17, 2017
Lighting the way for sea turtles at Gulf Islands National Seashore	Dec 30, 2016
Surviving the desert at Joshua Tree National Park	Dec 29, 2016
Making the sands sing at Great Sand Dunes National Park	Dec 28, 2016
Tracking wild horses at Assateague Island National Seashore	Dec 27, 2016

# APPENDIX F: PHASE 3 INTERVIEW SAMPLE COMPARED TO PHASE 2 SURVEY SAMPLE

**Gender:** Evenly split compared to survey sample.

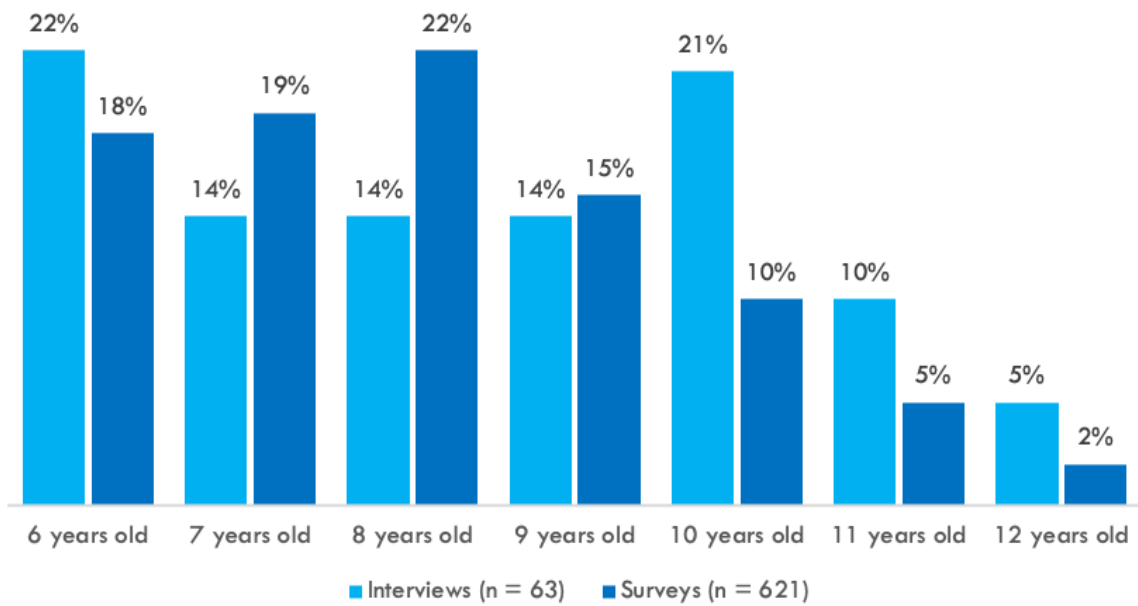


**Race/Ethnicity:** Interview sample more racially/ethnically diverse than survey sample.

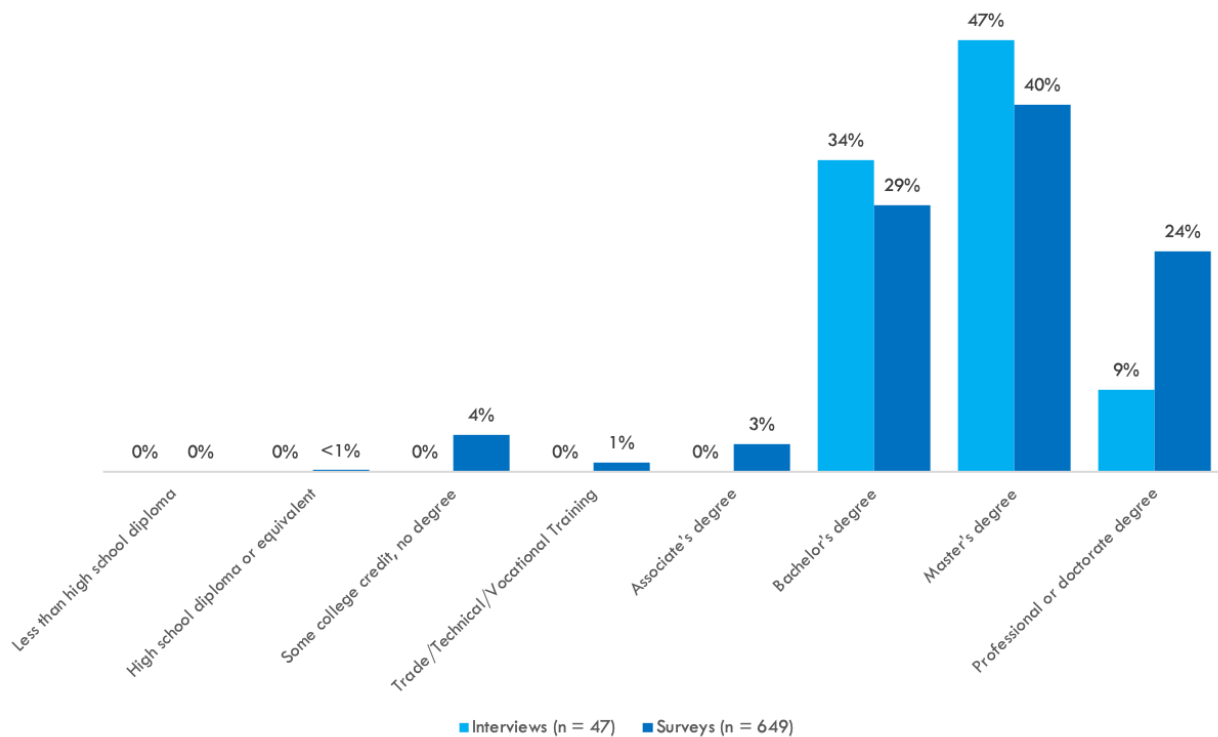




**Age:** More six-year-olds and ten-year-olds in the interview sample than the survey sample.



**Highest level of education:** No households with lower than a college degree in the interview sample compared to the survey sample and fewer households with a doctorate or professional level degree.



**STEM Households:** Less STEM households in interview sample than survey sample. STEM households are defined as households where at least one adult in the household self-identifies as working in a STEM area.

