

# APPRAISE

## Annotated Instrument and Research Brief



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## What is APPRAISE?

What does it *feel* like to belong, or to be excluded? How do experiences of race, gender, class, dis/ability and other intersecting factors influence the ways we feel in a science learning environment? How can learning institutions draw on an understanding of these features of identity and emotion to invite a deep sense of belonging that affirms dignity for learners whom those institutions typically marginalize? The Museum of Science, Boston (MOS), EdTogether, and Children’s Museum of Pittsburgh have investigated these questions through an NSF-funded project (DRL-1906688) that explored promising and problematic exhibit practices by assessing relationships between exhibit design, identities, affective experience, and museum engagement at science exhibits.

## Why did we create this research brief?

This Annotated Instrument and Research Brief was produced to share lessons learned through our pilot and feasibility study with the broader informal science learning (ISL) field. This report exists to document our approach to collecting authentic feedback from youth (ages 10-17) whose identities sit within the intersections of those typically marginalized in science learning (nearly 90% of our participants were girls and non-binary youth, youth of color, and/or youth with disabilities). This report describes the data collection tool we developed with annotations for practitioners interested in using it themselves, and it summarizes the efforts we took to iterate on our measures based on ongoing collaboration with youth staff and youth advisors. In-depth research results can be found on our [project page](#) at InformalScience.org. We have also included in-depth coding rubrics, details about data validation, and summaries of prior iterations of the APPRAISE protocol.

## Who should read this research brief?

This report was developed for researchers and practitioners interested in gathering authentic, meaningful feedback from youth about their feelings of belonging at exhibits. This is a practice-oriented document meant to present more of a “how to” guide, with accompanying background and rationale for our methods, rather than a technical report on our findings. Readers should review this report alongside the APPRAISE protocol itself, found on our [project page](#) at InformalScience.org.

## What’s next?

The work that generated this product was a pilot and feasibility study. At the time of this writing, the APPRAISE team is developing a proposal for a follow-up grant to implement the use of the APPRAISE protocol in a larger study addressing the intersections of identity, appraisals, exhibit design, and science engagement outcomes, towards shifting equity-focused practices in research.

# What's Included in the Annotated Instrument?

## Facilitator Guidance

Each page of this report includes an introduction to a section of the APPRAISE instrument, and tips from the creators of the protocol on how to implement each activity with youth. This section is meant for researchers or practitioners who want to use the protocol.

### Suggested script:

*This section also includes a sample script (in italicized blue font) that facilitators might follow to guide participants through the APPRAISE activities.*

## Instrument Screenshots

Each page of this report includes a screenshot of a section of the APPRAISE instrument.

These images are meant to help preview the APPRAISE instrument and provide a visual cue for facilitators guiding participants through the activities.

**Please access the full instrument at our [project page](#) on InformalScience.org.**

## Instrument Development

Our pilot and feasibility study sought to assess the value of leveraging appraisal theory and identity in museums and to consider relationships among 1) exhibit design, 2) identities, 3) appraisals of exhibits, and 4) visitors' engagement with exhibits.

We posited that the context (exhibit design) and who you are (identities) contribute to the ways you interpret your environment (appraisals of exhibits), and that those interpretations influence the way you act in a museum (visitors' engagement with exhibits).

Throughout the report, we summarize the work that went into developing the final protocol, including:

- Operational definitions for, and youth perspectives on, the following constructs:
  - Identity
  - Exhibit design
  - Appraisals
  - Outcomes
- Description of measure development:
  - Early iterations
  - Considerations towards improvement
  - Description of the final iteration
  - Types of data generated and analysis procedures

# APPRAISE: Annotated Instrument

This Annotated Instrument is organized to include the following:

**Facilitator Guidance:** On each page, you'll find screenshots of the instrument and step-by-step instructions for using the APPRAISE protocol as intended.

**Instrument Development:** Each page also includes an accompanying section that describes our approach to developing the different constructs and activities in the protocol, and occasionally includes quotes from youth to illustrate the types of data you might collect.

## Contents

Facilitator Guidance	Instrument Development	Page
Introduce the Research	Research Constructs	<a href="#">6</a>
Introduce the Workbook	Research Instruments	<a href="#">7</a>
Preview the Research	Research Procedures	<a href="#">8</a>
Section 1: Identity	Identity: Youth Voice	<a href="#">9</a>
Introduce Identity	Identity Measures & Items	<a href="#">10</a>
Complete Identity Pages	Identity Measures & Items	<a href="#">11</a>
Show Science Identity Video	Science Identity Video	<a href="#">12</a>
Rate Science Identity Items	Science Identity Items	<a href="#">13</a>
Pause and Reflect: Identity	Qualitative Methods	<a href="#">14</a>
Complete Peer Interviews	Identity Interview Items	<a href="#">15</a>
Section 2: Exhibit Appraisals	Appraisals: Youth Voice	<a href="#">16</a>
Introduce the Exhibits	Exhibit Use Procedures	<a href="#">17</a>
Preview the Exhibits	Preview Appraisal Items	<a href="#">18</a>
Use the Exhibits	Exhibits: Youth Voice	<a href="#">19</a>
React to the Exhibits	Reaction Appraisal Items	<a href="#">20</a>
Pause and Reflect: Exhibits	Outcomes: Youth Voice	<a href="#">21</a>
Complete Peer Interviews	Exhibit Interview Items	<a href="#">22</a>
Hold Final Debrief	Debrief Methods	<a href="#">23</a>
Invite Final Reflections	Final Reflection Items	<a href="#">24</a>
Close the Session	APPRAISE: Youth Voice	<a href="#">25</a>
Conclusion		<a href="#">26</a>

# Introduce the Research

The introductory pages of the instrument are designed to help youth preview what's ahead and introduce youth to the three key constructs: identity, exhibit design, and feelings of belonging (or that an exhibit feels like it's "for me").

## Suggested script:

*Hi, my name is \_\_\_\_\_, and my job here is \_\_\_\_\_. Thank you for agreeing to participate in our research today! We'll be passing out workbooks to each of you. This workbook will help us better understand how identity, exhibits, and feelings of belonging all connect.*

# Research Constructs

## Operationalizing Our Constructs

**Personal Identity** includes the many ways youth consider "what makes them, them," and takes into account demographic characteristics (age, gender, racial and ethnic groups, disability status, language) that shape how youth navigate the social world.

**Science Identity** includes the extent to which youth believe they are (or are not) a "science person," coupled with their own feelings about science, and what they like and dislike about science.

**Exhibit Design** includes the attributes of exhibits that matter to youth: format, content, physicality, characteristics that enable orientation, and aspects of exhibits that might be or appear "broken."

**Appraisals** encompass a range of feelings (positive or negative, relevance, familiarity, value, whether something feels "doable" or "effortful," and socially oriented feelings); belonging is tied to whether an exhibit felt like it was "for me" or "not for me."

**Outcomes** are the consequences of visiting exhibits youth felt were "for me": Wanting to tell others about the activity, wanting to learn more, doing the activity "the way I wanted," and wanting to try similar activities. Alternatively, the consequences of an exhibit feeling like it's "not for me," from youth's perspective, include: not even trying an exhibit, exiting early, feeling bored or confused the whole time, or feeling like the museum didn't think about its visitors.



## Introduce the Workbook

Once youth have a workbook, they'll likely be eager to open it up and begin filling it out. Be prepared to remind youth to follow your guidance for the first few activities.

### Suggested script:

*Now that you all have a workbook, turn to the first page.*

*I'll guide you through the first few activities.*

# Hello!

Thanks for agreeing to be a part  
of today's research!

Please keep this workbook with you  
until you're done for the day. It will  
guide you through our session.



## Research Instruments

### Early Iterations of Research Instruments

The first round of instrumentation included a written protocol, interview guide, and observation form carried by the researchers, plus various survey sheets and meaning-maps that youth worked on with researchers present.

### Improvement

These early instruments were cumbersome for researchers to manage. Because researchers controlled the instruments, youth had little agency over their participation in each section. Further, feedback from project advisors pushed us to reconsider what we were trying to do differently in this study compared to traditional research "on" youth.

### Final Instrument

The current instrument lives in the form of two workbooks: One that includes identity surveys and interview questions, and another that includes only the Preview and React exhibit appraisal surveys. The affordances of this approach include being able to hand off the instruments to youth, who then have agency over their level of participation along the way. While researchers are not always in control over the data youth share, we have found that this sense of ownership helps generate rich data that addresses questions about the relationship between our constructs of interest.

# Preview the Research

Previewing the session's procedure can help some youth feel prepared for what's to come. Feel free to read this page's content verbatim.

## Suggested script:

*As a preview for the day: We'll start by having you describe what makes you, you and interview each other about your responses. We'll visit exhibits where you'll rate your first impressions of them. You'll get to try the exhibits and then rate your final impressions. You'll get to interview each other about how you felt at the exhibits, then we'll have a full-group conversation.*

## You will use this workbook to:



1. **Describe** yourself and what makes you, you!



2. **Interview** each other about your responses.



3. **Preview** exhibits and rate your first impressions.



4. **Try** exhibits and rate your final impressions.



5. **Interview** each other about your experiences.

# Research Procedures

## Early Iterations of Research Procedures

In our first study, youth engaged with researchers one-by-one, moving through activities that explored personal identity and science identity, invited pre-appraisals and post-appraisals of exhibits, and asked youth to answer up to 24 open-ended interview questions posed by a researcher.

## Improvement

Researchers noticed the length of time it took to complete just one participant session, as well as the overall emotional tenor of these sessions (e.g., some youth were shy, few shared more critical feedback). We looked at what data were being generated by each section of the protocol to help identify redundancies and opportunities to shorten the overall procedure.

## Final Procedures

In the final version of the procedure, data collection addresses the same themes as in early studies, but does so in a more youth-led way. Activities are structured so that youth interact more with *one another* than with a researcher, and each activity has been streamlined to only address the most important questions based on youth advisor feedback. For example, youth now respond to only 10 open-ended questions, which are all posed by peers.



## Section 1: Identity

Section 1 is meant to address identity in several ways. Youth will describe themselves in open-ended ways, they'll respond to a demographics survey, and they'll consider their science identities specifically. Any of these aspects might play a role in youth's experiences at exhibits.

### Suggested script:

*The first section is about what makes you who you are.*



Who  
are  
you?

## Identity: Youth Voice

Youth will describe their identities in expansive ways.

"I put 'imagine.' If I'm really thinking about something, I think about it a lot and **imagine myself doing whatever**. I put 'discover' because **I find something new every single day**."

"I picked a little library because **I love to read**. I picked a piñata, and I did that because my brother got a piñata and he told me not to break it and I broke it. **It reminded me of that**."

"I picked a 'detour' sign because **I always get distracted** when walking somewhere. The recycling bin **reminds me of this park** around my house. I picked the pride flag because **I'm gay**. I picked a bunch of ducks, and **I like ducks**."

"I put a picture of someone studying, because I feel like I was supposed to be academic. But recently, I don't enjoy school anymore. **I'm proud of myself** for getting through last year."

"**I love to bake**. Sometimes when I'm feeling sad, or I have nothing to do in my free time I just go and bake, which makes me relax. And lastly but not least, **I'm Muslim**. So I put Muslim."

"**I like how science opens my mind**, keeps my brain thinking."

"**I don't like being in science class**, sometimes. It's my least favorite subject. Science will definitely not have a role in my future. I think science class is enough for me."

"**I like how science helps people do things**. Science has helped people create robots that do hard work for humans, saving many lives. **I dislike that science can be really gross at times**. Like, sticking a needle in your arm or dissecting a dead frog."

"**I feel like science is part of our everyday life** somehow. It can be like in health, in math, in our everyday life, in our jobs. I just think it's always everywhere, whether you like it or not."

# Introduce Identity

Again, youth will be eager to begin completing the next page of the workbook. The instructions are fairly self-explanatory to some, but taking the time to be clear about the instructions and materials will help all youth feel prepared for these activities.

## Suggested script:

*Learning more about what makes each of our visitors unique can help us build exhibits for everyone. We'd like to learn more about you! This might include your characteristics, how you describe yourself, and how you feel about different topics – for example, how you feel about science.*

## Section 1:

# Who are you?

Learning more about what makes each of our visitors unique can help us build better exhibits for everyone!

We'd like to learn more about you and what makes you who you are.

Different aspects make up who we are, such as:

- Our characteristics
- How we describe ourselves
- How we feel about different topics (for one activity, we'll focus on how you feel about science)

# Identity Measures & Items

## Early Iterations of Identity Measures and Items

### *What Makes You, You?*

Early tools to describe youth's personal identity were adapted from personal meaning-mapping instruments, where youth were guided through a multi-stage activity to share words and images to describe themselves and what they thought about science, on a template that was modeled after an Instagram layout. The goal was to encourage youth to reflect on their self-concepts, and then invite youth to reflect on whether they wanted to change anything on these maps after trying exhibits.

### *Demographics Survey*

In the first study, the demographics survey was administered at the very end of the research session, and included items adapted from the COVES exit survey (Collaboration for Ongoing Visitor Experience Studies, 2018). Adaptations were made based on youth advisor input ahead of data collection.

### *Improvement*

The first study showed us that the meaning-map instrument took too long to implement in its multiple stages. Further, separating the meaning-mapping from the demographics seemed to keep youth from reflecting on *both* of these ways of describing themselves when discussing their exhibit experiences. Discussions with project advisors helped us reflect on the order of the demographics items, as well as the overall relationship between these two measures.

# Complete Identity Pages

Make sure youth have access to writing utensils and the inspiration stickers (if you are using them). Provide at least 10-15 minutes for this section.

## Suggested script:

*On the What Makes You, You page, you'll get to describe yourself using words, drawing, or the stickers we have provided. The next page is a set of closed-ended questions asking about some of your different characteristics.*

*If you have any questions about how to fill out these two pages, let me know!*

# Identity Measures & Items

## Final Identity Measures and Items

The final design of the What Makes You, You? activity eliminated the Instagram template and made the instructions more open-ended, after several rounds of feedback and co-creation with youth. A final set of "inspiration stickers" was co-curated with youth to reflect the range of identity characteristics most salient to youth.

*The sticker images are included as an appendix on page 35 and can be printed on Avery 22805 label sheets.*

The demographics survey underwent a few minor edits based on youth feedback and changes to the COVES questions, and it was positioned earlier in the protocol so that both the open- and closed-ended identity questions were presented as equally important.

## Types of Data Generated and Analysis Procedures

The What Makes You, You? sheets generated snapshots of youth's identities, though interview data was the main source of data analyzed to describe identity.

Demographics surveys generated mostly quantitative data. Demographic data were analyzed using percentages to describe the sample.

The image shows a digital representation of a spiral-bound notebook. The left page is titled "What makes you, you?" and contains the text: "There are many ways to describe ourselves! Describe yourself below on your own terms, using words or images." Below this is a large blank space for drawing or writing, with the text "Write · Draw · Collage" at the bottom. The right page is titled "What are your characteristics?" and contains several sections of questions with checkboxes and text input fields:

- How old are you?** (Text input field)
- What is your gender?**
  - Girl
  - Boy
  - Non-binary
  - Prefer to self-describe:
  - Prefer not to say
- With which racial or ethnic group(s) do you identify?**
  - American Indian or Alaskan Native
  - Asian or Asian American
  - Black or African American
  - Hispanic or Latina/o/x
  - Native Hawaiian or Pacific Islander
  - White or Caucasian
  - I identify as:
  - Prefer not to say
- What language(s) do you speak?**
  - Cape Verdean Creole
  - Chinese
  - English
  - Haitian Creole
  - Portuguese
  - Spanish
  - Vietnamese
  - I speak:
  - Prefer not to say
- Do you have a permanent or temporary disability?**
  - Yes
  - No
  - Prefer not to say
- If yes, how would you describe the disability?**
  - Mobility
  - Cognitive
  - Visual
  - Auditory
  - Learning
  - I describe my disability as:
  - Prefer not to say

# Show Science Identity Video

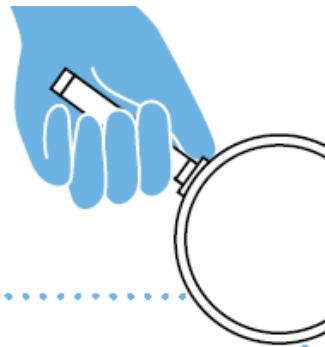
Youth carry a wide range of feelings about science, and we want to tap into their authentic feelings. The Science Identity Video was created to represent a range of science identities youth might hold. Encourage youth to finish watching the video before responding to the survey items.

Video link: <https://youtu.be/KU5rDAXXvi0>

## Suggested script:

*Next, you're going to reflect on your feelings about science. We'll start by watching a short video.*

How do you feel about science?



Now you'll watch a short video ↗

Hear how different people feel about science. (~3 min)

# Science Identity Video

## Early Iterations of Science Identity Video

In early studies, we used a video to introduce youth to different ideas about science, ranging from stereotypes about “what a scientist looks like,” to messages about the range of ways science might play a role in our lives. This video was meant to tap into a broad conception of science, including the potentially harmful sides of science.

## Improvement

The original video may have been perpetuating concepts about science we were intending to dispel. For example, some youth of color were observed laughing at one part of the video that illustrated a stereotypical “old white man in a lab coat” as a scientist, and then responded to questions about science by describing Bill Nye the Science Guy. Team members reflected on the fact that the video continued to position youth as people who needed to be “taught” these ideas about science, rather than people with their own valid perspectives, with the autonomy to communicate them.

## Final Science Identity Video

A new Science Identity Video was produced in collaboration with youth, in which youth themselves shared their own ideas and feelings about science – the good and the bad – in a light-hearted, humorous interview style like videos commonly seen on social media. By illustrating different science identities from the youth who actually held these identities, this new video seemed to encourage participants to share more nuanced and authentic descriptions of their own science identities.

# Rate Science Identity Items

Good exhibit design should invite visitors with a range of science identities to feel a sense of belonging. Measuring science identity up front helps us better understand the identities youth are coming in with. Inviting youth to consider their authentic relationship with science will prime them to consider these feelings once at the exhibits.

## Suggested script:

*Now, think about your own feelings about science and fill out the questions on this page.*

### How much do you disagree or agree with each statement?

(Check one for each statement)

	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
1. I am a science person	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. My family sees me as a science person	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. My friends see me as a science person	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. My teachers see me as a science person	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Science is an important part of who I am now	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. I think science will play an important role in my future	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

# Science Identity Items

## Early Iterations of Science Identity Survey Items

Our early science identity measures used validated scales developed by Vincent-Ruz & Schunn (2018), and the science fascination scale (Chung et al., 2016).

## Improvement

Youth advisors suggested that the original 4-point scale for these measures (YES!, yes, no, NO!) was not sufficient. Youth wanted a fifth “neutral” option and suggested that an agreement scale (which we were using for other measures) would increase clarity. Consistency in our scales also meant we would decrease cognitive load for participants, an important factor particularly for youth with learning disabilities. Further, our analyses suggested that the Activation Lab items did not provide enough additional nuance in our results to merit the time it took to complete.

## Final Science Identity Survey Items

The final survey items include the four science identity items adapted from Vincent-Ruz & Schunn (2018), plus two items developed based on emergent findings from open-ended questions. The agreement scale (strongly disagree = 1, disagree = 2, neutral = 3, agree = 4, strongly agree = 5) aligns across all measures in the protocol.

## Types of Data Generated and Analysis Procedures

This set of questions generates quantitative data. Science identity scores were calculated by averaging responses across the scale, allowing us to calculate means and standard deviations and apply regression analyses to assess how science identity related to other metrics.

## Pause and Reflect: Identity

Peer interviews invite youth to feel more comfortable and less nervous, and encourage more joyful, honest feedback. If other adult chaperones, parents, or guardians are with the youth, encourage them to take a step back with you while youth discuss the questions on their own.

### Suggested script:

*For this part, you'll answer questions together in small groups, and audio-record your answers.*

*(Share site-specific instructions for audio-recording.)*

## Pause and Reflect!

In small groups, you will audio record yourselves as you each answer some questions out loud.

Once you have started recording, read the first question aloud and have all of your group members respond before moving to the next question.



## Qualitative Methods

### Early Iterations of Qualitative Data Collection Methods

In the first study, researchers led all interviews with youth, probing about youth's responses to their meaning-maps and science identity reflections, and later about their experiences at exhibits.

### Improvement

Qualitative data collected by researchers was often thorough, but relatedly included more details than might have been salient or important from youth's perspective. Our first study included so much qualitative data, it was difficult to process and analyze it in a sensible way that would be useful for practitioners to glean insights.

Further, once we began exploring the option of inviting youth to interview each other, we noticed one marked change in the quality of data – the amount of laughter. Youth who interviewed each other brought joy and humor to the table. Some youth who had participated in both the original researcher-led version and the newer youth-led version commented about feeling “less nervous” when doing research with their peers.

### Final Qualitative Data Collection Methods

Our finalized approach for gathering qualitative data asks youth to “pause and reflect” with each other. Youth follow the interview instructions in a range of ways, resulting in less structured interviews, but more authentic feedback overall.



# Complete Peer Interviews

While youth record their interview discussions, feel free to hang back, or float around the room with a “light touch” (meaning no need to listen in or probe to deepen youth’s responses). Youth will provide a range of responses, some with more detail and some with less. At this point in the protocol, the most important consideration is whether youth feel comfortable being open and honest in the research.

**No suggested script.**

# Identity Interview Items

## Early Iterations of Identity Interview Items

In our initial study, identity-specific interview questions asked youth to describe what they put on their meaning maps and why, how they think their meaning maps might change in the next 10 years, what parts of science they connect with (and do NOT connect with), and whether they think science will play a role in their future.

## Improvement

By testing different versions of these questions, assessing the types of responses they elicited, and gathering input from youth advisors, we polished the phrasing and cut the length of the interview questions youth asked each other.

## Final Identity Interview Items

The final interview questions ask youth to describe what they included on their What Makes You, You? sheet and why; their perceptions of science museums; how they feel about science; and what they like and dislike about science.

## Types of Data Generated and Analysis Procedures

These questions generate qualitative data. Personal identity responses were categorized into themes co-developed with youth: memories; social groups; activities, likes, and interests; science identities; academic/career; personality; demographics; pop culture; values; abilities; and physical attributes. Science identity questions were categorized based on whether relationship to science was positive, neutral, or negative and into themes around what drove this relationship, including: (dis)interest in certain science subjects, the processes of doing science, the perceived difficulty of science, and the relevance of science to other aspects of the participants' lives.

## Pause and Reflect!

In small groups, you will audio record yourselves as you each answer some questions out loud.

Once you have started recording, read the first question aloud and have all of your group members respond before moving to the next question.



1. What did you include on your “What makes you, you?” sheet, and why?

2. Talk to each other about how you would fill in the blanks:

- a. Science museums make me feel \_\_\_\_\_  
because \_\_\_\_\_
- b. Science museums are for people who \_\_\_\_\_  
because \_\_\_\_\_

3. Do you feel like you can be yourself at a science museum? Why or why not?

## Pause and Reflect! (cont.)

4. How do you feel about science? Why?

5. What do you like about science (if anything)?

6. What do you NOT like about science (if anything)?

Let the Researcher know when you are done!

## Section 2: Exhibit Appraisals

Section 2 gets youth into the exhibits to preview exhibits, try them, then react. Because this section can be exciting for youth, be prepared to keep track of more moving parts: Are youth doing Preview or React surveys? Where are youth in the exhibit? How many surveys have youth completed?

### Suggested script:

*Thank you for sharing more about yourselves!*

*Next, we'll be heading into the exhibits.*

## Appraisals: Youth Voice

**Youth will honestly articulate how exhibits make them feel.**

“This exhibit was meant for me because **it allows you to be yourself more**. Customizing your own fabric is interesting.”

“That one was the best one with the shoelaces. **It was making me mad, but it was interesting because you had to actually try to do something, not just look. Actually engage.**”

“I didn't really like that exhibit. **That's pretty hard to learn.**”

“The exhibit **puts you in the place of that person**. I'm a person that I like to see how different things are, like different places or different experiences that I never tried, is something that I like to do. So, I feel like that's why it was designed for someone like me.”

“The exhibit was just boring. You had to, I don't know, I think you had to match things. **It was kind of confusing. And I also got distracted easily**. So, I ended up just leaving.”

“I feel like there should be instructions... The guy's not even talking, you're just reading. **Seems kind of boring. That one I feel like you need to be mature.**”

“I don't know if this is on purpose, but all the more feminine-like clothing, they're like on these really nice mannequins. But then the one masculine thing is like on a hanger, off to the side, in a corner. Maybe that wasn't intentional, but **that's like a little disheartening.**”





# Introduce the Exhibits

You might find you'll need to repeat the initial instructions for this section a few times, both in the research area, and in the exhibit hall. This is normal. These activities can be over-stimulating for youth and researchers. Patience and repetition are key.

## Suggested script:

*Once we're in the exhibit halls, you'll do two main activities. First, you'll preview exhibits and share your first impressions. Then, you'll try exhibits and share your final reactions.*

*(Travel to exhibit(s).)*

## Section 2: Visiting Exhibits

Next we'll head to the exhibits!

### Preview

→ First you will preview some exhibits (without trying them).

Answer questions about them based on your initial observations.

### React

→ Then you will try at least two of the exhibits you looked at.

Answer questions about them based on your reactions afterwards.

# Exhibit Use Procedures

## Early Iterations of Exhibit Use Procedures

In our first study, youth were guided by researchers to preview three exhibits, respond to a pre-appraisal survey, then try one randomly selected exhibit and respond to a post-appraisal survey. The researcher gathered observation data about youth's use of the assigned exhibit (dwell time, thoroughness of use, social interaction, and general notes).

## Improvement

Initially, the research team had conceptualized exhibit engagement behaviors as "outcomes" that might vary based on feelings of belonging. However, youth input on their own conception of the consequences of engaging with exhibits helped us reconsider the importance of these observed metrics. Further, through input from advisors and practitioners, we began to prioritize youth choice and autonomy in deciding which exhibits to try, as these were important factors in understanding how youth appraisals were related to such choices.

## Final Exhibit Use Procedures

Our final exhibit use procedures still involve a researcher guiding the pre-appraisal portion of exhibit use. Because the exhibit use activities can be stimulating for youth, this guided approach helped create structure when the task required youth to "not try" exhibits (which can be difficult). After the preview surveys are completed, youth are invited to try exhibits they previewed, then complete post-appraisal surveys. Youth can engage more naturalistically with exhibits and each other, which is an important characteristic of most informal science learning contexts.

# Preview the Exhibits

Guide youth through the exhibits in order, allowing at least 3-5 minutes per preview survey. You might need to remind youth not to “use” the exhibits yet.

## Suggested script:

*I'll lead you through previewing some exhibits. Let's start at Exhibit #1. Make sure “Exhibit #1” is marked on your page.*

*Take a look at this exhibit, then rate how you feel about it.*

*(Continue through each exhibit.)*

# Preview Appraisal Items

## Early Iterations of Preview Survey Items

Our early process for crafting the appraisal survey items involved compiling items from appraisal literature. We generated a library of items and categorized them into thematic “feeling” buckets: energy feelings, positive and negative feelings, feelings of relevance, feelings of familiarity, feelings associated with attention, feelings of value, whether something felt doable, whether something felt effortful, and feelings related to social aspects. Our first survey included 22 items spanning these categories.

## Improvement

Input from youth advisors helped us revise a list that represented the range of appraisal categories, was not too long, and worked well with youth-centric language.

## Final Preview Survey Items

The final pre-appraisal instrument includes 10 items set to an agreement scale that aligns with other surveys in the protocol. The 10 items still address the themes that emerged from our initial review of appraisal literature but are less redundant and more youth-friendly.

## Types of Data Generated and Analysis Procedures

This survey generates quantitative data. Appraisal scores were calculated by finding the average value across the items, allowing us to calculate means and standard deviations and apply regression analyses to assess how appraisals related to other metrics.

**Preview**

Exhibit No. 1 2 3 4 5 6 7 8

How much do you disagree or agree with the following statements about your first impressions of this exhibit?  
(Check one for each statement)

	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
1. I have a positive feeling about it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. I want to check it out	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. I've never done anything like it before	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. I think I would be good at it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. It seems like it would take a lot of effort	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. I think it would be worth my time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. My friends would like this exhibit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. My family would like this exhibit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. I definitely want to use this exhibit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. This exhibit seems like it was designed for someone like me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

[Insert exhibit photo here]

## Use the Exhibits

Next, you'll invite youth to move at their own pace and make their own decisions in the space for about 20 minutes. Inviting youth to make their own decisions may feel overwhelming for adults, but youth choice is critical at this stage.

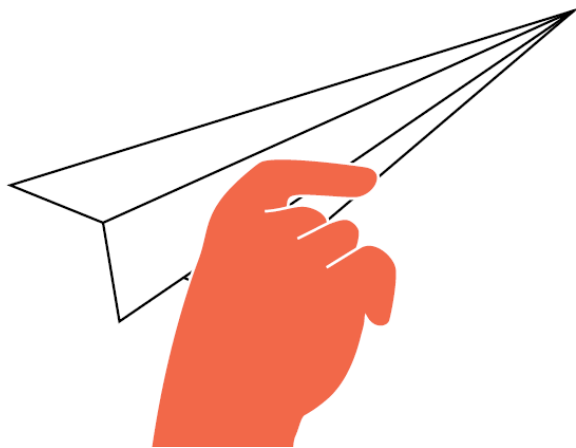
### Suggested script:

*We're done previewing the exhibits! Next, you'll get to try any of the exhibits you previewed.*

*Try the exhibit, then once you're done, fill out the survey describing how it actually made you feel. Make sure to mark the number of the exhibit on your "React" surveys.*

## Next, let's try out exhibits.

Please use at least two of the exhibits you previewed, then fill out a "react" survey after each exhibit.



## Exhibits: Youth Voice

**Youth will identify exhibit design that works (or not) for them.**

*"What makes a good exhibit?" "One that's **attention-catching, engaging, interesting**. And, like simple, like easy to understand and use, and one that's like sort of personal."*

*"The more different things you have, the more people will probably want to come. **Everybody likes different things.**"*

*"I'd say that for explanations and stuff since it's all about learning, **it shouldn't be sciencey**. And by that, I mean it **shouldn't be wordy**, like boring I guess." "It should be exciting, more fun." "The man in the middle of the exhibits, you know what I'm talking about right? Like when you would press the button then he would be there. I skipped a lot of those, if I'm being honest. I was like, nope, skip that." "The **long explanations should get right to the point**, and not drag out too much. 'Cause a lot of people don't have the attention span and would like to go on to different exhibits."*

*"**I did not need to see myself in an exhibit**. I just want to mess with the exhibit and see if it's shiny or not."*

*"For me, I personally—considering I'm Indian—**it would definitely have been cooler to see maybe like a Sari** or something like that, considering it is pretty diverse. But, at the same time, these exhibits change. So, there's always potential for that."*

*"At a museum you might want some exhibits that make you feel, 'Wow, it doesn't really matter what gender or what race I am.' But some that are like, '**Maybe since this is more directed towards people like me, I would really want to do this.**'"*

# React to the Exhibits

While youth try exhibits and complete surveys, your main task will be to answer clarifying questions and make sure youth are completing the correct survey. You may also make note of exhibits that youth seem particularly drawn to, or other observations you might follow up about during the final debrief.

## No suggested script.

Once youth have completed at least two “React” surveys, regroup and return to your research area.

# Reaction Appraisal Items

## Early Iterations of React Survey Items

The development of the post-appraisal survey mirrored the development of the pre-appraisal survey. Items on the post-appraisal were phrased in the past tense. In the first study, one unique item was also added to the post-survey to assess one potential outcome of engaging with exhibits, measuring whether the exhibit “made me feel like a science person.”

## Improvement

Feedback from project advisors helped us question whether the “science person” outcome question was too limiting. Through discussion with youth about the consequences of trying exhibits, we generated outcomes that *actually matter to youth*. These items closely aligned with science capital literature, which helped inform revisions to these items.

## Final React Survey Items

The post-appraisal items for the final version of the survey mirror the pre-appraisal items. Three new items assess outcomes: wanting to tell others about the activity; wanting to learn more because of the activity; feeling able to do the activity “the way I wanted”; and wanting to try other activities similar to this one. A final question asks if youth tried an exhibit alone or with someone else.

## Types of Data Generated and Analysis Procedures

This survey generates quantitative data. Appraisal and outcomes scores were calculated by finding the average score across the items, allowing us to calculate means and standard deviations and apply regression analyses to assess how appraisals related to other metrics.

**React**

Exhibit No. 1 2 3 4 5 6 7 8

How much do you disagree or agree with the following statements about your final impressions of this exhibit?  
(Check one for each statement)

	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
1. I had a positive feeling about it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. It held my interest	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. I've never done anything like it before	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. I was good at it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. It took a lot of effort	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. It was worth my time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. My friends would like this exhibit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. My family would like this exhibit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. I will tell other people I know about this activity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. This activity seemed like it was designed for someone like me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. This activity made me want to learn more	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. I was able to do this activity the way I wanted	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13. I want to try out other activities that are similar to this activity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14. Did you try this exhibit with someone else?	Yes <input type="radio"/>		No <input type="radio"/>		

## Pause and Reflect: Exhibits

The next interview gets to the heart of the APPRAISE approach. However, once you return to the research area, you might find youth's energy levels have dropped. This is to be expected after the stimulation of visiting exhibits. You can remind youth there are only two activities left.

### Suggested script:

*Now you'll get back into your small groups and answer a few more questions with each other about your experiences at the exhibits! Then we'll finish up with one full-group discussion.*

## Pause and Reflect!

In small groups, you will audio record yourselves as you each answer some questions out loud.

Once you have started recording, read the first question aloud and have all of your group members respond before moving to the next question.



## Outcomes: Youth Voice

Youth will describe the consequences *that matter to them* of design that is “for me” or “not for me.”

“So when you're using an exhibit that's good for you, what might you be doing? Or thinking? Or feeling, or even saying?”

“I'll feel like I want to **keep doing it**, and not just walk away.”

“I'll be like, '**What's gonna happen next?**' And wondering if it's gonna be fun or if it's just gonna be boring completely.”

“I'll probably be **enthusiastic** about it or try to **invite other people** if it catches my eye.”

“I feel like **talking about it with someone**, or saying, ‘Oh, I just went at this exhibit and it's really interesting and something that I think you would like.’”

“An example of when you use an exhibit that's **not** good is like, you'll probably **want to walk away** and try a different exhibit. Or you'll probably think, like, ‘Oh, all the other exhibits are probably like this. **Yikes.**’”

“If I'm looking at the exhibit and it's too many words, **I'm not going to it.**”

“I hate exhibits where you have to read and it's pretty much just saying the same information, just different wording. 'Cause normally **I'll just leave half-way through it.**”

“If I go to one of the exhibits and it's not really interactive, I would kind of **get bored and try and run off** to another exhibit, so I don't have to stay there.”

“It would probably be like, you don't think that the exhibits were really thought out, or **like the museum didn't think about how people feel in the exhibit.**”

# Complete Peer Interviews

The final set of peer interview questions typically generate the most useful data about how youth see the relationship between identity, exhibit design, and feelings of belonging. Again, youth comfort and openness are key for gathering authentic feedback about their experiences.

## No suggested script.

Float around the room answering any questions.

# Exhibit Interview Items

## Early Iterations of Exhibit Interview Items

In the first version of the exhibit interviews, researchers asked youth to reflect on whether their identities “matched” the exhibit they tried, probed youth about why their appraisal ratings may have changed between pre- and post-surveys, and explored why youth thought an exhibit made them feel like a science person (or not). The goal was to describe how the design of the exhibit might have influenced these appraisal shifts and feelings.

## Improvement

The initial survey was particularly long, especially if youth reported several appraisal shifts. Further, while data helped us associate specific appraisals with design elements, we were not gathering data that helped us associate *overall feelings of belonging* and exhibit design. Each successive study helped us identify which questions led to the most useful data and clarify confusing wording.

## Final Exhibit Interview Items

The final interview includes four questions. Youth describe what they thought “someone like you” meant, what they chose first and why, and which exhibits felt like they were (and were not) designed for someone like them and why.

## Types of Data Generated and Analysis Procedures

These questions generate qualitative data. Responses are categorized by identity themes, exhibit design themes, and how these themes cluster into “for me” and “not for me” categories. This clustering helps illuminate relationships between identity, design, and feelings of belonging.

## Pause and Reflect!

In small groups, you will audio record yourselves as you each answer some questions out loud. Once you have started recording, read the first question aloud and have all of your group members respond before moving to the next question.



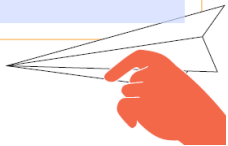
On your exhibit surveys, question #10 asked about whether an exhibit was designed for “someone like you.”

1. When you answered that question, what were you thinking “someone like you” meant?

2. Which exhibit did you choose to use first, and why?

3. Which exhibit(s), if any, were well designed for someone like you, and why?

4. Which exhibit(s), if any, were NOT well designed for someone like you, and why?



Let the Researcher know when you are done!



# Hold Final Debrief

Once peer interviews are completed, a full-group discussion will allow you to hear directly from youth about their experiences. Debrief topics might be specific to your context or exhibits and can dig more deeply into any themes that matter to you and your exhibit team.

## Sample questions might include:

**Reiterate:** *What were some exhibits that felt like they were for you (or not for you), and why?*

**Expand:** *What was it about the exhibits that made you feel that way? When an exhibit is “for you” (or not), what happens next? How do you react in the moment, or later on?*

**Dig deeper:** *How do you think your identities – what makes you, you – relate to your feelings at exhibits? Do you think exhibits **should** represent or relate to different identities?*

# Final Debrief

The last part of today’s session is a full-group debrief. The museum staff and/or researcher will ask the group some questions. You can ask your own questions, too! This is your chance to offer advice to museums about how to design better exhibits for you.

To conclude the debrief conversation, you will be asked to fill in the following sentences:

# Debrief Methods

## Early Iterations of Debrief Methods

In every version of our implementation of this research protocol, we dedicated time for researchers to ask for final feedback and input from youth. These debriefs almost always included feedback on the research itself and whether there were any suggestions to improve. Debriefs also helped the team probe more deeply on each construct over time, so we could gradually build an understanding of how youth understood our constructs to help validate our measures.

## Improvement

For our purposes, there was never “one right way” to hold these debriefs. They were purposefully flexible to meet the team’s needs while attending to youth’s input and interest in continuing the research activities at this point in the session.

## Final Debrief Methods

Ultimately, we found that holding a debrief provided youth with an opportunity to reiterate feedback they felt was important, expand on their experience with exhibit design, and deepen their meaning-making about the relationships between the constructs of interest. Further, asking for feedback on the actual research activities provides an opportunity for the research team to improve its process.

## Types of Data Generated and Analysis Procedures

Data generated are qualitative and may vary from study to study. Responses should be reviewed by members of the research team to assess whether any content might be analyzed with similar data from other parts of the protocol (e.g., if youth describe why exhibits were “for me” or not).

# Invite Final Reflections

The very last page of the workbook presents an optional fill-in-the-blank activity for youth to share feedback about identity, design, and belonging.

## Suggested script:

*Today we talked about three big topics: What makes you, you; exhibit design; and whether an exhibit feels like it is for you or not.*

*Take the final moments to think about your experiences today. Then, fill in the blanks on this final page to describe how you would put all these pieces together.*

The image shows two overlapping worksheet pages. The top page is titled 'As someone who...' and has a blue rectangular box for a response. Below that is 'when an exhibit...' with another blue box. At the bottom, it says 'I feel like it is for me.' The bottom page is titled 'As someone who...' with a blue box, followed by 'when an exhibit...' with another blue box, and 'I feel like it is NOT for me.' at the bottom. Both pages have a spiral binding on the right side.

# Final Reflection Items

## Early Iterations of Final Reflections

Early studies attempted to ask open-ended questions of youth about their understanding of the relationships between identity, design, and belonging. These questions were typically asked in the full group debrief.

## Improvement

We found it difficult to scaffold youth to talk about their concepts of identity and connect their identities with abstract ideas about exhibit design. By the end of the pilot and feasibility study, we had a better sense for how to communicate the connection between these constructs.

## Final Version of Final Reflections

The final version of this set of reflection questions asks youth to “fill in the blanks” to describe “as someone who” (holds a particular identity), “when an exhibit” (uses a certain design strategy), “I feel like it is (not) for me.”

## Types of Data Generated and Analysis Procedures

These questions generate structured qualitative data. We can analyze these data using the same thematic categories as the open-ended interview questions about exhibits that were “for me” or “not for me” in the peer interviews. Because these responses are more focused, analysis can be conducted more quickly. However, these responses sometimes tend to be more abstract and less tied to actual experiences youth had in the exhibits, which can lead to challenges in using the responses to inform improvements to specific exhibits.



## Close the Session

Inviting any lingering questions or thoughts from youth can help ensure you haven't missed anything youth find important to share. Remember to thank youth for their time and distribute any incentive they might be receiving for their participation.

### Suggested script:

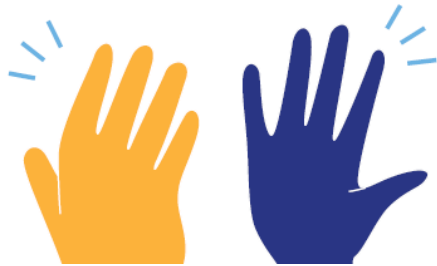
*Do you have any final questions or thoughts?*

*Thank you again for your time and input today!*

## That's the end!

Thanks so much for participating in today's session.

Please give this workbook to a researcher before you leave.



## APPRAISE: Youth Voice

**Youth may also share how the research made them feel.**

“It was a new experience. **It was kind of fun to just be able to, like, express our opinions about the certain things,** especially since, like, I've never really seen these exhibits before anywhere else. “

“I thought it was just really fun, because you got to try new things. **And you got to find out a little bit more about yourself, and what you like to do.”**

“**I really liked how we interview each other,** because I feel like it was more natural than like if we did it with an interview. I mean, like, I already know you guys. But then if someone came in who didn't know you, then it might be awkward for them. So I think that was cool.”

“You got to be interviewed with a friend, and I think it made me feel less nervous to mess up my speaking, because sometimes **speaking with an adult you haven't met before, it kinda makes you nervous.**” “And adding on to her, **if you mess up when you're talking to your friend, you can just kind of laugh about it.** But like she said, when you get nervous about talking to an adult, like when you mess up with an adult, it kind of gets awkward.”

“I thought it was a really interesting experience, that **people actually care about other people's thoughts, especially kids like us.**”

# Conclusion

## Team Reflections

Through the work of the pilot and feasibility study, we not only developed a research protocol that centers youth voice, we also generated knowledge about the relationships between identity, appraisals, exhibit design, and outcomes. While the results of this work are described in more detail in other project products, we share some of our top take-aways here.

**How youth feel about exhibits is rooted in how they see themselves.**

**These feelings are impactful, influencing youth's engagement in ISL experiences.**

**Youth description of their own identities in relation to exhibit experience helps complexify understandings of identity when designing for minoritized audiences.**

- **More than a checkbox:** When youth talk about their identities and how those identities influence their decision-making about exhibits, it's rarely talk about demographic factors like race, gender, and abilities. Instead, youth tend to foreground features including their interests, activities, and personalities. However, demographic identities were salient when exhibit design did not attend to them, or explicitly excluded them.
- **Asset not deficit:** There were no demographic differences between youth with low and high science identities in our study. We see this as a promising asset: How can exhibits nurture youth's inherent science identities?

**The protocol provides a scaffolded approach for museum professionals and youth to have impactful conversations that inform exhibit design.**

- **Format over content:** Youth often focused on an exhibit's activity format – more than the content, look and feel, or physical design – when talking about what made an exhibit feel like it's designed for them.
- **Prioritizing youth voice:** The protocol supports youth metacognition so young people can advocate for their needs and interests, even when their feedback is critical or pushes back against the power exhibit designers hold.

## Directions for Future Research

Future work can build on this project to provide further granularity about how to design exhibits that expand a sense of belonging and how to use emotion as a tool to humanize the relationships between visitors and designers in ways that help us truly feel, connect, and affirm one another.

# APPRAISE: References and Appendices

## Contents

Resource	Page
References Cited	<a href="#">28</a>
Planning the Research	<a href="#">29</a>
Pilot and Feasibility Study Participant Characteristics	<a href="#">30</a>
Coding Rubrics	<a href="#">31</a>
Data Validation Methods	<a href="#">34</a>
“What Makes You, You?” sticker templates (Use with Avery 22805 labels)	<a href="#">35</a>

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# Before you Begin

Preview what will be required to set up, conduct, and manage the activities described in this Research Brief:

- Plan to Conduct Research with Human Subjects Ethically
- Recruitment
- Obtaining Consent
- Research Area Setup
- Exhibition Setup
- Workbook Setup
- Managing Data



# Planning the Research

Plan to Conduct Research with Human Subjects Ethically:

- Complete Human Subjects training.
- Obtain Institutional Review Board approval if you intend to use the protocol for research.

Recruitment:

- Consider where and how you'll invite groups of youth (ages 10-17) to participate.
- The protocol can accommodate single-groups (such as families) or larger groups that can be split up into small-groups of 3-4 youth each.
- Having one adult facilitator for every 5 youth can help ease the burden of setup and facilitation.
- Communicate expected commitment (2-hour session) and any incentive to participate.

Obtaining Consent:

- Prior to the research, ensure youth and their parents or guardians have given consent.

Research Area Setup:

- Designate a quiet area for participants to gather and reflect, including table space.
- Print inspiration stickers, if using them, and set out writing instruments for youth.
- Plan how youth will audio record interviews.

Exhibit Setup:

- Select 4-8 exhibits youth will preview and try.
- Print and tape large numbers on each exhibit.

Workbook Setup:

- Print enough workbooks for each participant.
- Decide on an identification system; if desired, pre-number each workbook pair.

Managing Data:

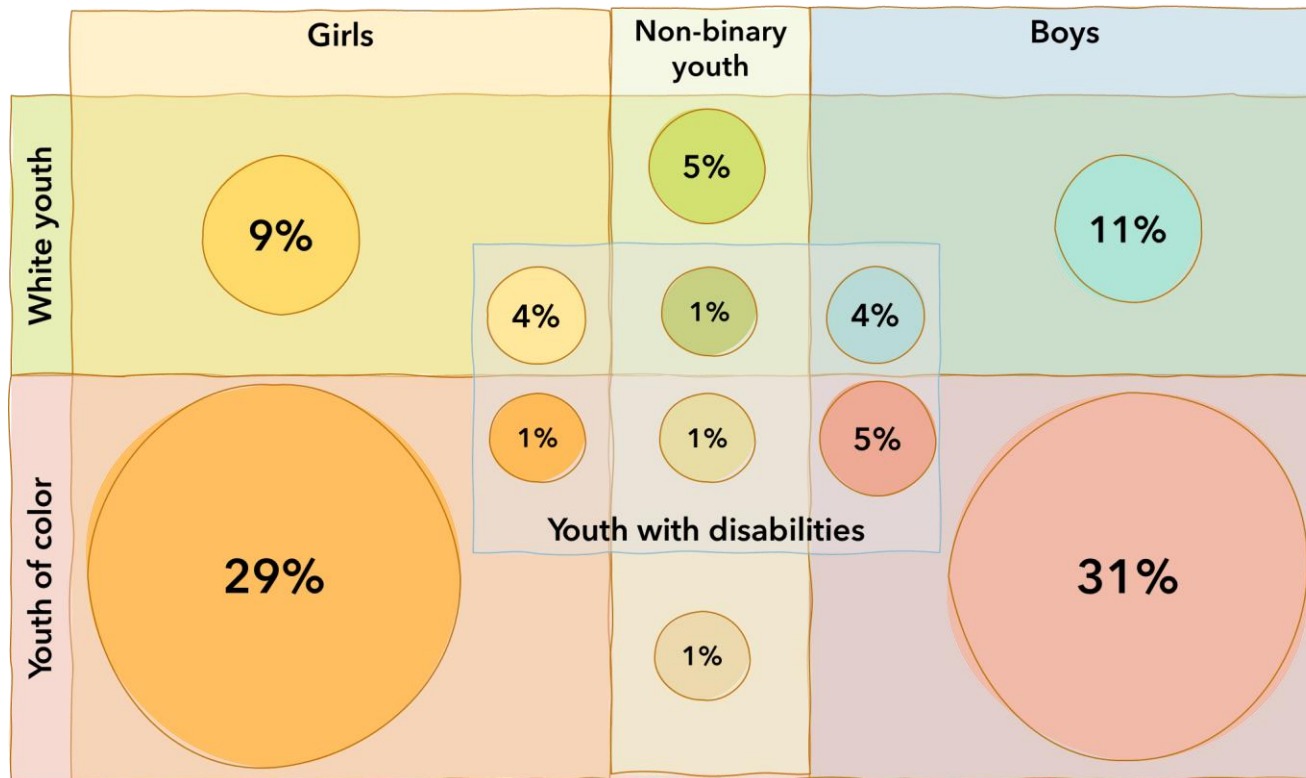
- Physical workbooks should be stored in a secure, lockable cabinet.
- Data should be entered or transcribed into a secure digital format for analysis.

# Pilot and Feasibility Study Participant Characteristics

One aim of this pilot and feasibility study was to center perspectives of youth whose identities are persistently minoritized in STEM. The characteristics of youth who participated across our pilot studies are summarized below.

- **99 youth participated** across 4 studies
- Youth ranged in age from **9 to 17 years**
- Youth spoke **10 languages**: English, Spanish, French, Chinese, Japanese, Haitian Creole, Arabic, Cape Verdean Creole, Portuguese, German
- Youth with disabilities represented **7 disability descriptors**: Mobility, visual, learning, auditory, cognitive, ADHD, sensory
- **89% of participants held identities typically marginalized in science**: girls or non-binary youth, youth of color, and/or youth with disabilities

Visual Representation of the Intersections of Participant Gender, Race or Ethnicity, and Disability Status (n = 92)



# Data Coding Rubrics

## Quantitative Data

All quantitative rating scales used the following values:

- Strongly disagree = 1
- Disagree = 2
- Neutral = 3
- Agree = 4
- Strongly agree = 5

Science identity scores were generated by calculating the average score across the survey items.

Appraisal scores were generated by calculating the average score across the survey items.

## Qualitative Data

**Coding rubric for analyzing data related to exhibit design:**

<b>Design Category</b>	<b>Category Definition</b>
Format	Elements of exhibit design that direct how visitors will use the exhibit, or what they will do there.
Content	The topics, information, or concepts being communicated through the exhibits. What the exhibit “is about.”
Physicality	Sensory elements of an exhibit’s design, including colors, size, texture, lighting, sounds, smells, etc.
Orientation	Design that supports or hinders visitors in knowing what they are supposed to do, or how to use an exhibit.
“Broken”	Elements of an exhibit that are (or are perceived to be) not working correctly or at all.

## Coding rubric for analyzing data related to personal identity:

Identity Category	Category Definition
Abilities	Descriptions of what someone can or can't do (or what they struggle with) socially, cognitively, physically, emotionally. Might not use "disability" language.
Academic / career	Descriptions of what youth do in school, what they want to be when they get a job, etc.
Demographics	This includes culture, race, ethnicity, sexual orientation, age, gender, religion, ability or disability (when they're specifically talking about a disability - if they're talking vaguely about what they're good at or their skills, it can be coded under the Abilities code).
Likes and dislikes	Descriptions of the sort of activities that youth like to do, likes in general, dislikes, what their interests are.
Memories or past experience	Descriptions of someone's past experiences, memories, or recalling that they are "reminded of..." a time or event.
Personality	Descriptions or adjectives that describe someone, like being "nice," "caring," or "funny" or use descriptive labels like artistic, creative, sporty, or hands-on learners.
Physical attributes	Describes personal, physical attributes that don't fit into the Demographics category (like height, hair texture, etc.).
Pop culture	Descriptions of identity in terms of movies/tv shows, music, celebrities, products or brands; it might include Starbucks or Amazon, or descriptions of products (like air pods) or other popular technology.
Science identity	Descriptions of youth's relationship to science - whether they like it or dislike it. This could overlap with academic or career, but if they reference science specifically, it should be coded here.
Social groups	Descriptions of social groups one is a part of, or how their relationships come up in their sense of self or behaviors (at an exhibit).
Values or beliefs	Descriptions of things that matter to youth, what their views or opinions are, what they care about, etc.



## Coding rubric for analyzing data related to science identity:

### Affective relationships with science

Category	Category definition
Positive affect towards science	Descriptions of one's feelings towards science that include interest, liking, or other positive emotion words.
Neutral affect towards science	Descriptions of one's feelings towards science that do not sway clearly positive or negative.
Negative affect towards science	Descriptions of one's feelings towards science that suggest a disinterest, dislike, or other negative emotion words.

### Content-based relationships with science

Category	Category definition
STEM discipline	References to specific fields of science such as chemistry, physics, biology, math, etc.
STEM processes	Mentions of what it is like to <i>do</i> science, including experimentation, figuring things out, etc.
Relevance to daily life	Descriptions of how science relates to participants' lives and interests, including specific things such as science being related to animals and also general comments about how science is part of everything we do.
Difficulty of science	This emergent code came from many participants mentioning how challenging they perceived science to be.

# Data Validation

The protocol invites youth to complete research packets, developed with youth researchers and youth advisors, that guide study participants through independent and peer-to-peer activities. The approach centers youth comfort over researcher control, and is able to generate data that sheds light on characteristics of identity and engagement that youth center as relevant. The items assess each construct in terms that are clear and understandable to youth, and represent the range of ways youth might think about these different constructs in the context of our exhibits.

We were able to validate our protocol through three main mechanisms:

- **Continuous youth input:** Instrumentation workshops with youth advisors, input from youth interns, and reflective feedback from youth participants after each study helped shape development of all aspects of the approach to research and the protocol itself. Youth provided feedback on logistical aspects of the research (length, flow), as well as measures (language used, content addressed, self-reported associations between constructs).
- **Focus on face validity:** While our initial plans often centered “prior research” as our source for developing valid measures, we shifted to center youth’s language, concepts, and experiences as a way to assess validity. As such, the protocol includes questions that have been vetted and used by over 100 youth, including approximately 20 youth advisors, 2 interns, and 99 participants.
- **Input from practitioners and advisors:** Our meetings with COV members, project advisors, and practitioners at the Museum of Science and Children’s Museum of Pittsburgh have led to many changes in our approach and overall guidance for our work. Examples range from adding questions (i.e., including language in our identity measures) to more comprehensive changes (i.e., radically rethinking how our science identity tools can actively scaffold a more nuanced approach to science rather than reinforcing dominant views of science).
- **Exploration of the psychometric properties of appraisal surveys:** Cronbach’s alpha was excellent at both exhibit preview and post exhibit use (.82 and .84, respectively), indicating high internal consistency. An exploratory factor analysis of the appraisal surveys indicated a single dominant factor which loaded to .30 or higher for most items (7 of 8 items on the post survey, and 6 of 8 items on the pre-survey), with item 1 (“I had a positive feeling about it”) and Item 4 (“I was good at it”) contributing the highest loadings.

