How to Design Successful Hands-on Activities for At-home Learners

Children’s Creativity Museum
Children’s Science Center Lab
Discovery Museum
Explora
Marbles Kids Museum

InterActivity 2022, St. Louis

This project was made possible in part by the Institute of Museum and Library Services #CAGML-246996-OMLS-20.
Ready to respond

★ **Largest and oldest** online collection of hands-on STEM activities

★ **Established resource** for educators (museum, K12, homeschoolers) looking for free digital materials
Project Overview

- IMLS CARES Act Grants for Museums and Libraries

- Update, refresh, and retool existing digital infrastructure to meet the growing needs of informal educators offering at-home STEM educational programming during the COVID-19 pandemic.

- Intended Audience
  - Caregivers and learners at-home
  - Informal educators reaching at-home audiences

- New at-home activities collection, at-home framework, and museum cohort.

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Members of the nationwide Howtosmile At-Home Activities Team

*Children’s Creativity Museum, San Francisco, CA
*Lawrence Hall of Science, Berkeley, CA
Boston Children’s Museum, Boston, MA
Carnegie Science Center, Pittsburgh, PA
Center of Science and Industry (COSI), Columbus, OH
Children’s Science Center Lab, Fairfax, VA
Discovery Museum, Acton, MA
Explora, Albuquerque, NM
Exploration Place, Wichita, KS
Florida Museum of Natural History, Gainesville, FL
Marbles Kids Museum, Raleigh, NC
Museum of Life and Science, Durham, NC
Sciencenter, Ithaca, NY
Paulmichael Maxfield & Cassie Byrd - Advisors

Conducted 4 full team meetings and asynchronously reviewed frameworks, exemplars, and cataloging plans.
What did we do?

1. **Reviewed and commented** on a draft at-home activities framework after discussing **exemplar activities** and each museums’ experiences.

2. Filled out a **Cataloging Plan** for each museum showing how activities fit the evolving framework along with revisions to make them more at-home ready.

3. **Worked in cohorts** to review each other’s Cataloging Plans and finalize additions to the new **At-Home Activities Collection**.

4. Finalized the new **At-Home Activities Framework** and cataloged additions into the collection.
New Framework
Now posted!
Sources and extensions on the Pg2.

howtosmile.org/topics/athome
A good at-home activity...

...has an exceptionally effective and easy-to-use guide

...is related to the everyday lives of learners

...engages the learner's senses

...encourages caregivers and learners to work together in a meaningful way

...lets learners practice and express their creativity

...uses common, low-cost household materials
What did we do with our new and very tasty framework?
Consider adding a video walk-through of activity and photos of all necessary materials.

Include specific step-by-step instructions with pictures.

Include prompts on how the caregiver can interact with the activity and work together with their learner.

Include ties to observable scientific phenomena or daily activities that are accessible to the target age range.

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You will need...

- A smartphone
- A glass bowl
- A small cardboard box
- A milk bottle
- A kitchen towel or toilet paper tube
- Sticky tape
- Squares
- A cardboard snack tube
- A mallet
- A score sheet
- A score sheet (one that you can play made on)

Top tip: If you have another phone, install a sound level meter app (free ones are available) and use it to measure how loud the sound is. If you can’t do that, then listen to the sound and compare it with the sound of the phone on its own.

Think and talk about...

- Which items make the best sound boosters? Why is that? And which ones don’t work as well?
- Why do you think the sound is different when you use the boosters?
- Where have you noticed sound being amplified or muffled in your own life?

Investigate...

- Experiment with different shapes and materials.
- What happens if you create a booster made of two materials (e.g., paper and glass)?
- Can you design a muffler for the sound — something that will dampen the sound instead of amplifying it?

Follow these steps...

1. Start playing a song on your phone. Listen and note down how loud it sounds. Put your phone into the different cups and bowls and listen how the sound changes.
2. Try making a horn out of paper and attach it over the speaker of your phone. Does this boost the sound?
3. If you have a card box or tube, cut a hole for your phone to fit inside it. Does it make a good tune booster?
4. Try combining different objects and materials to make something a bit more complex.

Science in your world

Loudspeakers are built into wooden or plastic cabinets that are carefully designed to make the sound louder and to make sure most of it comes out of the front of the cabinet, so less sound is lost at the back.
Balancing Sculptures

Use materials from around your home and in the recycle bin, along with your own problem-solving skills and persistence, to create a sculpture that balances from a single point.

Recommended Age: 6+ years old
Time needed: 15+ minutes
Link to the Video: https://www.youtube.com/watch?v=6_aKOkLExvY

What You Need
- A chopstick, dowel, stick, or similar object, and a way to make it stand up
- String
- Scissors
- Tape
- Glue
- Assorted materials like: cardboard, corks, toilet paper or paper towel tubes, paper clips, yarn, toothpicks, paper, stuff from the recycle bin, toys like LEGO or TinkerToys
- Optional: A friend or two

What You Do
- Figure out a way to make your chopstick stand up
  - Drill a hole in a block of wood and glue it in
  - Stand it up in a container of playdough or clay
  - Stand it up between 2 books or boxes, or inside a cup, and tape it in place
  - What else can you try?
- Now it’s time to play around. Test a few objects to see if they balance on the end of your stick. What can you do to make them balance? Think about other structures you have seen that involve balancing—look at some photos and the video. How do YOU balance?
- Keep trying. Sometimes your sculpture will fall over, but that’s OK. Try a few things and if you are working with a friend, bounce ideas off each other. Keep trying different techniques and materials until you’ve got a balancing sculpture you’re happy with.

Tips for Adults
- If you are the friend that is helping your child, be sure to let your child take the lead. You may see your child trying something that you know won’t work, but just let it happen. Your child is learning!

This activity can be frustrating. Model persistence and remember this is supposed to be fun! Laugh when things fall over, and encourage their next idea.

- To make this activity more simple, encourage your child to start by balancing two objects. To make it more challenging, encourage them to add more parts.
- As your child is working, ask them questions about their design, such as:
  - What is working well?
  - What isn’t working? Why do you think it’s not working?
  - Tell me about your design. What materials did you use? How did you put them together?

Learning and Skills Connection
- Persistence: Focusing, sticking to it, learning from mistakes
- Experimenting: Making and testing predictions, trying multiple solutions
- Working flexibly: Incorporating and revising ideas based on new information, employing objectivity and acknowledging subjectivity
- Collaboration: Respecting, drawing from, and building on the ideas of others, working within a team

What’s Going On?
Balance means there is an equal distribution of weight. An object is balanced when it is stationary (not moving), and that happens when forces are equal on all sides. Imagine you are standing still. You are balanced. Now stand on one foot. What happens? You probably put your arms out to the side without thinking about it. Doing that shifts things around so that the forces pushing on your body are equal, and you can be still again.

Doing STEAM with Kids
STEAM stands for Science, Technology, Engineering, Art, and Math. There are lots of ways you can explore these letters, apart or together. Ask your child to make predictions, describe what they see, and to imagine possibilities and solutions. Don’t worry so much about the “right” answer. Developing curiosity, and problem-solving skills are important first steps to doing STEAM!

305 Congress Street | Boston, MA | 617.426.6500 | BostonChildrensMuseum.org

The activity encourages caregivers and learners to work together in a meaningful way

Include specific step-by-step instructions with pictures

Label basic activity characteristics such as target age range and time required.

Add a short introductory question and/or description...STEM background information, in plain language.
DIY Bath Bombs

Recommended Ages: 4-12

Bath bombs come in all shapes, colors, and sizes, depending on their ingredients and molds, which make them great for trying at home. Ingredients can range from bath salts, fragrances, colors, glitter, and more.

**Materials:**
- **Bowl**
- **Spoon**
- **Silicon Mold**
- **Water**
- **1 Tablespoon**
- **1 Tbsp Citric Acid**
- **1 Tbsp Baking Soda**
- **1 Tbsp Epsom Salt**
- **2 Tbsp Cornstarch**

**Optional Material:**
- **Food Coloring**
- **Essential Oil/Scent**
- **Oil (olive, coconut, etc.)**

**Procedure:**
1. Mix all of the dry ingredients into the bowl with the spoon.
2. If using any other liquid ingredients such as oil, essential oils, or food coloring, mix them with the water now.
3. Using your teaspoon, measure 1 teaspoon of water. Pour all of the water from your teaspoon onto one spot of your dry mixture. What is happening?
4. After observing, quickly use your spoon to press down on the wet spot in your dry mixture to stop the reaction. Do not mix the wet spot with the rest of your ingredients until after the reaction is complete! You’ll know the reaction has finished when the bubbling stops.
5. Use your hands to make sure everything’s combined. The mix should still feel slightly powdery, but hold together a little bit when you squeeze or pinch it.

**What happened?**

When you add the bath bombs to water? Baking soda and citric acid are responsible for the fun fizzing in your bath, as a result of the chemical reaction that happens. A chemical reaction is a process in which one or more substances are converted into a different substance.

\[
\text{Citric Acid (C}_6\text{H}_8\text{O}_7^+ \quad + \quad \text{Sodium Bicarbonate (NaHCO}_3^+ \quad \rightarrow \quad \text{Carbon Dioxide (CO}_2^+ \quad + \quad \text{Water (H}_2\text{O})} + \quad \text{Sodium Citrate (Na}_3\text{C}_6\text{H}_5\text{O}_7^+) \]

This is an acid-base reaction. You may have tried mixing together baking soda and vinegar, to explosive results! When a weak base, in this case baking soda (sodium bicarbonate (NaHCO₃)) meets a weak acid, a gas is produced to make bubbles! For bath bombs, instead of using vinegar as the weak acid – because no one wants their bath to smell like vinegar – we use citric acid (C₆H₈O₇). The gas that is produced is carbon dioxide, the same gas you exhale when you breathe out. When that gas is released in the bath, it pushes up through the water to create fizzing bubbles.

**DID YOU KNOW?**

A chemist is someone who studies everything about the different chemicals that exist in our world. Like acids and bases! If you liked exploring this activity, maybe chemistry is for you!

Include step-by-step instructions with pictures. Learners should not have to read between the lines for challenge steps.

Use common items found around the home or recycled materials.

Do not require expensive materials or materials that can’t be found locally.

Include sensory elements such as vibrant colors, rich sounds, interesting textures, and tasty treats.

Add a clear introductory question and/or description, complete materials list, and accessible background information to support STEM content.
Include sensory elements such as vibrant colors, textures, sounds

Provide suggested questions for caregivers to ask learners.

Add creative pathways for learner to repeat activity

Add a video walkthrough of activity
**Squishy Soil**
**What makes up the soil?**

What makes up the soil under our feet? Soil contains living and dead organisms, plant material, water, air, and minerals.

The sediments in soil can be grouped by texture, and most soils have a combination of all three.

- **Sand** is the largest of the three sediments. Sand feels gritty when you rub it between your fingers.
- **Silt** is much smaller in size. When dry, silt feels similar to flour in texture.
- **Clay** is very fine. When wet, clay is sticky.

The amounts of sand, silt, and clay in your soil affect how much water and air the soil can hold and how well it can support plants and animals.

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**Soil Test - Ribbon Technique**

**What you’ll need:**
- Dirt/soil
- Water

**Here’s what to do:**
1. Hold a small handful of soil.
2. Add enough water to the soil to make a ball. If you can’t make a ball, the soil is very sandy. How can you shape it?
3. Feel the ball with your fingers. What is the texture like? Is it gritty (sand), silky (silt), or plastic/sticky (clay)?
4. Roll the dirt into a ball again. With your thumb, gently press it out over your forefinger to make a hanging ribbon.
5. If you can make a short ribbon, your soil texture is more loamy, a mixture of sand and clay.
6. The longer the ribbon, the more clay is in your soil. Try this technique again with the same soil or with a different soil sample. What do you notice?

**Explore further:**
Find a local farmer and ask what they do to test their soil! What combination of sand, silt, and clay is best for planting their crops?
Consider different entry points to this exhibit and set play scenarios at each.

Include specific step-by-step instructions with pictures.

Creative pathways to grow the activity.

Add a video walkthrough of activity.

Build a bee hotel and fill it with friendly bees. Take a buzz around outside and pretend to pollinate.

What You Need:
- Cardboard box
- Colorful tape or paint
- Cardboard tubes
- Yellow, black, and white pipe cleaners

What You Do:
1. Decorate the cardboard box using colorful tape or paint. The box will be the exterior of your bee hotel.
2. Fill the box with cardboard tubes.
3. Make a few pretend bees. Twist together one yellow and one black pipe cleaner. Wrap them around your finger to create the bee body.
4. Cut one white pipe cleaner in half. Thread it through the bee body and shape it into wings.
5. Play around with your bees. Have them fly back and forth between the bee hotel and flowers or plants in your yard or garden.
6. When you’re done pretending, set your bee hotel up outdoors to attract pollinators.

Did You Know? Many species of bees are solitary. They live alone and not in hives. They don’t have a queen and don’t produce honey. Solitary bees lay their eggs in small holes. You’ll know that solitary bees are using your bee hotel if they cover the opening to a tube with mud.

Words to Use:
- Pollinator: Insects or other creatures that transfer pollen to flowers or plants so that they produce seeds.
- Solitary: Single or alone.
- Pollen: A fine powder produced by flowers, which is carried by the wind or by insects to other flowers of the same type, making them produce seeds.

Change It Up:
- Add additional plant material to your bee hotel. Fill the area not occupied by the tubes with sticks, pine needles, or leaves.
- Build a more permanent bee hotel. Find out how here: https://www.nationalgeographic.org/media/build-your-own-bee-hotel/
Let’s break into groups…

1. **Reflect on the framework** with session leaders

2. **Identify some components** that could be added to your current activities or new activities you could create.

3. **Discuss methods and choices** with the group (e.g. how to make a how-to video, take photos, or add language about caregivers, etc)

4. Add notes to your At-Home Worksheet
New Collection
(over 300 activities added to howtosmile)

howtosmile.org/topics/athome

We want to know about your activities!
Project Survey Results, Final Thoughts

Extent to which participants found value in Howtosmile project activities

- Reviewing and identifying your organization's activities for the at-home collection
- Filling out your organization’s cataloging plan
- Revising activities

Extent to which participants thought project activities were important to overall professional growth

- Identifying and discussing the needs of at-home learners
- Learning about essential components of hands-on STEM activity guides

“Great project! Collaborating with other institutions was an excellent experience and the meetings were amazing, very well organized and very insightful of what other institutions are doing for at home learners.”

Many museums repeated activities even when creating new content.

Demonstrated need for this type of PD, is there a path forward for a bigger cohort?

Shows the need for a centralized resource & customization in favor of individual development.
Thank You!

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Choose one or more framework criteria that you want to add to your own STEAM hands-on activities.

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<th>A good at-home activity…</th>
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1. What is the source of the activities you want to revise for at-home learners?
   [Here you could add a current collection at your museum (either online or in digital format), or activities in the public domain that you want to adapt.]

2. How do these activities currently align with the At-Home Activities Framework? Discuss generally or each one individually.
   [This is your starting state…what are the strengths of the activities for at-home learners?]
3. How do you plan on making your activities more at-home “ready” using the framework criteria that you identified above.
[Add notes for several activities, or talk about a collection as a whole.]

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<th>Activity title</th>
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4. Are your hands-on activities possible candidates for the Howtosmile.org At-Home Activities collection (howtosmile.org/topics/athome)? Answer these questions:

- Is it a fun, high-quality activity that engages and motivates learners with a solid connection to science or math.
- **Is there a printable PDF that is publicly accessible on your website?**
- Does the activity have a simple description, step-by-step photos or a video that can quickly summarize the experience and outcomes for educators?
- Did you sufficiently revise the activity to align to the At-Home Activities Framework (or was it already aligned)?

*If you answered YES to all these questions, please consider submitting your activities to the session leaders to be cataloged into Howtosmile! Email porcello@creativity.org*