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Adapting Hands-on Family Learning to a Virtual Platform

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Abstract. Whole-family STEM learning programs don't have to end while we are all staying safely at home. This interactive session will give you an overview of the NASA Family Science Night (FSN) curriculum and how it has been adapted to function on virtual platforms as FSN @Home. Learn tips and tricks for engaging families online, the challenges we have faced during pilot testing, and options we have explored for giving families physical access to hands-on learning materials. FSN is a research-based astronomy curriculum that engages middle school students and their families in STEM topics in a comfortable out-of-school time setting. The main objectives of the program are to bring families together to collaborate on activities and to change attitudes about learning science by helping both students and their parents embrace the idea that anyone can "do science." Highly engaging, hands-on learning activities provide opportunities for families to practice the process of "doing science" together at home, which can include many attempts and mistakes, and often leads to more questions rather than a single "right answer" — which is what makes science so much fun! FSN uses a hands-on approach to learning science and the FSN @Home adaptation requires that families have easy and safe access to activity materials. Materials are intentionally designed to be low-cost and reusable. The FSN @Home adaptation can be conducted using one of several options for delivering, lending, or giving away materials to facilitate hands-on whole-family learning in the home. After the session, our team is available to consult with prospective FSN @Home implementers as they decide how the program could be conducted in their community and prepare for events.

1. NASA Family Science Night Background

NASA Family Science Night (FSN) is a research-based astronomy curriculum that engages middle school-aged students and their families in STEM topics in a comfortable out-of-school time setting. The main objectives of the program are to bring families together to collaborate on activities and to change attitudes about learning science by helping both children and their parents embrace the idea that anyone can "do science." Highly engaging, hands-on learning activities provide opportunities for families to practice the process of "doing science" together, which can include many attempts and mistakes. This often leads to more questions rather than a single "right answer" — which is what makes science so much fun!

Each session includes a variety of instructional techniques, including kinesthetic activities, art, and writing, in order to engage many different types of learners. The structure and content of each session has been designed very specifically for whole-family learning, with the expectation that adults and children will be interacting and learning as equal participants in all activities. This differs from many traditional models of children's out-of-school-time programming, as it relies on full family participation throughout the event.

The NASA FSN curriculum was originally designed to be run by educators in a school, library, museum, or other location where a multi-generational audience can come to learn together, both as a family and as a community. Our NASA FSN distance-learning adaptation, known as NASA FSN @Home, developed in 2020 as a response to the COVID-19 global pandemic, preserves the main objectives of the program by making whole-family learning accessible to participants while they are safely in their homes. However, the authors think it is important to note that while the virtual edition of the program is valuable for engaging families during a crisis, in-person events are still the most powerful and effective way to guide whole-family exploration and learning, when we are able to safely do so again.

For more information on the original, in-person NASA Family Science Night curriculum, and the research into family learning that drives the program, please refer to "STEM Served Family-Style: Improving Attitudes and Achievements" (Mitchell 2019).

2. COVID Pivot to NASA Family Science Night @Home

2.1. What is a COVID Pivot?

"COVID Pivot" is a new term being used to indicate how education and outreach efforts have had to rapidly change their approaches to meet the needs of learners in the new learning environment created by the COVID-19 pandemic. While distance learning is a well-established method for delivering instruction over the internet or via correspondence, it suddenly became a primary instructional method in 2020, as institutions, businesses, and schools were closed across the country in the midst of the 2019/2020 academic school year.

2.2. Pivoting from an In-Person Model to Distance Learning

In the FSN @Home learning model, families attend a live online event, with facilitator(s) guiding families through the activities using videoconferencing software such as

Figure 1. A family explores together at home during a live FSN @Home event while a facilitator leads families through activities through videoconferencing.

Zoom, Microsoft Teams, Google Meet, etc. Though the instruction occurs online, FSN @Home is a hands-on STEM curriculum and requires that families have easy and safe access to specific physical learning materials.

2.3. Distributing Hands-on Learning Materials to Families at Home

Material management takes careful coordination and some extra time in a distance-learning model. There are several options we have considered for delivering, lending, or giving away materials to facilitate hands-on whole-family learning in the home, depending on the size and needs of different communities.

Option A: Material Lending Locally The first option for providing access to learning materials is to lend kits to families with a designated pick-up/drop-off location in your community. This option allows materials to be recycled and reused. During our initial pilot-testing of FSN @Home, each participating family picked up a packaged kit of learning materials at their local middle school before they attended the online event from the safety of their home. Families returned materials after the event to the same location within a designated time period.

The main challenge of this option is getting busy families to pick up and drop off materials within a designated time window. One of the best ways to facilitate this is to choose a convenient, central location in the community and to provide a choice of days and a variety of times to accommodate the busy lives of families.

Option B: Shipping Materials The second option we considered for providing access to learning materials is to ship kits to families. This may be the best option for reaching families living in larger, spread out communities or in extremely rural areas. You could also consider providing a return mailing label to families to facilitate the return of more expensive, non-consumable items, if you wanted to reuse them. Consider that if families sign up for multiple sessions, they could keep and reuse some materials for subsequent sessions.

Some sessions are more conducive to this option than others. Sessions with smaller materials, like a session with just printed cards and a few small items like plastic dinosaurs and pennies, would be relatively easy and inexpensive to ship. Other sessions

Figure 2. NASA FSN @Home learning material kits sit outside a school for contactless pickup.

have larger, heavier, or more delicate materials. While most of the supplies needed for NASA FSN are intentionally low-cost, there are a few sessions with more expensive components, which is something to consider if you are going to allow families keep materials.

We did not test this option during our implementation of the pilot, because we were working with a relatively small local community where in-person distribution was feasible.

Option C: Families Acquire Materials A third option we considered was to provide a session materials list to families and ask them to locate and purchase supplies on their own, though we do not recommend this route. While NASA FSN activities have been designed to use easily-accessible and inexpensive materials whenever possible, with many available at grocery or craft stores, we recognize that asking families to acquire their own materials is a burden on their finances and time, which may be especially limited during a pandemic. Choosing this option may result in families showing up to online events without the supplies necessary to participate, or the exclusion of families who lack the means to obtain and prepare supplies. If you must use this model, we can recommend which sessions have the most affordable, easy-to-find supplies.

3. Sample NASA FSN @Home Session: Exploring the Moon

3.1. Session Structure

Some NASA FSN in-person sessions are more adaptable to the distance-learning model than others. The original program contains ten two-hour sessions, and we have currently adapted seven sessions that are conducive to learning in a home environment.

While the structures of the original, in-person program and the @Home adaptation are almost identical, we had to make modifications to some activities and discussions. We have created supplemental documents to support educators in their implementation of the @Home model.

A sample session will be used to illustrate the logistics involved in running a family program virtually. Our session on exploring the Moon has four learning activities. There is a warm-up activity, an approach we use in every session to engage families at the start of the event, two exploration activities, and a transfer of knowledge activity. Each activity builds on the last, and the sequence of activities has been designed to fit within the two-hour design of the original program. While our original in-person program does not use slide presentations as a method to engage audiences, we found these are necessary in the distance-learning model.

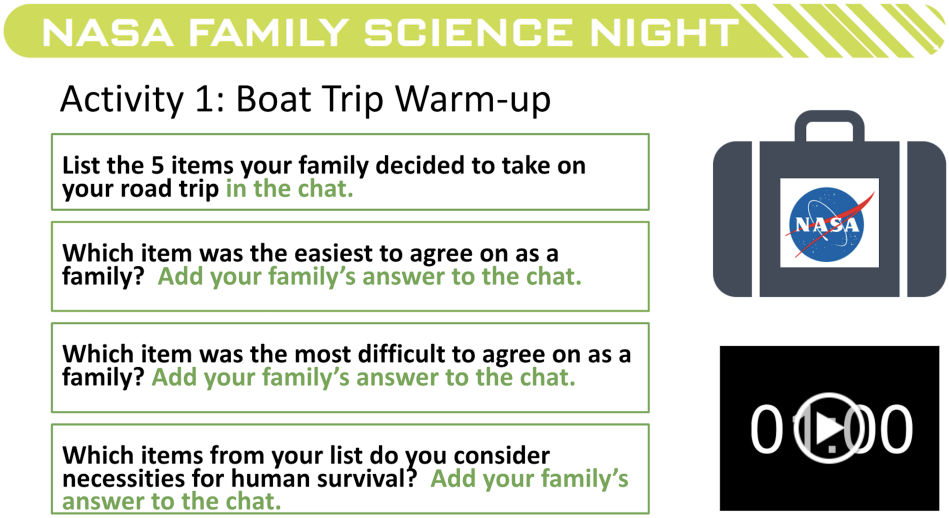

Figure 3. A NASA Family Science Night @Home Presentation slide for the warm-up activity for Session 6: Mission Lunar Outpost.

3.2. Engaging Families in a Virtual Space

NASA FSN is designed for facilitators to act as coaches, helping families collaborate to solve problems and communicate effectively. During an in-person event, it would be straightforward for facilitators to walk around to watch and listen to what families are doing during an activity. While @Home facilitators cannot interact as easily with families, seeing the audience online can help them assess each family's engagement level, their understanding of concepts during activities, and their needs during the event.

During a virtual event, it can be very hard to see what families are doing on-camera and to gauge their level of understanding while they are on mute for the majority of the session. Not all families will choose to be on camera the entire time, and you may not be able to see some family members all of the time (or at all) due to the camera angle.

Clear, explicit instructions for how to do activities, both verbal and on-screen, and anticipating possible miscommunications are the best ways to set families up for success when doing activities at home. When appropriate, facilitators should model

how to do experiments on camera for families to see. The *FSN @Home Presentation* that we provide includes many of the essential instructions for activities on the slides, as well as suggested supplementary verbal instructions for facilitators to use, located in the presenter notes.

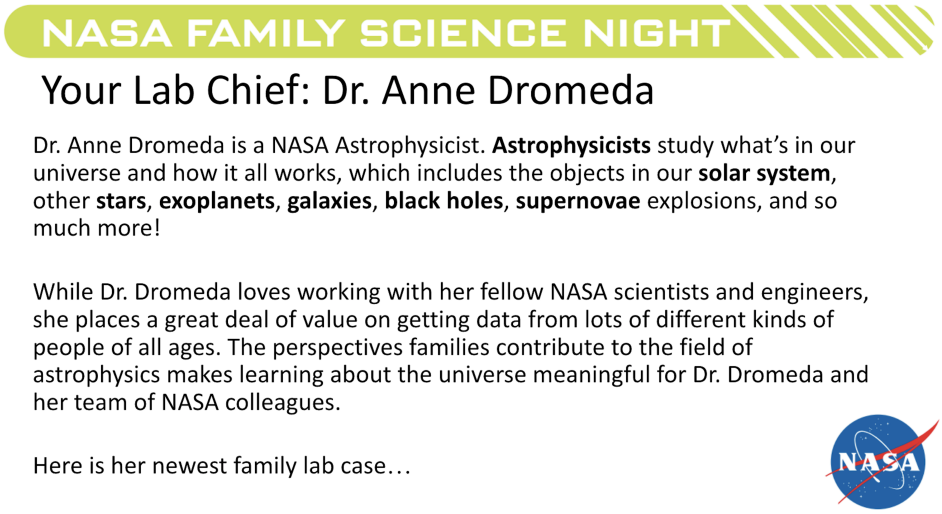

Figure 4. A NASA Family Science Night @Home Presentation slide used to guide family discussion.

Looking through the answers in the chat and post-activity discussions are valuable for assessing whether families successfully completed an activity and understood its core concepts. The facilitator discusses the responses they see in the chat and can ask follow-up questions to families if they see any misconceptions. We created a *FSN @Home Participation Tracker* to help facilitators keep track of which families are sharing their activity results and participating in the discussions. This can help make sure each family has an opportunity to answer questions and share their ideas with the group, and help facilitators identify and engage families that are hesitant about participating.

This example session has four activities, though some NASA FSN sessions only have three. Depending on the type of activity, we try to balance having families share ideas in the chat and on-camera. How you balance these two options will depend a lot on the number of families that are attending the event. If there a lot of families, there will be fewer opportunities for each to share on-camera, considering time constraints.

We chose to cap our pilot events at twelve families, which was partly determined by the number of resources we had available to us (material kits and facilitators) and also by how we wanted to interact with our families online. It was important to us to maintain a sense of community in the virtual learning environment, giving families as many opportunities as possible to interact with one another and the facilitators.

3.3. Adapting Activities to the @Home Environment

Our @Home session on exploring the Moon is almost identical to the original in-person session, with a slight modification to the third activity. The in-person version of that activity has participants mapping a room-sized model of a simulated lunar surface, which

requires the use of a large, open space. For the @Home adaptation, we adapted this to a smaller, tactile version, built using a banker's box (sturdy box with handles and a lid) and various inexpensive craft supplies: coin rolls representing lava tubes, buttons representing craters, plastic craft gems representing minerals, ribbon representing mountain ranges, and hot glue blobs representing water ice.

This new "Lunar-Surface-In-A-Box" could also be used at an in-person event, if you don't have adequate space to build the larger model. The outcome of this activity, whether using the large-scale or table-top model, is for families to understand how terrain affects lunar exploration. However, the shift in learning modality from a largely kinesthetic activity to a primarily tactile activity may be a challenge for some learners.

The NASA FSN program includes a variety of activities that are aimed at meeting the needs of a diverse set of learners, especially considering the mix of adults and children. Keep in mind that kinesthetic activities are the most difficult to adapt to a distance-learning environment, when the facilitator cannot be in the same room with families to help direct their movements. Facilitator coaching is particularly important in kinesthetic activities in order to make sure the movements accurately reflect the phenomena they are modeling and to avoid misconceptions.

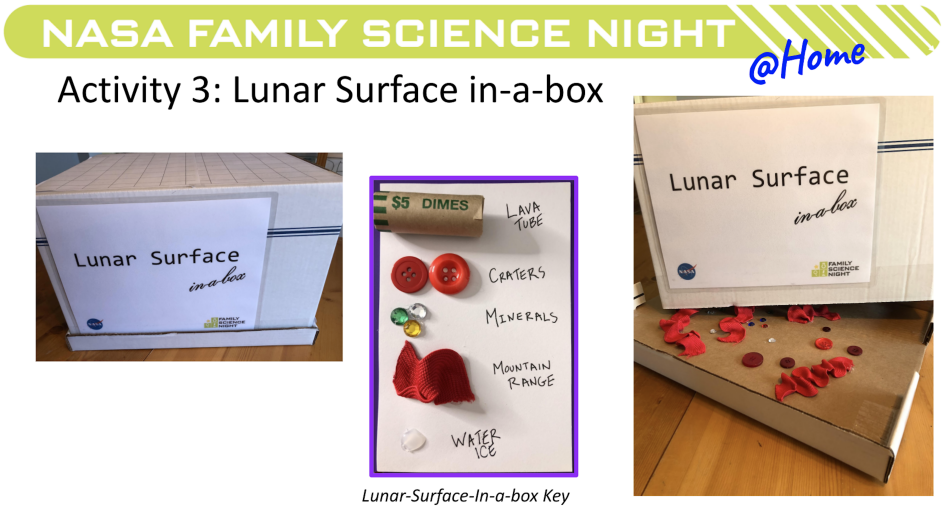

Figure 5. The "Lunar-Surface-In-a-Box" is an example of an activity that was modified to meet the needs of learners at home.

3.4. Resources Available

As mentioned above, our team has created several documents to support facilitators with running a NASA FSN @Home event. The presentations are useful for keeping families on track and providing visual cues for instructions. We have made handouts to help families identify and use the learning materials in their kits during a session. There is also a comprehensive program guide to help educators plan, prepare, and run a successful event. A new NASA FSN website is currently under development, but all of the digital files for currently-available sessions can be requested directly from FSN @Home project lead Christina Milotte at christina.h.milotte@nasa.gov.

4. Evaluation

Evaluation of the in-person NASA FSN program focuses predominately on the interactions of families as they work together, and changes in their behaviors and attitudes after participating in an event (Mitchell 2019). For the @Home distance-learning adaptation, our evaluator adapted the methods and tools used to evaluate our in-person program, in order to collect data on the success of this new version with our pilot audiences.

4.1. Initial Pilot (June - December, 2020)

Our Astrophysics Education Team at NASA Goddard did an initial pilot test of seven adapted @Home sessions between June and December of 2020 in a rural community in Washington County, Maryland. A total of 28 families participated in this pilot, with twenty five percent of families attending multiple events.

An evaluation survey administered at the end of each event asked families to identify the skills they had the opportunity to practice together during the activities and to state something new they had learned about astronomy, science, or each other. While many families were able to accurately describe a new astronomy concept they learned about, we were just as interested in what families learned about one another. A family wrote in their evaluation, "*One thing we learned is patience. We think very differently!*" One parent wrote, "*We do not get much family time, but during this pandemic we have been able to spend more time together. What my husband and I learned is how much (our son) loves science and how intelligent he is when it comes to science.*"

Our team continues to gather data as the pilot is implemented in more communities across the country, including partner-run events in Michigan and Georgia. Data gathered from these events will be used to improve the NASA FSN @Home distance-learning model and activities, while our team continues to find new ways to bring high quality STEM education to people of all ages in a variety of different learning environments.

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