



STEM FAMILY CHALLENGE (STEM^{FC})

The Center for Inquiry Based Learning (CIBL) and The Science House (TSH) created the STEM Family Challenge (STEM^{FC}) program to provide schools, after school programs, and other youth serving organizations the opportunity to build and enhance relationships with family members and to engage and inspire young people to explore STEM in a fun way. Planning an event like a STEM^{FC} or a Science Night is a BIG undertaking and requires a lot of resources and time to plan and execute effectively. Also, a STEM^{FC} event ought to be fun, hands-on, accessible, cover different topics and interests, and give families opportunities to design, build, compete and take home something fun! This is where we come in. We provide a turnkey kit that any school, after school program, or any other youth serving organization can pull off with even limited volunteers.

CIBL and TSH's STEM^{FC} program is a 100-minute program that combines science learning and family bonding with school community participation. STEM^{FC} provides hands-on and competitive activities that demonstrate a variety of scientific principles and make STEM (science, technology, engineering and mathematics) learning fun, accessible, and more appealing to today's students. The STEM^{FC} program is designed for parents and caregivers to self-guide their students through each activity, thereby supporting family-learning experiences that encourage children to continue pursuing STEM subjects through higher academic levels.

Each STEM^{FC} kit provides all the materials, supplies, and directions for 4 highly engaging and motivating activities for up to 40 families (~175 family members). We highly recommend limiting the event to 40 families. However, if you have more than 40 families wishing to participate then host multiple STEM^{FC} events. For example, do one event that is for grades K-2 and then do another event that is for grades 3-5. If you would rather do only one event, then you can order 2 STEM^{FC} kits and serve up to 80 families (~350 family members), but this will require more tables, space, and volunteers to make the event successful. One further point, when we first started speaking with schools many of them assumed very quickly that they would have 350-400 people at the event. This turned out not to be true. There are many events, activities, and opportunities that compete for your community's time. It is best to plan for a targeted number of families and not assuming that every family in the school will participate.

At the STEM^{FC}, families will have a blast competing together in the following exciting activities in four 20-minute activity blocks:

Brick by Brick

(Two Classrooms with a Hallway in Between)

Families learn about how well they communicate with one another. One family member (the designer) views a constructed object (made of LEGOS®) alone in one classroom and then must enter the hallway and explain to another family member (the communicator) how to build the object, the communicator enters the other classroom where the third family member (the builder) sits with a bag of LEGOS® and the builder must take direction from the communicator in order to build the original object. Best reconstruction of object wins!

Float Your Boat

(Media Center, Science Lab, Cafeteria, or Several Classrooms)

Families design a boat that will hold as much weight as possible without sinking. Most mass held wins!

It is Rocket Science

(Gym, Cafeteria, or Large Open Space)
Families construct and launch paper straw rockets. Rocket launched the farthest wins.

No Bones About It
(Media Center, Cafeteria or Several Classrooms)
Families assemble a skeleton from cut out bones. Most bones placed correctly wins!

These activities reflect our inaugural kit. We are working on two other kits with completely different activities so that each STEM^{FC} is fresh. Each STEM^{FC} kit will also provide flyers, Spanish language versions of directions for each of the activities (coming soon), signs, instructional online videos for activities (coming soon), images and layouts for each activity, and tips to make the event a great success. Our goal is for your community to think highly about your school or organization and its special programming, like STEM^{FC}, that you are providing for your students to foster a love of learning STEM at school and at home. A STEM^{FC} coordinator will come to your location to help facilitate your event, but this will cost an additional \$250 consultant fee plus travel expenses.

CIBL and TSH tested STEM^{FC} activities in numerous schools throughout NC during the 2019-2020 school year. We learned so much from piloting this event in schools across the state with diverse populations and set ups. Below we describe how we approached STEM^{FC} events and provide tips on how to make your event successful.

Prior to the STEM^{FC} Event

First, you need a leader. You need a person that is organized and excited about pulling off a great event for the school/organization and the community. It's great to have a "committee", but ultimately you need a strong, reliable person to make this event a great success. Choosing the wrong person will doom this event before the planning even gets started.

Second, set a date or date for the STEM^{FC}. Check with leadership (Principal, Asst. Principal, Director, Secretary, etc.) to get the event on the Master Calendar. Make sure you have the full support and backing for your school or organization's leadership. Make sure they are available to attend the event (don't forget to ask them to serve as greeters!) and that there are no major conflicts with other events. You will want to schedule a STEM^{FC} event at least 90 days ahead of time and order the STEM^{FC} kit. The kit cost is \$475. If you need a coordinator to help with the event, then you will need to schedule the event on either a Tuesday or Thursday night between the hours of 6:00 pm and 8:30 pm. A \$250 consultant fee will be charged along with additional travel expense fees.

Third, once the date is set, make sure you also reserve the space. You will need 3 large spaces: a gymnasium, a cafeteria, and a media center, as well as two smaller spaces: 2 classrooms that are across the hall from one another. Classrooms can also be adjacent to each other. If you do not have all of these spaces, then you can definitely make other spaces you have available work. Each space will need to have at least 6 free-standing, 6-8ft rectangular or round tables (except the classrooms). Cafeteria tables with attached seating or round tables are permissible. However, chairs are not needed or preferred for these activities. Note, if you are doubling the size of your event (e.g. more than 40 families), you need to have double the number of tables for each space.

Fourth, recruit volunteers for the event among staff, PTA members, community members, etc. Create a Sign-up Genius for volunteers to assist with activity stations, guides, and greeters. You will need to provide a minimum of 14 volunteers for this event. You will need at least 2 volunteers per activity (minimum of 8 total) and one volunteer guide/group leader per group (4 total). Volunteers should be trained prior to the event (or have them

arrive 1 hour before the event). It's best to have each volunteer work through the activity they are volunteering for so that they are ready to support participants. Greeters (2 total) are also great to have and school or organization leadership personnel are great options for this role.

Fifth, send STEM^{FC} event flyers to all students for Monday folders or via electronic communication to parents. Include a due date to sign up for event (due date should be at least 2 weeks prior to the event, but 30 days is even better). Create a Sign-up Genius for parents to register their families. You will want to know how many family members are attending from each family. You will want to know how many adults and how many children (and their ages) plan to attend. This will help you in splitting families into 4 equal groups. In piloting this event, we found that dividing groups based on children's age is most effective. However, family units should NOT be broken apart (for example, if a family has a 1st grader and a 5th grader). Please keep family units together (it is a STEM **Family** Challenge). Some schools/organizations serve pizza. If you plan to do this, you will want to get pizza orders during this process. We will include a sample spreadsheet (in MS Excel) to help you in organizing volunteers, spaces, and groups for your event.

Sixth, send reminders any way you can up until the night before the event. We have found that about 25% of families that commit to coming to the event don't show up (similar to any event). You, of course, can't count on the fact that 25% won't show up and must prepare that all will show up, but the more you can remind families the better. Also, because families won't show up, allow families that show up last minute or sign-up late to come.

Day of the STEM^{FC} Event

STEM^{FC} events can be done on Saturdays and even during the days during the week depending on your school or organization, but we are going to assume here that the event will take place on a weeknight. If your plan is not to hold your event on a weeknight then just adapt the schedule below to meet your needs. Also, while the program is designed for 100 minutes of activities, there is also another 60 minutes included for arrival, pizza, welcome, introductions. If you will not be serving pizza then you can have parents arrive 30 minutes later (at 6:00 pm). Below is a suggested schedule.

As noted earlier, we will run four activities: Brick by Brick (in two classrooms across from each other separated by a hallway), It is Rocket Science (in the Gym), No Bones About It (in Media Center), and Whatever Floats Your Boat (in the Cafeteria). Each event and its rules are summarized on subsequent pages.

It Is Rocket Science

Description:

Families will construct a straw rocket to fly as far as possible. Families must work together to build one rocket. It takes multiple hands and careful attention to detail to build a functioning straw rocket.

Materials:

Each station must have:

- 1 Direction Sheet on how to build a straw rocket
- 1 1/2 sheet of paper that has a straw rocket template on it
- 1 Pencil
- 1 Straw
- 1 Pair of Scissors
- 1 Dispenser of Scotch Tape

The test flight area must have:

- 1 12-15-meter measuring tape
- A marked start line using Painter's tape
- Sticky Notes to place at landing spots of straw rockets

Space:

A gym or gym-like area. You need area big enough for an area for constructing rockets, another for testing rockets, and another for testing rockets. See the attached gym diagram on how to set up the space.

Volunteers:

6 volunteers would be optimal but can be run with as few as 4 (or even 2 if absolutely necessary).

Competition:

Families check-in at competition location and receive a directions sheet of how to build straw rockets, a sheet with two straw rocket templates, a pair of scissors, scotch tape, and a straw. It is best to have this laid out prior to them arriving so they can start immediately. Families may also make their own straw rocket designs and not use directions. Families will have up to 15 minutes to construct up to two straw rockets while also testing each. After 15 minutes, families can no longer construct, or test fly their models and must make two official flights. They may make one flight with each rocket or two flights with one rocket.

Families will be allowed to attempt two (2) official flights for scoring. The two official flights are made in sequence (one after the other) and families can proceed to make their official flights when ready (don't have to wait the whole 15 minutes if they are ready). Official flights are made with an official volunteer spotter. It is best to have numerous spotters to speed up measuring of planes. The family member (preferably a child) making the official flight should notify a spotter that they are ready and audibly announce the countdown, "3-2-1 BLOW IN THE STRAW!" Rockets must be launched behind the launch line and are measured to the spot where the plane first touches the floor. Spotters measure distance from center of launch line to spot where plane first touched ground.

Families may also make two (2) official launches using the STEM 101 Straw Rocket Launcher.

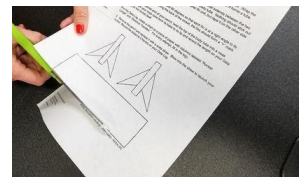
Scoring:

The final score is the longest distance flight to the .10 of a centimeter.

It Is Rocket Science

Direction Sheet

Step 1: Cut out the large rectangle along the dotted lines. This will be the body tube of the rocket.



Step 2: Cut out the two fin units.



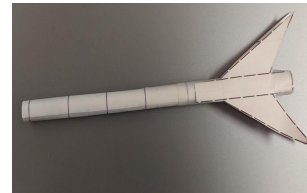
Step 3: Wrap the large rectangle from Step 1 around a pencil length-wise. Make sure it is wrapped tight!



Step 4: Tape it along its seam. Use small pieces of tape! Make sure entire seam is taped. Be sure not to tape it to the pencil!



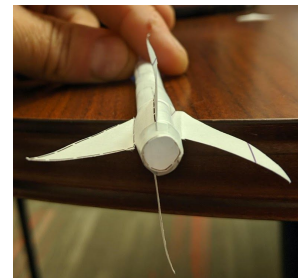
Step 5: Attach fin units by aligning the bottoms of the small rectangle that extends between the fins with the end of the body tube of the rocket and tape the fin to the body tube on the top and bottom of the rectangle. When taping fin unit to the bottom, cut thin pieces of tape so that the tape doesn't extend past the hole.



Step 6: Do the same thing for the other fin on the opposite side, making a “fin sandwich.”



Step 7: Bend the fins on each fin unit 90 degrees so that they are each at a right angle to each other. When you look along the back of the rocket, the fins should form a “+” mark.



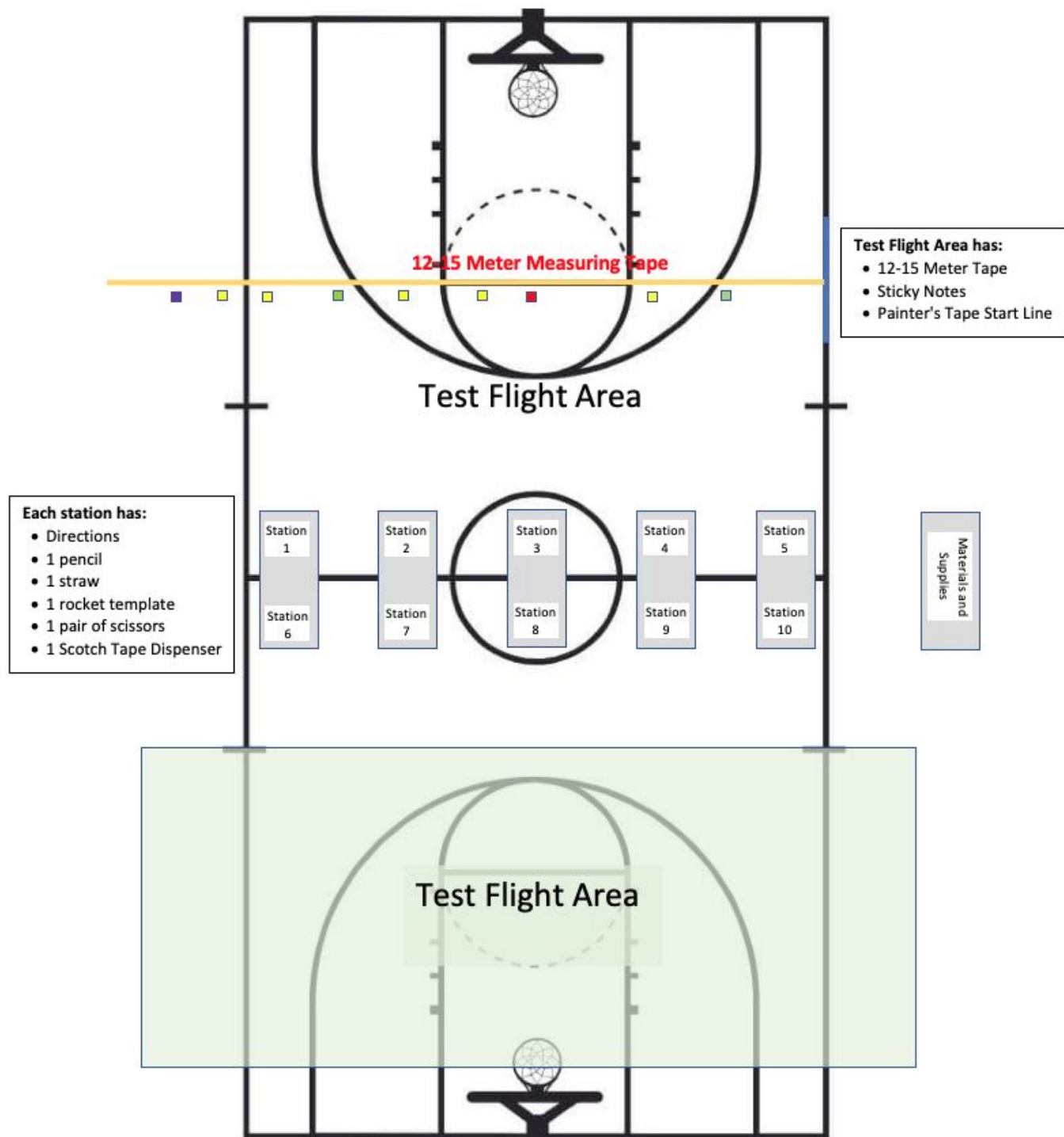
Step 8: Press the nose of the rocket together with thumb and index finger. Seal with tape.



Step 9: Place rocket on your straw and blow hard into the straw to launch your rocket. Once you are ready, go to the launch site and see how far you can launch your rocket!

It Is Rocket Science

Gym Layout



Brick by Brick

Description:

Families and teams need to be able to work with each other. Every person is different. They may know different things, have special skills, have particular strengths and weaknesses, and come from distinct experiences. Each person is important, and communication is critical in reaching goals. Imagine if you couldn't communicate; how would you feel? In what ways would you be able to complete a task? Today we are going to complete a family communication challenge. There are different roles you may play

Materials:

- Material Bags with Legos for Each Family
- 2 build models
- 2 red brick 2x2, 2 red brick 2x4, 2 green brick 2x2, 2 green brick 2x4, 2 white brick 2x2, 1 white brick 2x4, 1 eyeball sticker

Space:

This event should be done in two classrooms that are directly (or nearly directly) across from each other. The event will use both classrooms and the hallway in between the two classrooms.

Volunteers:

2 volunteers are required

Competition:

Family members will fill one of the following roles:

Designer (1): In one of the classrooms there will be an already built LEGO® model. Only Designers can go in this classroom to see the model. The Designer will see the model initially for 3 minutes. The Designer observes the original model and tells the Communicator all the details he/she can remember about the model. The Designer is never allowed in the other classroom where the Builder is and can never see what the Builder is doing. After the initial 3 minutes, the Designer has two passes to look at the model for 30 seconds after the initial 3 minutes.

Communicator (1): The Communicator is not allowed to see the model. The Communicator listens to the Designer (in the hallway) to learn how to build the model. Once the Communicator has listened to the Designer, he or she will enter the classroom with the Builder and tell the Builder what the Designer described in order to build the model. The Communicator is not allowed to use their hands, touch the LEGOS, or put anything together when communicating with the Builder. The Communicator can go back and forth from the Builder to the Designer (in the hallway) as many times as needed (or until time runs out).

Builder (1): The Builder is located in the other classroom and receives a bag of around 30 building blocks (LEGOS). The Builder is the only person who may touch or put together the LEGOS. The Builder takes direction from the Communicator. The Builder may not speak or leave his/her station or see the original model.

Observers (1-3): Observers are other members who will observe what they see about the communication. What did you see? Do the Builders know what they are being told to do? If not, what happened? Observers may only watch – they may not talk or answer questions.

Now that you know the roles, here is how to play:

1. In the classroom without the model, decide as a family which role each member will be playing. If for some reason your family only has two people, then combine the Builder/Communicator role and eliminate the Observers.
2. The Builder will stay put and be given a bag of LEGOS which they may spread out in front of him/her. The Designer and the Communicator go into the hallway.
3. When indicated, the Designer goes into the room with the model for 3 minutes. They will do their best to study the model and memorize the design.
4. After 3 minutes, the Designer goes into the hallway and describes the design to the Communicator. Set a timer for 10 minutes as soon as the Designer leaves to classroom with the model.
5. When ready, the Communicator enters the room with the Builder and describes to the Builder what the Designer described to them. As a reminder, the Communicator is not allowed to use their hands, touch the LEGOS, or put anything together when communicating with the Builder. The Communicator can go back and forth from the Builder to the Designer (in the hallway) as many times as needed (or until time runs out).
6. The Designer has two passes to look at the model for 30 seconds after the initial 3 minutes. They can do this while the Communicator is talking with the Builder.
7. When the 10 minutes are up, call time, bring the families together. Have the families look at everyone's structure and compare to the original.
8. Have Observers report out on what they saw. How did participants fill in their roles? What was challenging?

Scoring:

1 point will be awarded for each correctly placed piece in the right direction.



No Bones About It

Description:

Each family will compete to see who can assemble the most bones in a human skeleton correctly in 15 minutes.

Materials:

Each family will receive:

- Skeleton cut-outs, 2 sheets per family
- Official score sheet
- Ziploc bag (at the conclusion of the activity, to take skeleton home)
- Answer key (at the conclusion of the activity)

Space:

This activity will require flat area where families can work either on flat tables or the floor.

Volunteers:

2 volunteers are required. Be sure no cell phones are being used. Also keep track of when families have begun to work so you can stop them at 15 minutes and score their skeleton.

Competition:

For each family:

- Check in with facilitator. Receive the skeleton cut-outs and have the facilitator write the times (start and end) on the score sheet.
- Find a flat place to work, either on a table or the floor.
- Families will have 15 minutes to punch out individual skeleton pieces and construct the human skeleton as accurate as you can.
- NOTE *You are only allowed to use your family members for information.*
- No cell phones or any other means of information are allowed.

Scoring:

When the official scoring time is reached, let a facilitator know you are ready to be scored. The facilitator will use the answer key and score your skeleton.

- 1 point will be awarded for each correctly placed piece.
- To receive points, bones must be placed correctly and be oriented correctly. Bones placed backwards or upside down will not be given credit.



Whatever Floats Your Boat

Description:

Each family will compete to see who can design a boat made of modeling clay that will support the most washers without sinking.

Materials: (* materials not included in kit)

Each family will receive:

- Half stick of modeling clay (extra clay is provided, allow families 2 half-sticks if interested)
- Each family will have access to testing stations that include: dishpan half full of water, parchment paper, rolling pin, washers 3/8" flat, paper towels*

Space:

This activity will require 5 flat tables that will get wet and access to water. A Cafeteria is ideal. Each table will serve as a testing station for two families.

Volunteers:

2-3 volunteers are required.

Competition:

For each family:

- Explain to each team the challenge; get a piece of clay to float. After they successfully accomplish the first challenge allow them an opportunity to see how many washers their boat can support without sinking. Explain the materials they are allowed to use. Let them know they can use their hands to mold their boat and/or rolling pins. If they use the rolling pins, it is suggested that they wrap a piece of parchment paper around the clay to avoid sticking to the pin.
- Hand out a 1/2 stick of clay and head to a testing stations and begin to design your boat.
- Encourage teams to try their designs often. There is no limit to how many times they test their boat. Create, test, fail, fix, test again... Repeat
- After they have completed the first challenge, getting the boat to float, teams will begin to add washers until their boat sinks. Facilitator will determine sinking. Any boat that is taking on any water is sinking.
- Score is determined by how many washers their boat supported **before** the boat sunk.
- At the conclusion of the activity have each team write their name and # of washers their boat supported on a post-it note and place on the recording sheet.
- Allow a few minutes for each team to clean up their station for the next group.

Scoring:

During the test, whenever the boat is taking on water, it is disqualified for sinking. The number of washers before the disqualification will be scored. Highest number of washers will be the official score.



Time	Activities
2:00 - 4:30 pm	Volunteers arrive, set up spaces, tables, activities
5:00 - 5:30 pm	Families arrive.
5:30 - 5:40 pm	Introductions, explanations of rotations, thanks for coming
5:45 - 5:50 pm	Groups travel to their First Activity - Group A to Activity 1; Group B to Activity 2; Group C to Activity 3; Group D to Activity 4
5:50 - 6:10 pm	Families participate in their First Activity
6:10 - 6:15 pm	Groups travel to their Second Activity - Group A to Activity 2; Group B to Activity 3; Group C to Activity 4; Group D to Activity 1
6:15 - 6:35 pm	Families participate in their Second Activity
6:35 - 6:40 pm	Groups travel to their Third Activity - Group A to Activity 3; Group B to Activity 4; Group C to Activity 1; Group D to Activity 2
6:40 - 7:00 pm	Families participate in their Third Activity
7:00 - 7:05 pm	Groups travel to their Fourth Activity - Group A to Activity 4; Group B to Activity 1; Group C to Activity 2; Group D to Activity 3
7:05 - 7:25 pm	Families participate in their Fourth Activity (Families dismissed to go home from this final activity at 8:10 pm)
7:25 - 7:30 pm	Groups travel to their Fifth Activity - Group A to Activity 4; Group B to Activity 1; Group C to Activity 2; Group D to Activity 3
7:30 - 7:50 pm	Families participate in their Fifth Activity (Families dismissed to go home from this final activity at 8:00 pm)

Rotation 1	Rotation 2	Rotation 3	Rotation 4	Rotation 5
It Is Rocket Science	Digital Playground	Whatever Floats Your Boat	No Bones About It	Brick by Brick
Digital Playground	Whatever Floats Your Boat	No Bones About It	Brick by Brick	It Is Rocket Science
Whatever Floats Your Boat	No Bones About It	Brick by Brick	It Is Rocket Science	Digital Playground
No Bones About It	Brick by Brick	It Is Rocket Science	Digital Playground	Whatever Floats Your Boat
Brick by Brick	It Is Rocket Science	Digital Playground	Whatever Floats Your Boat	No Bones About It

Rotation 1
It Is Rocket Science - Multi-Purpose Room 5:50 - 6:10
Digital Playground - Learning Commons 6:15 - 6:35
Whatever Floats Your Boat - Cafeteria (Turn in your meal tickets here) 6:40 - 7:00
No Bones About It - Room 108 7:05 - 7:25
Brick by Brick - Room 112 7:30 - 7:50

Rotation 1
It Is Rocket Science - Multi-Purpose Room 5:50 - 6:10
Digital Playground - Learning Commons 6:15 - 6:35
Whatever Floats Your Boat - Cafeteria (Turn in your meal tickets here) 6:40 - 7:00
No Bones About It - Room 108 7:05 - 7:25
Brick by Brick - Room 112 7:30 - 7:50

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It Is Rocket Science - Multi-Purpose Room 5:50 - 6:10
Digital Playground - Learning Commons 6:15 - 6:35
Whatever Floats Your Boat - Cafeteria (Turn in your meal tickets here) 6:40 - 7:00
No Bones About It - Room 108 7:05 - 7:25
Brick by Brick - Room 112 7:30 - 7:50

Rotation 2
Digital Playground -Learning Commons 5:50 - 6:10
Whatever Floats Your Boat - Cafeteria (Turn in your meal tickets here) 6:15 - 6:35
No Bones About It - Room 108 6:40 - 7:00
Brick by Brick - Room 112 7:05 - 7:25
It Is Rocket Science - Multi-Purpose Room 7:30 - 7:50

Rotation 2
Digital Playground -Learning Commons 5:50 - 6:10
Whatever Floats Your Boat - Cafeteria (Turn in your meal tickets here) 6:15 - 6:35
No Bones About It - Room 108 6:40 - 7:00
Brick by Brick - Room 112 7:05 - 7:25
It Is Rocket Science - Multi-Purpose Room 7:30 - 7:50

Rotation 2
Digital Playground -Learning Commons 5:50 - 6:10
Whatever Floats Your Boat - Cafeteria (Turn in your meal tickets here) 6:15 - 6:35
No Bones About It - Room 108 6:40 - 7:00
Brick by Brick - Room 112 7:05 - 7:25
It Is Rocket Science - Multi-Purpose Room 7:30 - 7:50

Rotation 3
Whatever Floats Your Boat - Cafeteria (Turn in your meal ticket here) 5:50 - 6:10
No Bones About It - Room 108 6:15 - 6:35
Brick by Brick - Room 112 6:40 - 7:00
It Is Rocket Science - Multi-Purpose Room 7:05 - 7:25
Digital Playground - Learning Commons 7:30 - 7:50

Rotation 3
Whatever Floats Your Boat - Cafeteria (Turn in your meal ticket here) 5:50 - 6:10
No Bones About It - Room 108 6:15 - 6:35
Brick by Brick - Room 112 6:40 - 7:00
It Is Rocket Science - Multi-Purpose Room 7:05 - 7:25
Digital Playground - Learning Commons 7:30 - 7:50

Rotation 3
Whatever Floats Your Boat - Cafeteria (Turn in your meal ticket here) 5:50 - 6:10
No Bones About It - Room 108 6:15 - 6:35
Brick by Brick - Room 112 6:40 - 7:00
It Is Rocket Science - Multi-Purpose Room 7:05 - 7:25
Digital Playground - Learning Commons 7:30 - 7:50

Rotation 4
No Bones About It - Room 108 5:50 - 6:10
Brick by Brick - Room 112 6:15 - 6:35
It Is Rocket Science - Multi-Purpose Room 6:40 - 7:00
Digital Playground - Learning Commons 7:05 - 7:25
Whatever Floats Your Boat - Cafeteria (Turn in your meal ticket here) 7:30 - 7:50

Rotation 4
No Bones About It - Room 108 5:50 - 6:10
Brick by Brick - Room 112 6:15 - 6:35
It Is Rocket Science - Multi-Purpose Room 6:40 - 7:00
Digital Playground - Learning Commons 7:05 - 7:25
Whatever Floats Your Boat - Cafeteria (Turn in your meal ticket here) 7:30 - 7:50

Rotation 4
No Bones About It - Room 108 5:50 - 6:10
Brick by Brick - Room 112 6:15 - 6:35
It Is Rocket Science - Multi-Purpose Room 6:40 - 7:00
Digital Playground - Learning Commons 7:05 - 7:25
Whatever Floats Your Boat - Cafeteria (Turn in your meal ticket here) 7:30 - 7:50

Rotation 5
Brick by Brick - Room 112 5:50 - 6:10
It Is Rocket Science - Multi-Purpose Room 6:15 - 6:35
Digital Playground - Learning Commons 6:40 - 7:00
Whatever Floats Your Boat - Cafeteria (Turn in your meal tickets here) 7:05 - 7:25
No Bones About It - Room 108 7:30 - 7:50

Rotation 5
Brick by Brick - Room 112 5:50 - 6:10
It Is Rocket Science - Multi-Purpose Room 6:15 - 6:35
Digital Playground - Learning Commons 6:40 - 7:00
Whatever Floats Your Boat - Cafeteria (Turn in your meal tickets here) 7:05 - 7:25
No Bones About It - Room 108 7:30 - 7:50

Rotation 5
Brick by Brick - Room 112 5:50 - 6:10
It Is Rocket Science - Multi-Purpose Room 6:15 - 6:35
Digital Playground - Learning Commons 6:40 - 7:00
Whatever Floats Your Boat - Cafeteria (Turn in your meal tickets here) 7:05 - 7:25
No Bones About It - Room 108 7:30 - 7:50