School Maker Faires as Preservice Teacher Education

Supplemental Materials

This document includes a brief overview of each station, and the rubrics created by the preservice teachers.

**Station 1: Bird Feeders**

*NGSS Alignment*: K-ESS3-3; K-ETS1-2; 3-LS4-4

*Description*: Students are provided a wide variety of recyclable materials and asked to use them to design and construct bird feeders. Before beginning, students must select a specific, local bird for which to design. Students must account for bird size, food source, and habitat in their design decisions. Further, discussing habitat serves as an opportunity to also discuss human impact on the environment, which is also supported by using recyclable materials for the bird feeder design.

*Example Materials*: Bottles, spoons, paper towel rolls, string, oranges, egg cartons, bird feed

*Online Resources*: <http://www.audubon.org/bird-guide>; <http://www.birdsleuth.org>

*Example Assessment Rubric:*

|  |  |  |  |
| --- | --- | --- | --- |
|  | **1** | **2** | **3** |
| *Engineering/*  *Construction* | Student is not able to draw their model or build their bird feeder using the recycled materials. | Student is able to draw their model.  Student is able to create an actual model using the recycled materials but do not take into account how the bird feeder will hang or how it will disseminate the food.  They also may/may not consider the weight of the food or size of the grain. | Student has used recycled materials to create a bird feeder.  Student has made an apparatus for it to be hung.  Student has taken into account the weight and size of the food when thinking of how the food will be distributed.  Student has tested the bird feeder by hanging and checking to see if it is balanced and supported. |
| *Function* | Student is not able to build appropriate bird feeder for birds in this area and can not justify the purpose of their design. (Handout with types of birds, shapes of beaks, sizes of bodies, types of food, etc. will be provided.) | Student is able to use information provided about the birds in this area to guide the construction of their bird feeder but there are slight discrepancies. They can justify certain elements but not all elements of their bird feeder are supported by the type of bird chosen. | Student is able to use information provided about the birds in this area to guide the construction of their bird feeder and can justify why they chose to build certain elements of their feeder to fit a specific bird. |
| *Recycling* | Student is not able to communicate the benefits of using recycled materials for the environment.  Student is not able to communicate how humans have a negative impact on the environment. | Students can communicate the positive benefits of recycling  - or -  Students can communicate the negative effects of human impact.    (Not both) | Student is able to communicate the positive benefits of using recycled materials to create their bird feeder.  Student demonstrates understanding that humans have a negative impact on the land. (Both) |

**Station 2: Making Playdough**

*NGSS Alignment*: K-ESS3-3; K-ETS1-2; 5-PS1-4

*Description*: Students are provided with the ingredients necessary to make play dough. Students are tasked with finding the correct ratios of ingredients necessary to create play dough at a normal consistency and texture. Students are encouraged to experiment with the ingredients, and customize the play dough to their preferences defined in advance (e.g., sticky, smooth, clumpy, etc.) The students are expected to measure out ingredients in order to use mathematical and computational thinking.

*Example Materials*: Flour, salt, oil, water, cream of tartar, food coloring, glitter

*Online Resources*: <http://www.instructables.com/id/How-to-Make-Playdough-Play-doh/>; <http://www.pbs.org/parents/crafts-for-kids/no-bake-play-dough/>

*Example Assessment Rubric for Primary Grades:*

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Emergent**  **1** | **Developing**  **2** | **Applying**  **3** |
| *Explanation of Components* | Students cannot explain that one individual ingredient does not make up playdough. There is no explanation that to make playdough you need all ingredients. | Students can explain that we need all ingredients to make playdough, but cannot determine if it would still be playdough if we removed one ingredient. | Students can explain that no one individual ingredient can make playdough, but it’s the combination of all ingredients. |
| *Explanation of Creating a New Substance* | Students cannot explain that mixing the separate substances (the ingredients) creates a new substance (the playdough). | Students can explain that they mixed different substances together, but cannot explain that those original substances made a new substance when they were mixed. | Students can explain that when the different substances are mixed together they make a new substance (the playdough). |
| *Changing Colors* | Students cannot explain that mixing different colors of playdough together makes a new color of playdough. | Students can somewhat explain that mixing different colors of playdough does something, but cannot explain that it is a different color than the two that made it. | Students can explain that mixing two different colors of playdough together makes a new color of playdough. |
| *Describing the Characteristics* | Students cannot describe either the traits of the original substances, or the traits of the new substance. | Students can somewhat describe the traits of the original substances and of the new substance, but leave out important details. | Students can describe the characteristics of the substances when they were separate, and the traits of the new substance accurately. |

**Station 3: Lunar Lander**

*NGSS Alignment*: K-ETS1-2

*Description*: Design and build a vehicle that will land on the moon and protect the astronauts inside. Students must use every-day materials to design an object that safely transports a marshmallow (aka astronaut) after dropping from a designated height.

*Example Materials*: Paper plates, paper cups, straws, paper, cardboard, marshmallows

*Online Resources*: <http://teachers.egfi-k12.org/lesson-build-lunar-lander/>

*Example Assessment Rubric:*

|  |  |  |  |
| --- | --- | --- | --- |
|  | **1** | **2** | **3** |
| *Modifications* | Students made no modifications to their lunar lander after the test  OR  Students made modifications to their lunar lander after the test and modifications were unsuccessful. | Students made some modifications to their lunar lander after the test that improved the design and made the next test successful. | Students made thoughtful modifications to their lunar lander that improved the design and led to a successful next test. |
| *Explanation* | Students were unable to explain modifications that were made, if any  AND  Students were unable to explain why their design was or was not successful. | Students explained what modifications they made and why  AND  Students explained why they thought their design was successful. | Students explained what modifications they made, why they made them, and how they helped their lunar lander successfully land  AND  Students explained why their design was successful and how the modifications helped their overall design. |
| *Successful Landing* | The student’s design did not remain in tact upon landing and/or the marshmallows fell out upon landing. | The student’s design remained fairly in tact upon landing and the marshmallows were secure. | The student’s design remained completely in tact upon landing, with minimal bouncing and/or tipping, and the marshmallows were secure. |

**Station 4: Magnetic Painting**

*NGSS Alignment*: 3-PS2-3

*Description*: Students will use magnets to paint. First, students must identify which objects will attract and repeal from one another. After, students place paint and magnetic objects on paper plate (or piece of paper), positioned in the cardboard box. Students use the magnetic wand to move the magnetic objects around through the paint, creating art.

*Example Materials*: Paint, paper plates, cardboard box, magnetic wand, magnetic objects (e.g., screws, washers)

*Online Resources*: <http://www.kidsplaybox.com/art-activities-kids-magnetic-painting/>

*Example Assessment Rubric:*

|  |  |  |  |
| --- | --- | --- | --- |
|  | **1** | **2** | **3** |
| *Scientific Procedures and Reasoning Strategies* | Doesn’t explain cause and effect relationship with magnet and/or materials. Doesn’t use correct terminology. (i.e. “these ones” instead of metals or magnets, etc.)  Unable to make predictions of which materials respond to a magnet wand. Assume all materials move according to a magnet wand. | Explanation is limited or without justification (i.e. “I think the coil/bolt/circle will move.”) | Explanation gives a prediction and a reason to justify. (i.e. “I think some materials will move because of the way the wand and the materials interact with each other,” or talks about the relationship between the want and the materials) |
| *Scientific Concepts and Related Content* | Unable to explain the magnetic force between objects and a magnet wand. | Limited understanding of the magnetic force between objects. Student may know that things can be magnetic and attract other things, but not able to explain that things like distance and weight affect the magnetic force or pull between objects. They may not be able to understand why the wand isn’t as powerful when a magnetic object isn’t as close to the wand. | Understands that magnetic force between a pair of objects do not require that the objects be in contact with each other. Also understand the factors that affect the strength of the force (properties, distance, orientation). |
| *Using Data Scientific Concepts* | Unable to make predictions of which materials respond to a magnet wand. Assume all materials move according to a magnet wand. | Able to identify objects that are attracted to magnets by looking at the materials, but does not understand scientific reasoning. | Able to sort objects into two groups--magnetic vs. non magnetic and understands one groups is attracted to magnets. |

**Station 5: Magazine Art**

*NGSS Alignment*: 4-PS3-2; K-ESS3-3

*Description*: Students create beads for bracelets and necklaces out of recycled magazines. Further, this activity provides an opportunity to discuss the process of recycling, which takes time and energy and produces carbon emissions. Finding a way to reuse paper goods ourselves reduces energy use in recycling.

*Example Materials*: Old magazines, glue sticks (or glue and paint brushes), scissors

*Online Resources*: <http://www.instructables.com/id/Make-a-RECYCLED-PAPER-BEAD-Bracelet/?ALLSTEPS>

*Example Assessment Rubric:*

What do humans do to hurt the environment? [Do you know why/how that hurts the environment?]

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 | Level 6 |
| Provides no answer. No clear understanding | Provides one example of what humans do to hurt the environment. | Provides two examples of what humans do to hurt the environment. | Provides three example of what humans do to hurt the environment. | Provides 3 examples of what humans do to hurt the environment.  Can begin to explain how they hurt. | Provides at least 4 ways humans hurt environment. Can explain *why or how* their examples produce harm. |

What do humans do to help the environment?

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 | Level 6 |
| Provides no answer. No clear understanding. | Provides one example of what humans do to help the environment. | Provides two examples of what humans do to help the environment. | Provides three example of what humans do to hurt the environment.  And a rationale for why/how that hurts the environment. | Provides 3 examples of what humans do to help the environment.  Can begin to explain how they help. | Provides at least 4 ways humans help environment. Can explain *why* or *how* their examples help. |

**Station 6: Make a Game Controller**

*NGSS Alignment*: 1-PS4-4; 4-PS3-2; 4-PS3-4

*Description*: Students explore computer programming and electronic circuits using a Makey Makey – an electronic invention tool that allows users to connect everyday (conductive) objects to computer programs created in Scratch. Using a circuit board, alligator clips and a USB cable, students can build complete circuits to send signals to the computer through every day objects. For example, a banana can serve as the computer’s space bar! In this activity, students were tasked with programming a game controller.

*Example Materials*: Computer with Internet access, Makey Makey (circuit board, alligator clips, USB cable), everyday (conductive) objects.

*Online Resources*: <http://makeymakey.com/education/>; <https://scratch.mit.edu>; <http://makeymakey.com/lessons/game-controller-challenge/>

*Example Assessment Rubric:*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Beginning** | **Emerging** | **Developing** | **Advanced** |
| *Drawing of device and description or code for system of communication* | Students’ drawing does not convey the setup of the device and their description does not convey how the system works. | Students have an incomplete drawing of their device.  Students have a vague or incomplete code or description for how they will transmit messages. | Students have a complete, though general, drawing that depicts their device.  Students have an established code that will allow them to transmit a limited amount of messages  OR they have a description of how they will transmit a limited amount of messages | Students have a detailed drawing that clearly depicts all the elements of their device.  Students have an established code that will allow them to transmit a wide variety of messages  OR they have a detailed description of how they will transmit a variety of messages. |
| *Description of how device/system solves the problem of communicating over long distances* | Students cannot describe how their device allows people to communicate over long distances. | Students partially describe how their device/system sends or receives information. | Students describe how their device/system sends and receives information. | Students describe how their device/system uses light and/or sound to send and receive information. |
| *Rationale behind choices for materials, device, system* | Students have no rationale for why they chose their materials and why they designed their device/system the way they did. | Students can only partially explain the rationale behind their materials and design  OR  Their rationale is not logical. | Students have a logical reason for their choice in materials and the design of their device/system. | Students have a logical reason that they can thoroughly explain for each of the choices they made as they selected materials and designed their device/system. They can explain how their choices improve the functionality of their device/system. |

**Station 7: Recycled Boats**

*NGSS Alignment*: K-2-ETS1-1; K-2-ETS1-2; 3-5-ETS1-1; 3-5-ETS1-2

*Description*: Students will be given an assortment of materials to create something that floats. Then, students will test how much weight (e.g., pennies) each boat can hold when floating in water. After, the teacher can facilitate a discussion contrasting each of the boat designs to determine why certain designs were able to support more weight than others. Students may be given another opportunity to redesign their boats using the new information they learned.

*Example Materials*: Cardboard, paper, cups, paper plates, straws, pennies

*Online Resources*: <http://inspirationlaboratories.com/how-to-build-a-boat/>

*Example Assessment Rubric:*

|  |  |  |  |
| --- | --- | --- | --- |
|  | *Ability to Plan* | *Reflection & Re-design* | *Buoyancy* |
| **Proficient**  **(3)** | Develop a detailed sketch to illustrate how the shape of the boat helps it function. Includes labels of what materials they used. | Clearly states a design problem *or* wish for more improvement, and illustrates plan for re-design. (i.e., identifies problem = boat does not float. Shows plan for re-design in order to fix problem) | Final design reflects evidence that their design would float. |
| **Somewhat**  **Proficient**  **(2)** | Develop a simple sketch to illustrate the shape of the boat.  Includes some labels of materials. | Identifies a simple design problem, but is not sure what needs to change in order to fix it. | Design has some buoyancy, but does not remain at the surface. |
| **Not**  **Proficient**  **(1)** | Draws a sketch that is hard to understand. | Redesign does not reflect an improvement OR there is no redesign attempted. | The design does not float. The materials chosen suggest that the student does not have a good understanding of materials  which are buoyant. |

**Station 8: Balloon Rockets**

*NGSS Alignment*: K-2-ETS1-3; DCI: ETS1.C

*Description*: Students make balloon-powered rockets. They experiment to see which design elements make the rocket travel a farther distance. Students can test different designs and make observations on how the size of the balloon correlates to how far the rocket traveled.

*Example Materials*: Balloons, toilet paper rolls, paper towel rolls, string, straw, tape

*Online Resources*: <https://www.scientificamerican.com/article/under-pressure-launch-a-balloon-rocket/>

*Example Assessment Rubric:*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Advanced** | **Proficient** | **Somewhat Proficient** | **Not Proficient** |
| *Data Analysis* | Student is able to identify the better design for the problem and give a reason why | Student is able to identify the better design for the problem | Student identifies the incorrect design but is able to give a reason. | Student is unable to identify which design is better or identify the incorrect design. |
| *Physical Science Understanding* | Student understands that the air in the balloon pushes the car forward or relates to letting a balloon go and it flying around the room. | Student understands that the balloon makes the car go. | Student is able to identify some aspects of necessary car parts (ie identifies the wheels as making the car go) | Student is unable to identify what is making the car go or gives an unrelated response (ie the colors) |

**Station 9: Squishy Circuits**

*NGSS Alignment*: 4-PS3-2

*Description*: Students use conductive (and insulating) playdough to build circuits. Students can light up LEDs using battery packs that supply electricity. Students can explore series and parallel circuits, as well as add motors and sensors.

*Example Materials*: Conductive playdough, insulating plaudough, LEDs, battery packs

*Online Resources*: <http://courseweb.stthomas.edu/apthomas/SquishyCircuits/>

*Example Assessment Rubric:*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Advanced (4)** | **Proficient (3)** | **Basic (2)** | **Below Basic (1)** |
| *Identification* | Student is able to verbally identify all the components of the circuit (battery, LED, play dough, wires) and explain the relationship among them. For example: The wires help electricity travel from the battery to the LED. | Student is able to verbally identify all components of the circuit (battery, LED, play dough, wires). | Student is able to verbally identify at least two components of the circuit, not naming all four but missing one or two (battery, LED, play dough, wires). | Student is unable to verbally identify the components of the circuit (battery, LED, play dough, wires). |
| *Function* | Student is able to verbally state the function of all four components of the circuit (battery, LED, play dough, wires).  For example:  1. The battery gives the wires energy  2. The wires help electricity travel from the battery to the LED.  3. The play dough acts like a wire and help give the LED lights electricity.  4. The LED lights up in response to the electricity supplied to it. | Student is able to verbally state the function of at least 3 components of the circuit (battery, LED, play dough, wires).  For example:  1. The battery gives the wires energy.  2. The wires help electricity travel from the battery to the LED.  3. The play dough acts like a wire and help give the LED light electricity. | Student is able to verbally state the function of at least 1-2 components of the circuit (battery, LED, play dough, wires)  For example:  The battery gives the wires electricity. Or, the battery is the power source. | Student is unable verbally state the function of any component of the circuit (battery, LED, play dough, wires). |
| *Picture* | Student’s picture of the circuit  demonstrates an understanding of four the components needed to complete the circuit and are in the correct place.  For example: The picture includes the battery pack, the wires being connected to each of the separated play dough parts as well as the LED light.    AND includes a loop of electricity to show the circular path electricity travels in. | Student’s picture of the circuit demonstrates an understanding of the four components needed to complete the circuit and are in the correct place.  For example: The picture includes the battery pack, the wires being connected to each of the separated play dough parts as well as the LED light. | Student’s picture of the circuit demonstrates at least two of the components, and/or some may be depicted in the wrong place.  For example:  The picture includes the battery pack and the LED lights but the play dough parts are touching. | Student’s picture of the circuit is  unrelated and does not show the four components of the circuit (battery, LED, play dough, wires). |

**Station 10: Stomp Rockets**

*NGSS Alignment*: 3-PS2-1

*Description*: Students can work in groups or individually to create stomp rockets, use their scientific knowledge to classify different rockets, and which ones will go higher than others, then develop hypotheses about which of the student made rockets will go highest, supporting their claims with evidence from trials.

*Example Materials*: Rocket launcher (can make or buy), paper, glue, scissors, tape, cotton, rocket template (free download in links provided below)

*Online Resources*: <http://www.instructables.com/id/Paper-Stomp-Rockets-Easy-and-Fun/>; <http://www.jpl.nasa.gov/edu/teach/activity/stomp-rockets/>

**Station 11: Car Races**

*NGSS Alignment*: ETS1.A; 3-5ETS1-2; K-2-ETS1-2; K-2-ETS1-3

*Description*: First, students draw a model of their car design. Next, students construct “cars” from bins of Legos and/or other materials in order to race their cars down a ramp. Teachers and students can determine what makes a car “successful.” Perhaps the winning car is the fastest or travels the farthest. Students can redesign their cars after their tests to better align with the predetermined constraints.

*Example Materials*: Legos, cardboard, CDs, rubber bands, scissors, glue, tape

*Online Resources:* <http://www.instructables.com/id/Using-Home-Materials-to-build-Car-toy/>

<http://www.instructables.com/id/Lego-Car-Race-Ramp/>; <http://tryengineering.org/lessons/rubberbandracers.pdf>