**Creating Ice Cube Insulators Using the Fab Lab**

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**Teacher(s): Richelle Jochem**

**Grade Level:** Middle school, but can be adapted up or down several grade levels.

**Lesson Length**:

Designing of boxes: 1-2 class periods, based on experience with software/drawing.

Building of boxes: 2-3 class periods, based on number of students using machines.

Testing of boxes, reflection, assessment: 1 class period

**Background/Context:**

 Students will create ice cube insulating boxes (at least 2) to test out materials that act as insulators. The boxes will need to be designed and created in the fab lab. Box designing will have to take place before this lesson begins. Box designing will be based on your ability to access software and programs. For example: Tinker cad is a free online program that is compatible with most 3-D printers. Students will need to measure the size of a standard ice cube before they begin their designs. If you’d like to get really creative, there are various ice cube tray molds available such as snowman molds.

**Resources and Materials:**

* Access to computers (students will need to access their designs).
* Various fab lab materials: foam insulation, cardboard, plastic filament, wood, Styrofoam, cardstock, fabric, tinfoil, etc.
* Fablab manager to help students use machines.
* Ice Cubes
* Thermometer

**Key Terms:**

* Conductor
* Insulator
* Thermal energy
* Heat transfer
* Temperature

**Standards/ “I can” Statements**

Next Generation Science Standards Covered:

|  |  |
| --- | --- |
| MS-PS3-3. | Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.\* [Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.] |

* I can create and design an insulator box for an ice cube.
* I can build several of my insulator boxes using differing fab lab materials and equipment.
* I can test my insulating boxes for heat transfer to determine what material works as the best insulator.

**Career Cluster links:** Engineering and Technology Pathway

**Procedure:**

Introduction/Hook:

Pose the following question to students: “What if you lost your lunch box on the first week of school. Your parent was really upset, and told you they would not buy you a new one. They told you to feel free to use materials around the house to build your own new lunch box.” You really enjoy your cold lunch/drink each day and need to find materials to build the best insulating lunch box you can.

Instruction:

1. Students come prepared to the fab lab with their designs for their ice cube insulators.
2. Students should have an idea about what 2 (or more) materials they’d like to build their boxes with (based on fab lab material availability).
3. Students will use various fab lab machines to build their ice cube insulator boxes. (At least 2 will need to be built in order for students to compare/contrast materials as good/poor insulators).
4. Once all students have at least 2 boxes created, return to the classroom to test the insulating abilities of the box.
	1. At this time, students will place an ice cube in each of their boxes, at particular time increments, students will take time/temperature readings of their ice cubes within the box. They should also take qualitative data on the observations they notice.
	2. After data has been complied, students will write reflective statements about what box material provides the best insulating properties.

Closing:

Students will share and compare their data as a classroom. Class with decide upon which material is the best insulator and why.

**Assessment:**

* Pre-assessment: Discussion of what materials (out of those available) students feel will be the best insulators for their boxes and why.
* Formative: Teacher questioning during testing of boxes.
* Summative: Students reflective statements written after testing of boxes.

**References:**
Original idea of testing insulators taken from “Save the Penguins” Stem Lesson plan by Christine G. Schnittka. <http://www.auburn.edu/~cgs0013/ETK/SaveThePenguinsETK.pdf>

**Attachments:**

-None at this time.

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**Reflection/Notes:**