UCONN

NEAG SCHOOL OF EDUCATION

Girl Scout Lesson

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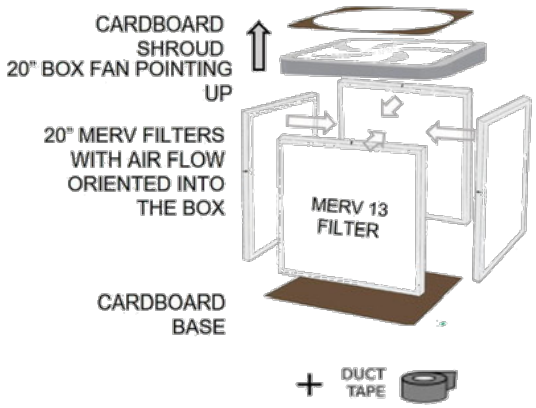
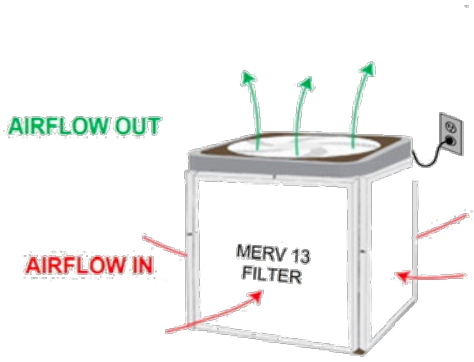
Unit Title: Corsi-Rosenthal Box Learning Modules
Science Area Focus: Engineering, Physical Science

Note: These instructional materials were co-developed by two graduate students and a professor/researcher in science education and in the Neag School of Education

Do-It-Yourself Box-Fan Air Filter, the Corsi-Rosenthal Box





Background Resources :

- How to build a C-R Box

Scientific Themes:
Air quality and human health

Objective:
To understand the impact of airborne pathogens such as COVID-19 on human health, how COVID-19 spreads through the air using water aerosols, and how air filtration systems can be used for protection against these effects.

Students will learn about :

- What factors cause COVID-19 and other airborne pathogens to spread rapidly through human populations
- How air filtration helps to reduce the spread of COVID-19 and other airborne pathogens
- How air quality impacts human health and can allow the rapid spread of pathogens

Agenda:

- Open Discussion (15 minutes)
- Activity #1: Building the Corsi-Rosenthal Box (35 minutes)
- Activity #2: Reflection using Models (15 minutes)
- Closing the lesson (10 minutes)

Activity Details

Time Needed : 90 minutes

Materials :

- **For the C-R Box**
  - four 1" or 2" MERV 13 filters
  - 20-in box fan with box
  - 20" x 20" cardboard square (make from fan box)
  - Duct tape
  - Scissors
- **For the models**
  - Large paper
  - Markers
  - Scissors
  - Tape

Lesson Plan Outline

Open Discussion (15 minutes)

1. The lesson will begin with explaining to students what the objective of today's lesson is and asking a series of questions for students to begin thinking about the topic and/or assess their initial understanding.
   a. *"Today we will be learning about the importance of air quality and how it affects our health."*
      i. *Why do you think air is important to us?*
      ii. *How can the air get "dirty"?*
      iii. *What happens if we breathe in "dirty" air?*
2. The discussion on air will transition into the impact of the COVID-19 pandemic on communities by asking them the following questions :
   a. *What do you remember or understand about the COVID-19 pandemic? Is there anything that you're still experiencing from the pandemic right now?*
   b. *What are some of the challenges that are experiencing from the COVID-19 pandemic?*
   c. *What do you think about when you hear the phrase, "air quality"?*
      i. If the instructor notices students are struggling to respond, they may ask the following question to help elicit student responses : "Where do you see differences in air quality?" or "Where do you see differences in how the air looks or smells?". See if the students are able to make connections to their everyday lives such as being around smokers, being near a diesel truck, smelling spilled gas, etc.
   d. *How do you think "air quality" relates to the COVID-19 pandemic?*

Activity #1 : Building the Corsi-Rosenthal Box (35 minutes)

1. Begin activity asking the following questions :
    a. *Now that we've seen a demonstration of how far aerosols can travel, including staying suspended in the air, we want to understand how to reduce the spread*
    b. *Can anyone think of examples of where they've had to separate two things from each other?*
        i. When students give examples, make sure to ask the follow up question : *What is being separated from each other and what is causing the separation?*
        ii. If students are struggling with providing examples, the instructor may ask, "*Has anyone seen or used a strainer? Can you describe what you saw?"* or *"Does anyone have fish at home? Do you know what keeps the water so clean?"* These could be some leading examples.

2. After students have given examples, the instructor will begin explaining what the students will be building a Corsi-Rosenthal-box and the purpose of filtration.
    a. *This idea of separation is similar to the process of filtration. A filter is a device used to remove unwanted particles from something. For example, a strainer can help us remove the rocks from a mixture of rocks and water. Today, we are going to be building a Corsi-Rosenthal box which will be a filter that can help us reduce the amount of virus-containing aerosols in the air.*

3. Begin direct instruction on how to assemble the Corsi-Rosenthal box. Be sure to be explicit in stating that this is going to be an air filtration device where we are pulling air into the box and tiny aerosols, dust, pollen, mold are more will be trapped in the filter media. Prompting students for each part of the instruction will be important. Watch this video (https://indoorairquality.initiative.uconn.edu/build-your-own/) for a good step by step instruction that highlights how to prevent common errors while building. While building the components, the instructor will be asking the students questions to support their sense-making about how the CR box works.
    a. *We are going to start with building the "box" of the Corsi-Rosenthal-box. We are going to connect all four of the filters together. We want to make sure that the arrows on the filters are facing inwards and the filters are arranged to form a square, NOT a rectangle.*
        i. *Why do you think it is important for the filters to face inwards before we attach the fan? (the filters are not bi-directional)*

    b. *The next step is to make sure that the four filters are taped together and there are no gaps or openings all along the edges.*

        i. *Why do we need to make sure that the corners of these filters are sealed and there are no gaps or see-through areas?*
            1. We are trying to ensure students understand that air can go through these gaps. We want the air to be going through the filter. Highlight the path of least resistance.

ii. Next, cut out a 20" x 20" square of cardboard from the box the fan came from, and tape it to the **bottom** of the box.

iii. *Now we will be building the **top** of the box by attaching the fan.*

iv. *How does air interact with a fan?*

1. Check for students' understanding related to what the is - the slanted blades create a drop in air pressure as they spin that causes air from the higher pressure outside air into and through the fan. (Optional resources for instructors How Ceiling Fans Works & Electric Fan)

v. Ask students to test the fan by putting a piece of paper in front of it.

1. *Which side of the fan is "drawing air in" and which side is "drawing air out"?*
2. *What differences on each side of the fan may help with this?*
    a. Check for students' understanding that the fan blades are shaped in such a way that it draws air in and then pushes air out.

vi. After students have determined which way the air is flowing through the fan, ask the following question

1. *Which way do we think the fan should be attached to the filter box if we know COVID-19 particles are where we are standing?*
    a. Check for students' understanding that the fan should be positioned to pull air in from the surrounding area, through the filter media, into the box and the clean air exits the box from the top, propelled by the fan

2. Model for students on how to attach the fan. Show students where air might leak out. Instruct students that there will be a lot of duct tape used.

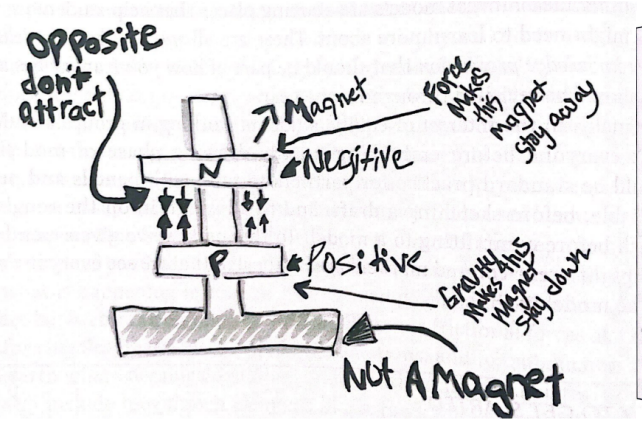
3. Ask the following question to help instruct students to add duct tape to their box.
    a. *Where do you think we may need to add more duct tape to avoid leaks?*
        i. Check for students' understanding that the corners of the box need to be taped to ensure that the only path the air can travel is through the filters, not through gaps.

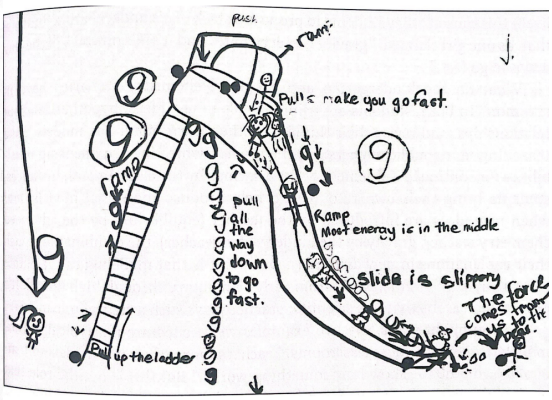
Activity #2 : Reflection using Models

1. After students have completed assembling their CR box, ask students to draw models to explain how the CR box works using the Modeling Template [Linked here]. Make sure to explain the purpose of why we are drawing models. While many types of models are possible (before/during/after, environmentally-based that include surroundings as well), the students will work to create a diagram that centers around the box and its anatomy.
    a. *Now that we've built a Corsi-Rosenthal box air cleaner, we are going to take some time to draw a model on how we think this box works. What happens inside and outside of the*

box to help reduce the spread of bad aerosols? Drawing models will help us visually see something that we don't normally see in our everyday lives. This will help us better understand what we built today and learned.

b. *Here is an example of a model (show image of model). Notice how there are drawings but also words to demonstrate how the person or group that created the model believes it works and to help other people who might see the model understand what the model is showing. We want to make sure in our model that we show what is happening inside and outside of our CR-box so that we have thought through what is important and so that other people can understand how a filter works and why it is important.*





2. Before allowing students to draw their own models in groups, advise students to make sure their model does the following
    a. Demonstrates the direction in which air is flowing
    b. Demonstrates why the air filters have to be facing a certain way (inward as indicated by arrows on the sides of their frames)
    c. Demonstrates an idea of what particles and pathogens might be pulled into the box
    d. Text explaining what is happening along each step for the journey of a pathogen going through the filter (text boxes or similar writing that could be describing that "here is where air is being pulled in by the fan" "air is being pushed out through filter" "particles are lodged/stuck in the filter material" etc.)
3. While students are making their models, instructors will walk around and ask questions to help students create their models. The following questions can be asked to help the students if they are struggling
    a. For students trying to show air flow, some ways of asking about it could be:
        i. *What are some ways to show that air is moving?*
        ii. *How might you tell your audience what is happening in this part of your model?*
        iii. *Now that you have shown the direction of air movement, how can you describe in words why it is important we know this?* (can be used to lead students to labeling parts of the diagram with text or text boxes to show their understanding of the process)
        iv. *What is something important that we talked about with air flow? How should it be moving?* (asking about direction)

v. *Why is it that the filter has to be facing a certain way? Could you talk more about this in your model?*

b. For students drawing the box, who seem to be struggling to label the parts or materials of the box, some possible questions could include:
   i. *I see you have finished drawing the box, do you remember some of the materials we used to put it together?*
   ii. *For these materials, could you describe to your audience why they are important for building the box?*
   iii. *I see you have finished drawing the box, what are some things about the box that you think are important to know?*

c. For students who have drawn the box, labeled it, and also demonstrated air flow components, and are now onto thinking about particles and pathogens:
   i. *So now that you have shown us how air is flowing, and that the filter is facing a certain direction, can you show us why it has to be this way?* (can lead back to or be used to reinforce question a-v if student is still struggling)
   ii. *So you know that the filters are designed to separate pathogens and particles from the air, can you show us some of these with your model?*
   iii. *I see you have added some air particles and pathogens like Covid around your box, can you describe how the filter is taking them out of the air? Why is this important to know?*

Closing the lesson (10 minutes)

1. Ask students to switch models with another group to observe the similarities and differences in their models.
2. After students have looked at another model, ask students : *What did you learn about from today's activities and the models?*
3. Encourage students to share with their families what they did today, learned, and ask family members what they think about their models and what they might add, if anything.