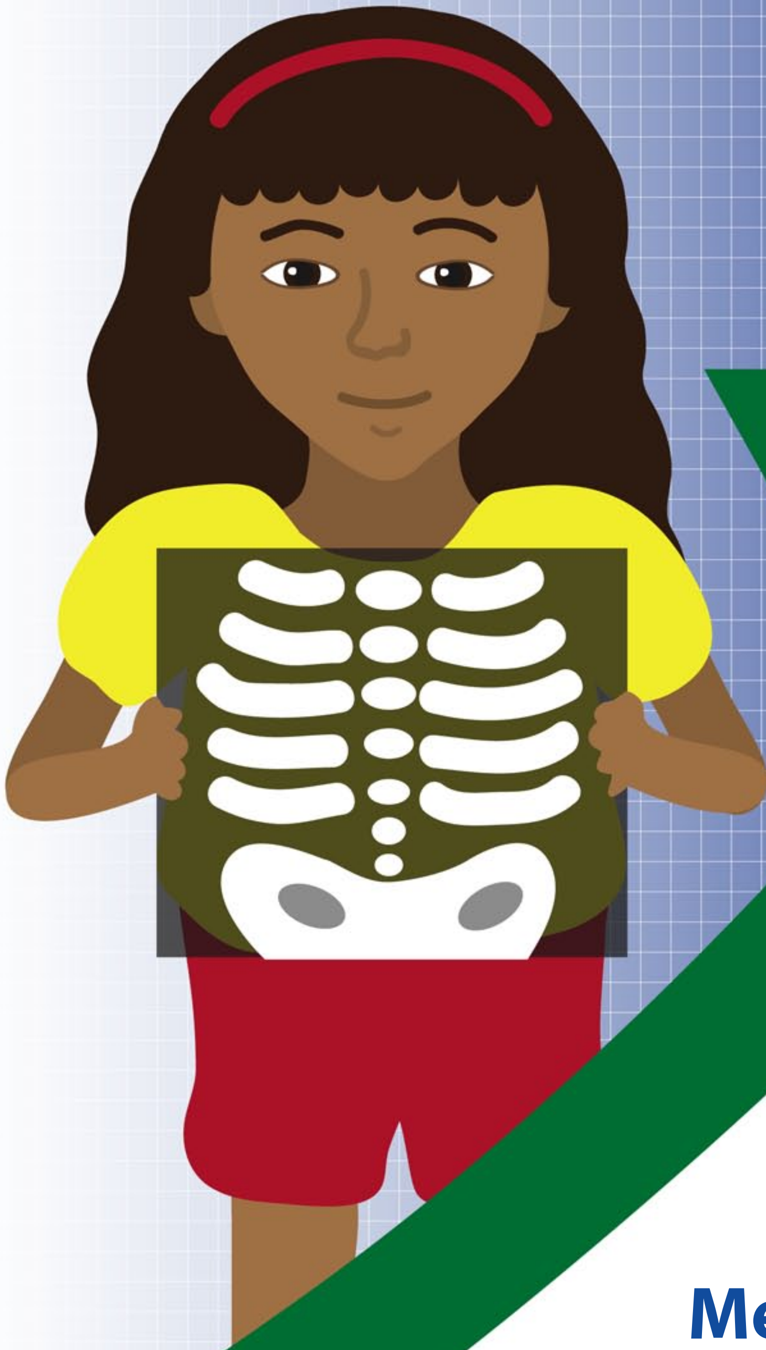


Medical Technology for the Developing World

TechXcite Discover Engineering

Youth Handouts

Activity 1: Solar Imaging

Name: ______________________________ Date: ______________

Materials List

- Sunprint© photo paper
- Sunprint© kit developing supplies
- Leaves or flowers
- Small aluminum pan
- Water

Procedure

1. Gather a few leaves or flowers of varying thickness or composition and arrange your objects on top of the Sunprint© paper.

   Note: Direct sunlight will expose the paper quickly and even ambient light in the shade or from a window will cause slow exposure so keep the paper out of the reach of the sun until the last minute.

2. Take the Sunprints outside and lay them in direct sunlight for 5 minutes. The areas exposed to the sun will turn from blue to white. When most the color disappears, the print has been fully exposed. The paper will continue to react until it is rinsed in water.

   Note: If it's cloudy, the process may take up to 20 minutes depending on the thickness of the clouds.

3. Rinse the prints in a pan of water. The white will turn blue and the blue will turn white. Leave it in the water for 2-5 minutes to get the deepest blue. If you are going to rinse it inside, block light from the paper while taking it indoors.

4. Examine each other's prints and identify some of the objects.

Exploration Questions

1. Explain what happened when the objects were placed on the photosensitive paper.

2. Were some objects reproduced on film more clearly than others? If so, which ones and why?

Activity 2: Density of Materials

Name: ______________________________ Date: ______________

Materials List

- Wood ball (5/8” dia)
- Wood ball (2½” dia)
- Marble (5/8” dia)
- Steel ball (5/8” dia)
- Plastic cup (16 oz)
- Water

Procedure

1. Discuss with your group the similarities and differences between the objects. Which objects do you think will float or sink when placed in water? Record your predictions in the chart below.
2. Test your predictions by placing the objects in the cup of water.
3. Record your observations in the chart below.

	Prediction	Observation
Large wood ball		
Small wood ball		
Marble		
Steel ball		

Exploration Questions

1. What causes an object to float or sink?

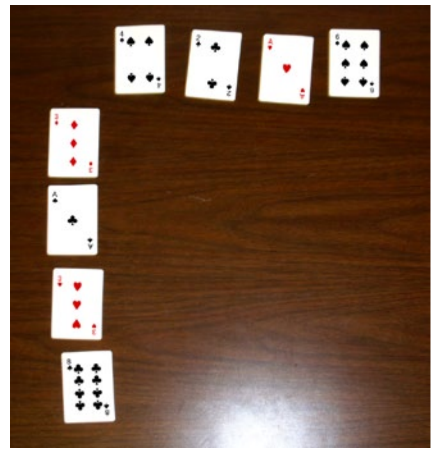
2. Would the same objects float or sink if the liquid was changed from water to syrup? Why?

Activity 3: What is Computed Tomography?

Name: ______________________________ Date: ____________

Materials List

- Deck of cards
- Markers or colored pencils

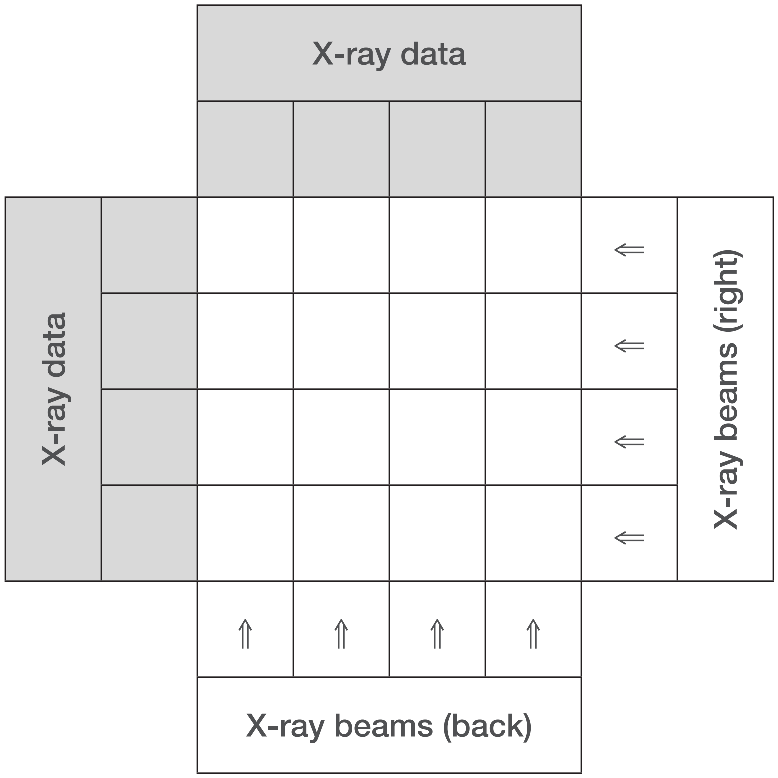


Procedure

1. Remove the kings, queens, and jacks from the deck, and use the ace as a 1. Shuffle the deck.
2. Imagine each playing card represents the data collected from an X-ray beam that passed through a section of your patient's head. The value of the card is the beam's measured intensity on the X-ray film. The lower the intensity, the more dense the tissue it passed through.
3. Randomly select 8 cards. Line up four cards horizontally and four cards vertically around a 4-by-4 grid (see example). Record the value of each card the "X-ray data" section of the diagram on the next page.
4. Each beam passes through four points in the head. To find out the density of one of those points, combine the data from both beams that pass through the point (for each square in the grid, add the card value at the top of the column to the card value in the row to the left).
5. Write the answer in its corresponding space on the diagram.
6. Color in the boxes using the color code below. This allows you to see an image similar to what a doctor would see when looking at a CT scan. In this case, a computer algorithm would assign a color or shade to each value in the cross section to produce a density map (or image).
7. Tumors are often more dense than healthy tissue. The section that blocks the most X-radiation from both sides of the head is the most dense. Which point is most likely to be a tumor in your image?

Number	Color
1-3	Red
4-6	Orange
7-9	Yellow
10-12	Green
13-15	Blue
16-20	Purple

Activity 3: What is Computed Tomography?



Exploration Questions

1. How does CT differ from a standard X-ray?

2. What are some advantages of CT over a normal X-ray?

Activity 4: Ultrasound and Submarines

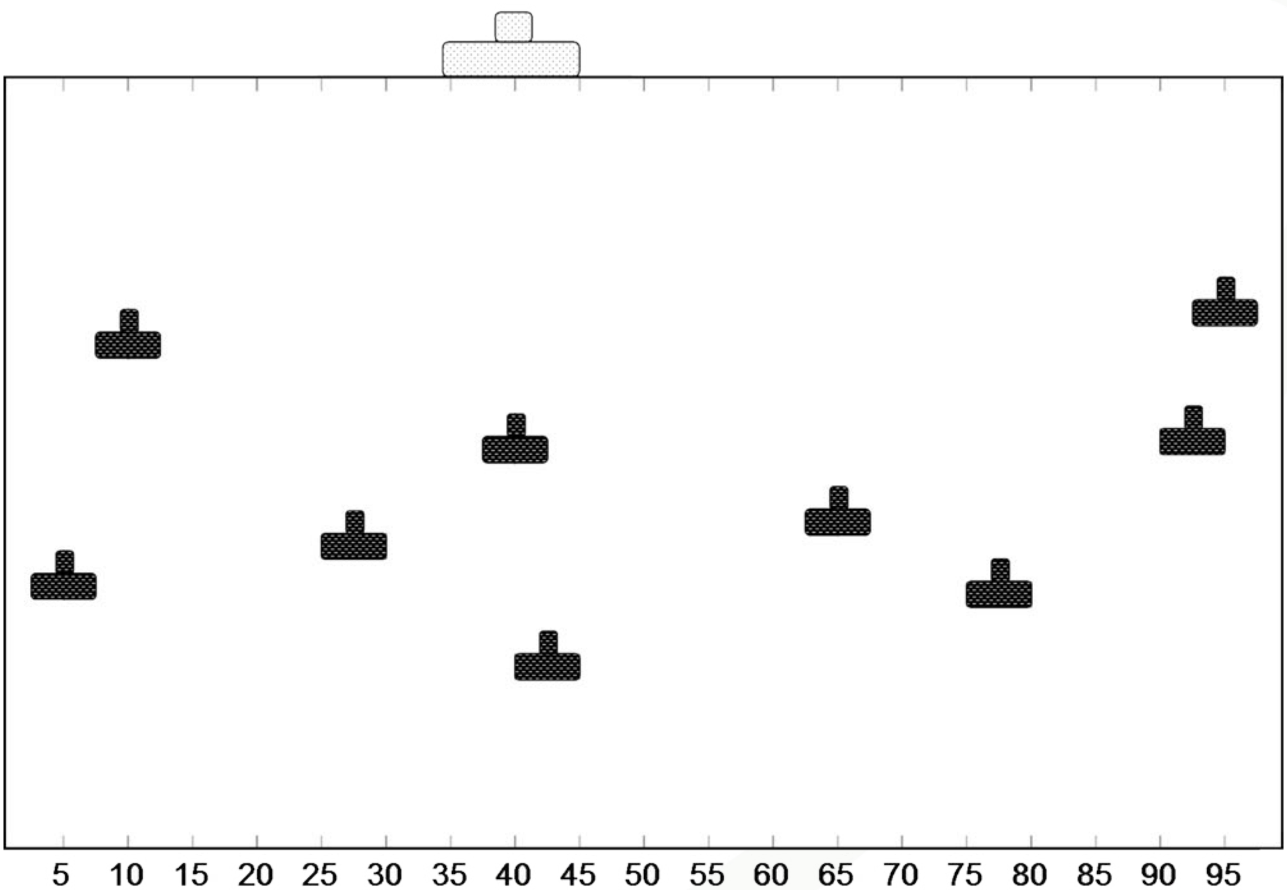
Name: ______________________________ Date: ______________

In the image below, a submarine at the surface needs to survey an underwater area 100 meters across. It can only use its sonar in bursts because it must listen for the echo to detect the objects. Help the submarine identify all of the objects below it that are at least 5 meters long and figure out the smallest interval between bursts that will still give an accurate reading.

Procedure

1. Starting from the left, draw vertical lines every 10 meters from the surface to the ocean floor.
2. How many submarines did your sonar hit (intersect)? How many did it miss? Record your answer in the chart provided below.

   Note: if the survey line does not clearly pass *through* the object (i.e. just touching the edge), it doesn't count as a hit. Also, if a survey line passes through an object more than once it only counts as one hit.
3. Repeat steps 1 and 2 with an interval of 5 meters.
4. Repeat steps 1 and 2 with an interval of 2.5 meters.



Activity 4: Ultrasound and Submarines

Interval	Hits	Misses
10 meters		
5 meters		
2.5 meters		

Exploration Questions

1. How far apart must your survey lines be to accurately detect all of the submarines in the field?

2. How does this number relate to the 5 meter minimum object size?

Activity 5: Imaging with Sound

Name: ______________________________ Date: ______________

Materials List

- Box or other small box with lid
- Pair of wooden chopsticks
- Ruler
- Graph paper
- Corrugated cardboard
- Objects for bottom of "sea floor"
- Markers
- Masking tape
- Scissors

Procedure

1. First, make a locator to take depth readings at specified positions. Remember, you should be able to tell precisely where your locator is in relation to the edges of the box and how deep the locator goes when taking your reading. Also keep in mind the size of the objects.

2. Draw a map of the terrain you plan to use. Before you receive supplies, you must show the instructor your locator and terrain design.

3. To build the 3D terrain, tape the graph paper onto a piece of cardboard. Then tape various objects on the paper to make your terrain (see example below).

   Your terrain may include anything that will fit inside the box. It can look like a landscape or it can include completely random objects. It could also be something specific. For example, you could design something that looks like the face of a baby inside a mother's womb. The key is for your subjects to be three-dimensional (ultrasound would not be able to detect a picture drawn on the paper).


Activity 5: Imaging with Sound

4. Exchange terrain maps. Put your terrain into another group's locator box, making sure the other group's members are not looking when you do it. Have the other group do the same for you. DO NOT LOOK.
5. Challenge the other group to find all of the objects that make up your terrain.
6. While they're mapping your design, create a map on graph paper of the other team's design using your own locator.

Exploration Questions

1. What were some problems you encountered while trying to interpret the terrain map provided by the other group? Were the problems related to sampling frequency or something about your designs?

2. How might you improve your locator design if you had more supplies or unlimited resources?

3. What was the smallest feature detectable in the terrain you created?