Holograms

The Big Idea

- Humans can’t see around bends, so they assume that objects they see are right in front of them, even if it’s only a reflection.
- Humans sense the distance to an object using focus and eye angle
- We can make an image appear to float in space by using a partial reflector, of an object that is some distance away from the reflector.

Materials

<table>
<thead>
<tr>
<th>Demonstration – Hologram postcard</th>
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<tbody>
<tr>
<td>Hologram postcard</td>
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<table>
<thead>
<tr>
<th>Focal Distance + Eye-Crossing (per group)</th>
<th>Smartphone Hologram (per group)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ruler with a post taped at 6 inches with the number 1 on one side and 3 on the other and another at 12 inches with 2 and 4 (re-tape is necessary)</td>
<td>Printed transparency template</td>
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<tr>
<td>Large hand mirror</td>
<td>Scissors</td>
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<td></td>
<td>Tape</td>
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<td>Worksheet with Sample holograms URLs + Instructions page (should be double-sided)</td>
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Prep Work

Prepare before the session:
- Phone fully charged/bring phone charger and on full brightness
- Have a video ready to show (search on YouTube for “hologram”)

Procedure

During session:
- Introductions (1 min.)
- Observe “Hologram” Postcards (2 min.)
  - How does our brain decide that something has depth? Shading, colors, turn the hologram and see behind etc.
  - How do you make something look 3D on a 2D surface like in art?
  - How does a hologram show depth differently than art?
• Focal Distance + Eye-Crossing (6 min.)
  o Remember to give instructions FIRST before they start.
  o Parents first (2 min.)
  o Hold ruler to your nose
  o Focus on post #1, then post #2
  o Students – make observations:
    ▪ What happens to parent’s eyes?
  o Parents – make observations:
    ▪ Can you see both dowels clearly at the same time?
    ▪ How many dowels do you see when looking at post #1?
  o Switch roles, students now hold the ruler (2 min.)
  o Observations/ask questions as group (2 min.)
    ▪ Eye angle for near/far object
    ▪ Double vision for object you’re not looking at
    ▪ Focus: One object sharp, other is blurry Telescope, binoculars, microscope – you turn a knob if object is blurry. Focusing these devices is Analogous to focusing your Eyes
• Focal Distance + Eye-Crossing with Mirrors (4 min.)
  o Redo focus experiment (2 min.)
    ▪ Hold mirror at end of ruler, and redo the focus/cross-eye experiment, but this time looking at the objects in the mirror (post #3 and #4)
  o Observations/questions (2 min.)
    ▪ Are you focusing on the mirror itself? You’re looking “through” the mirror.
    ▪ While looking at LAST post, how far do you think you’re looking?
    ▪ While looking at the LAST post, how many posts do you see?
    ▪ Eye parallax (going cross-eyed) causes closer posts to be doubled!
• Smartphone Hologram – Demonstration (2 min.)
  o Leaders – show projector on their smartphones (YouTube Video)
  o Can use a tablet with video file pre-loaded + large hologram projector for demo
  o Turn off the lights, hold the Projector square with the phone, walk around class, holding at eye level within ~4 feet of each observer
• Smartphone Hologram – Hands-on (10 min.)
  o Have the families cut out the solid lines of template on the transparency, then fold the dotted lines and tape the overlapping side
  o Launch the QR codes/URLs on your smartphone and test it out.
  o Try it with a mirror instead
    ▪ Object seems to be behind the mirror – you are looking through mirror
  o Try it with one face of transparency
    ▪ Image from your phone gets reflected towards you by the transparency,
• 3D Televisions & Displays are a major research field right now! Many big TV manufacturers are working on it.
• Understanding how people can be “tricked” into seeing depth is important for making Sci-Fi type 3D computers possible.
• Troubleshooting / Extra Notes
  o Bottom of projector should be cut out nicely and straight along lines, to make projector sit flat.
  o More tips? Please email outreach@ips.ece.ucsb.edu