



“Seeing” the Sun’s Corona with Your Hands (for sighted learners)

ACTIVITY OVERVIEW:

This tabletop activity invites sighted learners to explore tactile art representations of the Sun’s corona with their hands without seeing them with their eyes. Participants enjoy a multi-sensory experience while connecting with an important way that blind learners experience the world.

While a participant is touching a tactile art image hidden inside a “mystery box”, they are also seeing a selection of six images outside the box and can try to figure out which tactile image they are “seeing” with their hands (see picture and caption of Figure 1).

Field testing revealed the need to prepare participants for success by showing them at least one example of how a visual image is represented in the thermoform tactile medium, and by asking them to study the six candidate images carefully in advance for distinguishing features.

Note: *This multi-sensory table top activity is a great option for informal learning events with activity stations.*

Learning Goals:

1. Connecting with the experience of blind and low vision learners
2. Knowing that humans have recorded the solar corona in many different media over time, from rock art to NASA spacecraft images
3. Discovering that the structure of the solar corona is different at a solar maximum (streamers all around the circumference) compared to a solar minimum (streamers concentrated near the equatorial zone)

Time: 3-10 minutes per participant per tactile (highly dependent on individual participants)

Venue(s)	A tabletop indoors or outdoors
Ages	6+
Materials	Tabletop, chairs, cardboard boxes, box cutter, thermoform tactile art representations of the solar corona, scarves or drapery, downloadables.
Time	3-10 minutes per participant per tactile
NGSS support	- See Appendix D, pg. 6



Figure 1: A tactile image is hidden beneath a covered “mystery box” on a table. A participant (PUNCH PI Craig DeForest) sits at this tactile station and put their hands into the box to explore the tactile art. A page showing six possible images is placed atop the box so the participant can try to tell which image they are “seeing” with their hands.



Materials:

1. Activity Table(s) (space for 2-4 tactile stations. Four stations fit on a standard 5' round table)
2. Chair (1 for each tactile station)
3. "Mystery" cardboard box (1 for each tactile station - cut according to the specs in **Appendix A**)
4. Box cutter or scissors (for preparing boxes - see instructions in **Appendix A**)
5. Paperweights or tape (masking, painters, or duct) for securing boxes and tactiles to the table
6. Drapery (to cover each tactile station; e.g. tablecloths, towels, or scarves)
7. 2-4 thermoform tactile representations of the solar corona (one per mystery box - see **Appendix B**)
8. Activity printouts
 1. [Matching image sheets](#) (one for every tactile station)
 2. [Supporting visuals](#) for the tabletop activity (one set) See **Appendix C** for display option
 3. [Descriptions of matching images](#) (to hand out to participants after the activity)
 4. [Participant answer sheet](#) (one per participant)

Setup:

1. Set up 2-4 tactile stations on a table depending on your available space. Three to four boxes works well for families. If only one box is available, the facilitator can change out the tactiles to give participants more than one chance to play. Each station should include:
 - a. A "mystery box" (see instructions in Appendix A) that is secured to the table using weights or tape.
 - b. Drapery to cover the mystery box so that one cannot see into the opening of the box.
 - c. A chair for sitting at the station.
 - d. A thermoform tactile that is secured to the table using weights or tape.
2. Place the [matching image sheet](#) in-between every two stations.
3. Have the supporting visuals on a nearby table to demonstrate the progression of ways the solar corona has been recorded through time and **to introduce the nature of the tactiles and how they were created** (see **Appendix C**).

Activity Steps:

1. Ask participants about the different senses we use to interpret the world around us (sight, touch, taste, smell, hearing) and if they've ever felt braille before as a way of reading with your hands.
2. Show an example image from the matching image sheets and ask how you might represent that image on a piece of paper that you can only touch but can't see. Describe that the image is an artist's representation of the solar corona - the outer layer of the Sun that can be seen during a total solar eclipse. Amplify any suggestions centered around representing brightness with the height of the paper.
3. Encourage participants to study the 6 image options from the [matching image sheet](#) and describe the unique features that they might be able to feel for that would help them identify the image by touch.



4. Invite participants to each sit down at a tactile station and to feel the paper carefully underneath the cloth-covered “mystery box” until they think they know which image their tactile corresponds to. You can either:
 - a. put the same tactile image in each box and have people guess as a group before switching out the tactiles
 - b. put different tactile images under each box and ask participants to indicate their guess on the [participant answer sheet](#) before moving to the next box.
5. Encourage participants to describe to you the features that they noticed with their hands that led them to choosing the matching image they chose.
6. Engage participants in further discussion about the artists’ interpretations of eclipses using the supporting visuals. Offer a copy of the [Descriptions of matching images](#) sheet if interested.

Background:

The [1-page handout](#) provides a brief overview of a total solar eclipse, the solar corona, the Sun’s activity cycle, and “space weather.” For more background on these topics check out [this website](#) (ref 1).

One of the available tactile images represents an ancient petroglyph in [Chaco Canyon](#), NM that may be a representation of a stormy solar corona seen during the 1097 total solar eclipse of the Sun (refs 2-5). This petroglyph could be humanity’s first record of a stormy solar corona in an enduring medium, 700 years prior to the hand drawings made during the 1860 total solar eclipse viewed from Spain (refs 6 and 7).

The thermoform tactile art for one of the 1860 hand drawings is shown in the orange-framed inset box at the upper right of Figure 1. The oval-like feature in the lower right quadrant of the tactile image is a possible solar storm (a Coronal Mass Ejection (CME) in progress. This interpretation of the feature was not made until after NASA spacecraft first identified CME’s in the 1970s (ref 6). Photographic imagery of the December 2020 total solar eclipse viewed from Argentina revealed a very similar feature (ref 7) - verified by NASA spacecraft to be a CME in progress during the solar eclipse (ref 8).

References & Resources:

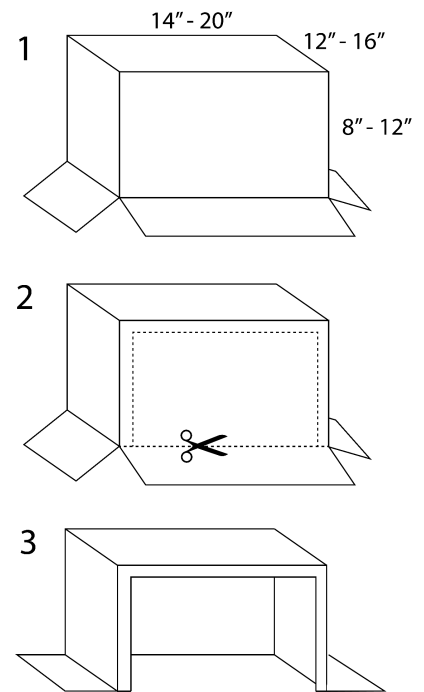
1. UCAR Center for Science Education: Sun and Space Weather
<https://scied.ucar.edu/learning-zone/sun-space-weather>
2. Vaquero, J.M. & J. McKim Malville. (2014). “On the solar corona petroglyph in the Chaco Canyon.” *Mediterranean Archaeology and Archaeometry*, Vol. 14, No 3, pp. 189-196.
https://www.academia.edu/36832101/ON_THE_SOLAR_CORONA_PETROGLYPH_IN_THE_CHACO_CANYON
3. “Chaco Canyon petroglyph may represent ancient total eclipse” University of Colorado press release Published: Aug. 8, 2017 By [Jim Scott](#)
<https://www.colorado.edu/today/2017/08/08/chaco-canyon-petroglyph-may-represent-ancient-total-eclipse>
4. “Solar Eclipse in 1097 May Be Rock-Carving Subject” a Scientific American *60-SECOND SCIENCE* podcast by [Emily Schwing](#) on August 18, 2017 [2 min 28 sec]
<https://www.scientificamerican.com/podcast/episode/solar-eclipse-in-1097-may-be-rock-carving-subject/>



5. “This New Mexico Petroglyph Might Reveal an Ancient Solar Eclipse: In 1097, a Pueblo artist may have etched a rare celestial event into the rock for all of posterity” by [Ben Panko](#) August 17, 2017 <https://www.smithsonianmag.com/science-nature/does-new-mexico-petroglyph-represent-ancient-eclipse-180964542/>
6. Eddy, J. A. (1974) “A Nineteenth Century Coronal Transient”, Astronomy and Astrophysics, Vol. 34, p. 235 (August 1974) <https://articles.adsabs.harvard.edu/pdf/1974A%26A....34..235E>
7. Astronomy Picture of the Day for 7 January 2021: Total Solar Eclipse 2020 Druckmuller & Moller <https://apod.nasa.gov/apod/ap210107.htm>
8. Recently Discovered Comet Seen During 2020 Total Solar Eclipse, 18 Dec 2020. <https://www.nasa.gov/feature/goddard/2020/recently-discovered-comet-seen-during-2020-total-solar-eclipse-SOHO>

Appendix A: Creating & setting up the “mystery boxes”

1. Find cardboard boxes that approximately fit the dimensions shown in Step 1 (at right). It is best to have one box per tactile you want to use. We recommend creating 3 - 4 boxes.
2. Cut off the front flap and the front face of your box as shown by the dotted lines in Step 2. Make sure to leave a 1”- 2” border on the front face to help the box keep its shape (see Step 3).
3. Use paperweights or tape to secure your mystery boxes to the table.
4. Weight or tape down one thermoform tactile in the middle of each box.
5. Use a piece of fabric like a small tablecloth to cover the box so that people can put their hands in the opening of the box without seeing the tactile that sits inside. See image below for an example of how a tactile station can be set up.



TIP: it is important that the opening be wide enough for a participant to be able to explore the thermoform tactile comfortably with both hands side-by-side. The opening should have no bottom rim as this tends to irritate the tender places under the wrist





Appendix B: About the Thermoform Tactiles

The thermoform tactile images used for this activity were first created in 2022 by University of Colorado graduate student and tactile artist, (now Dr.) Nicole Johnson. PUNCH Outreach is working on a means for these tactiles to become more broadly available to the community upon request. Please contact us at punchoutreach@gmail.com if you are interested in obtaining a set of your own for carrying out this activity or for working with Blind and Low Vision learners (other activities in development).

Appendix C: Neighboring Table Display to Support Success & Learning with the Activity



A tabletop display that is in the same vicinity as the Seeing With Your Hands set up has proven of value in supporting participant success with the activity, and also with the achievement of the Activity Goals cited in the Activity Overview.

- A. This set of six images summarize how human beings have rendered an **active** solar corona through time from the Chaco petroglyph (possible), to hand drawing, to painting, to ground-based photography, to space-based photography. It is a nice, succinct way to convey this learning.
- B. The set of images in this area provide context for the Chaco Canyon “eclipse” petroglyph
- C. These images to the right of the “C” (whatever they are specifically) should accomplish three things:
 - a. Reveal the difference between the coronal structure at solar minimum and solar maximum (for the pair that are not in the boxes, either the ground-based, or space-based pair that compares solar max-solar min
 - b. Reveal how a visual image is translated or interpreted by a thermoform tactile art representation and the nature of what the learner will be touching inside the box
 - c. Reveal a clay model that is the artistic basis of creating thermoform tactiles.

Note that also displayed are resources for Blind and Low Vision learners that were created by other colleagues (e.g. the 3-D printable Sun cut-away and the NASA booklet explaining eclipses).



Appendix D: Connection to NGSS

One major theme of “Seeing’ the Sun’s Corona with Your Hands” is the progression of engineering, technology and science throughout time and its resulting influence on society and the natural world. The set of tactile images demonstrate how human beings have learned to record the solar corona through time from the Chaco petroglyph (possible), to hand drawing, to painting, to ground-based photography, to space-based photography. Each new approach brings additional perspective and capability for new scientific understanding. Science and technology are interdependent and technology use varies over time and from region to region. These ideas are best expressed in [Appendix J - Science, Technology, Society and the Environment](#) of the NGSS standards, and especially in the table included below.

1. Interdependence of Science, Engineering, and Technology			
K-2 Connections Statements	3-5 Connections Statements	6-8 Connections Statements	9-12 Connections Statements
<ul style="list-style-type: none"> Science and engineering involve the use of tools to observe and measure things. 	<ul style="list-style-type: none"> Science and technology support each other. Tools and instruments are used to answer scientific questions, while scientific discoveries lead to the development of new technologies. 	<ul style="list-style-type: none"> Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the development of entire industries and engineered systems. Science and technology drive each other forward. 	<ul style="list-style-type: none"> Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise.