

Hopi Lavayi & Classroom Geometry  
Using Coordinate Lessons to Bridge Hopi Language to Artwork

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## INTRODUCTION

### Context

During the 11<sup>th</sup> Century, the Hopi people settled in the village of Old Oraibi on Third Mesa, which is currently known to be the oldest continuously inhabited village of North America. There are three Hopi mesas (First Mesa, Second Mesa and Third Mesa) that are subdivided into villages. First Mesa consists of Hano (Tewa), Sichomovi, and Walpi; Second Mesa consists of Mishongnovi, Sipaulovi, and Shungopavi; Third Mesa consists of Kykotsmovi, Oraibi, Bacavi, Hotevilla, Upper Moenkopi and Lower Moenkopi. The Hopi villages occupy a minute portion of the 1.5 million acres granted to them by the federal government, which is surrounded by the 17.5 million acre Navajo reservation.

The Hopi people migrated to the northeastern region of Arizona during the 1100's. Hopi culture has been maintained through oral traditions passed down through generations, and through cultural practices that replicate the connectivity they have with the land and ancestral spirits. Today, oral traditions are impacted by the diminishing of the Hopi Lavayi (language) brought on by the influences of Western society. The Hopi Lavayi has a Uto-Aztecan language base (a family of about 30 Indigenous languages used in the Western United States and Mexico) and three known dialects, distinct among the three mesas. It was not until recently, the Hopi language was written into a Hopi Dictionary, published in 1998 through the University of Arizona. Hopi Lavayi is taught in some Pre-K and K-12 schools across the Hopi reservation, the education of Hopi Lavayi is not mandated by the Hopi tribe. Language revitalization is a growing concern amongst many Indigenous tribes of North America, including the Hopi tribe. As Hopi Lavayi is diminishing, there is a discrepancy about where Hopi Lavayi should be taught and learned, whether the responsibility lies within the home or the classroom.

The social structure of the Hopi people are both matrilineal and exogamous; which means that each Hopi member belongs to one clan through their mother's clan and exogamous meaning that each clan member cannot marry into their own clan. The Hopi people still conduct their own traditional Hopi weddings, over the course of 1-2 weeks and at the site of the groom's residence (village). Today, many of the Hopi families still abide by and respect both the matrilineal and exogamous structure of the Hopi people. The Hopi women hold a very high status and are considered valuable to the Hopi people; they own the homes and the lands, while the men maintain the physical structure of the homes and maintain the lands through farming and ranching.

The life of a Hopi follows a yearly cycle from birth to elder, and is guided by the phases of the moon. Each year, cultural practices occur within the same moon phase; which supports their strong culture and religious beliefs. Their greatest and most valuable asset is the corn they harvest from dry-farming (raising crops with no irrigation, only moisture is provided by nature through rainstorms), along with various beans and melons. Cultural practices of the Hopi people include katsina (spirit-being) and social dances, which are the most commonly practiced amongst the Hopi tribal members currently. Direct participation of katsina dances are limited to the males of the tribe that have gone through an initiation process, females have the indirect role of

preparing the food for the dances. Participants of the various social dances are both male and female that have also gone through an initiation process.

For 24 years, I have taught mathematics to 8-12 graders in the only tribally-controlled high school located in Polacca, Arizona, on the Hopi reservation. In 1987, Hopi Junior Senior High School (HJSHS) opened its doors to approximately 500 Hopi and Navajo students, excluding approximately 200 Hopi students who acquired waivers to remain at boarding schools and neighboring public schools in Winslow, Flagstaff, Holbrook, Ganado and Tuba City. By 1989, HJSHS housed close to 800 Hopi students from the villages of the Hopi reservation, including Moenkopi village with a daily commute of over 70 miles one direction to attend HJSHS. The student body included Navajo students from neighboring communities: Jeddito, Low Mountain, Dilkon, White Cone, Teesto, Hard Rock, Rocky Ridge, Coal Mine, and Pinon. During 2023-2024, enrollment has declined to approximately 375 high school students and 160 junior high students.

Although HJSHS provides a nurturing environment that supports academic excellence, the rich and historic cultural practices force Hopi students to balance the Western world and Hopi life. Western education has been supported by the Hopi government, communities, and families for many years, until more recently with the diminishing of Hopi culture and Lavayi. The Hopi tribe has been more focused on the revitalization of Hopi Lavayi, which is the core (driving force) of all Hopi cultural practices, beliefs and history. Many Hopi tribal members still believe that the ability to speak and understand Hopi Lavayi identifies and verifies a Hopi, more so than the bloodline.

Upon entering the halls of HJSHS, Hopi students still show respect to others and come to school to get an education. It is pretty evident that the students are rich in culture through the songs they sing (or hum) and their artwork resembling the Hopi katsinas and symbols. Many of the Hopi students live in multi-family homes, with grandparents or with relatives; very few students live with both their birth parents. Hopi teenagers have the everyday household chores of taking out trash, washing dishes, prepping food, cooking, fetching water, chopping wood and bringing in coal (during the winter months). Students who reside in the western part of the reservation (Third Mesa) may still live in homes without electricity or running water; the family depends on the input of each child as they complete their chores. Many of the homes without water and electricity choose to remain close to the historic lifestyle of their ancestors. Some would think of these families to be at a disadvantage, however, I have observed and interacted with Hopi students for 24 years and found that the more west that the student resides, the more they understand and speak Hopi Lavayi. They are also better readers (fluency), perhaps it may be due to absence or limited television time and more time to read books and newspapers. The balance of life has to be challenging for many of the Hopi students.

The physical stature of the Hopi men was short and thin, which supported their ability to run long distances. The Hopi tribal lands is home to a two-time Olympian and a 1912 Silver Medalist in the 10,000 meter run, Louis Tsökahovi Tewanima. The tradition of long distance running still resonates within the halls of HJSHS, placing the school on the U.S. map with 27 consecutive boys state cross country championship titles from 1990 to 2016. The girls cross country teams captured 22 state titles during a 26-year span from 1987 to 2013. In addition to

the cross-country state titles, HJSHS has both a boys basketball state championship title from 1997 and a girls basketball state championship title from 1988.

As a daughter, mom, granddaughter, grandmother, sister, aunt, community member, educator, and role model, I offer the school, community and students my experiences and knowledge (Western and Hopi). Living most of my life on the Hopi reservation, I have participated in many cultural activities and learned to speak and understand Hopi Lavayi from birth. I have attended Second Mesa Day School (elementary years), Hopi Day School (middle school years), Flagstaff High School (freshmen year), Alexander-Dawson College Prep (junior year), and Hopi Jr-Sr High School (sophomore and senior years). My family has endured both positive and negative experiences with Western education; my grandmother being forced to leave her home in Hotevilla to attend school at Keams Canyon Boarding School, her father (my great-grandfather) went to Alcatraz for disputing the force of Western education on his daughter. My mother, daughter, and I have both accomplished Bachelors and Masters degrees in education from Northern Arizona University and the University of Arizona; my mother taught 39 years, I will be entering my 25<sup>th</sup> year of teaching and my daughter will start her 10<sup>th</sup> year of teaching. From one extreme to the other, the balance of Western and Hopi life has been a challenge for myself and will be for most Hopi students.

## **Rationale**

Loss of language is an epidemic across all native nations, one that the Hopi tribe is facing throughout their schools, communities, villages, and homes. In 2010, census recorded 6,780 Hopi speakers, since then it has declined significantly amongst the tribal members. Although Hopi students use the language through singing songs, the language is rarely used for conversation amongst the younger population. Upon introducing themselves (which has become a practice amongst all Indigenous people), Hopi students have rehearsed the introduction without truly understanding the meaning of the introduction (i.e. given name, clans, etc.).

Hopi Lavayi is the heart and soul of Hopi culture, evident through generations of oral communication about their history, stories, songs, and daily conversations. Although cultural practices are not in danger, the significance and meaning of cultural practices are impacted by the decline of Hopi Lavayi. At birth, most tribal members are given a tungni (name) at a hair-washing ritual, the name identifies the clan for whom the individual is born. The hair washing ritual signifies the introduction of the newest member to their relatives, both maternal and paternal. A tribal member will accumulate other names as he/she goes through various initiations throughout their lifetime. Over the course of their lives, most tribal members will be identified with their birth name, by family and village members. The hair washing and naming practice is the beginning of each Hopi's life, followed by many other cultural practices, both complex and historic.

Bridging culture with Geometry through art would be relevant to both Hopi and Navajo students, as they are immersed in art through cultural practices at an early age. Hopi and Navajo students are surrounded by art through cultural practices (attire, foods, stories, etc.) and beliefs (spiritual beings – katsinas, sun, moon, land). The attire of Hopi culture is complex and significant to each cultural practice, the foods are made for certain occasions and made with ingredients that are

grown and harvested using methods passed down from ancestors. Majority of Hopi students become naturally talented artists from being exposed to the arts used in their culture, taking that natural talent to the classrooms at all ages. Hopi art is symmetrical, which allows the use of Geometric concepts to represent and describe transformations; describe rotations and reflections.

Native nation building is the process by which a Native nation strengthens its own capacity for effective and culturally relevant self-government and for self-determined and sustainable community development (McKinley, B., & Brayboy, J., 2005). Native Nation Building includes:

- Native Nations set and guide the agenda.
- Native nations make long-term, strategic and generation-focused decisions.
- Native nations focus on establishing effective governing institutions to strengthen economic development.
- Native nations see their culture and values as key assets for the rebuilding process.
- Native nations have diverse leaders at all levels who empower and educate citizens.

The Hopi Tribe does not currently seem to be incorporating these Native Nation Building tenets into day-to-day operations in order to see progress towards the restoration of Hopi Lavayi.

### **Content Objective**

The Content Objective is for students to gain increased understandings of geometry vocabulary in English as well as Hopi Lavayi and how to use technology to represent geometric figures and motions. Art is a favorite pastime of many Hopi members, young and old. Using artwork to revive a few Hopi words at a time, is one of the many efforts used to revive Hopi Lavayi. Hopi artwork has many detailed characteristics, each signifying the history and practices of the Hopi people.

Students will choose or create a piece of artwork that they can manipulate to show various criteria of transformations, including translations, reflections, rotations, and dilations. Students will be able to describe the transformations using Hopi Lavayi and mathematical computations. Students will share their artwork, in detail using the descriptions of the various transformations, with their peers.

### **Teaching Strategies**

One of the most important factors to consider as we begin to look at strategies for this unit is the Hopi Moon phases that guide the Hopi Life cycle. Many of the students on the Hopi reservation follow the Hopi Life cycle and fewer are aware of the Hopi Moon phases. As I planned out this unit, we had to consider the Hopi Moon that would fall within the unit and determine whether the activities were appropriate. The following is a brief introduction and summary of each of the Hopi Moons within a westernized calendar (January – December).

**Tömö'paamuya (January) – The Moon of Positive Hopi Life**, it is the month for winter social dances, which represents prayers for snow. This month is specifically set aside to rid our lives of the crazy emotions and for being joyful in an outrageously manner. We do this to eradicate all the wildness we have in ourselves in order to prepare for the solemn religious ceremony that follows in February.

**Powamuya (February) – The Cleansing Moon**, cleansing for a new life ahead. After the period of excessive joyful fun, mortals are now ready to accept the spirits, the katsinam.

**Ösömuya (March) – The Moon of Whistling Winds**, opens the month for dances that create a happier environment for all life forms. Everything will grow and the rains will come to nourish the crops.

**Kwiyamuya (April) – The Windbreaker Moon**, the winds are very strong so windbreakers are built to help the soil stay intact and protect the plants.

**Hakitonmuya (May) – The Wait Moon**, it is time to wait for the warmer corn planting weather. Early planting season is for planting Hopi beans, pumpkins, squash, gourds, and melons, all of which include several varieties of each type.

**Wuko'uyismuya (June) – The Planting Moon**, is a time for family gatherings and planting. This is the time we plant in the large fields and for the rain to come support the corn's growth. After the plantings, there are katsina dances. These dances give the Hopi farmers the opportunity to pray for the coming of the rains, for an abundant harvest, and for a good and happy life.

**Tala'kyelmuya (July) – The Going Home Moon**, is the month of summer warmth and summer solstice. The katsina season has ended, the plants have blossomed, and all other plants and wild spices are growing. They are depending on the sun's heat and light to mature. Hemis Katsinam bring stalks of corn and melons to regard the people for their efforts, to recognize the goodness of the people.

**Tala'paamuya (August) – The Moon of Positive Hopi Life**, after the katsinam leave the Hopi villages, the summer social dances begin. These dances bring the last rains of the summer for the growing crops, for a good harvest, and to prepare the fields for the next season.

**Nasanmuya (September) – The Feasting Moon**, a month of happiness and appreciation for our crops. The fresh crops of corn, melons, vegetables, peaches, and wild greens are picked for feasting.

**Angakmuya (October) – The Harvest Moon**, the majority of plants have now fully matured. Corns, beans and some melons are usually ready to be harvested. The men father the crops and bring them to the women for caring and preparation for storage.

**Tömö'kyelmuya (November) – The Initiate Moon**, is the last moon of the year. It is blessed by a mens society ceremony (Wuwtsim tiikive) for the benefit of learning the Hopi Life. It marks the beginning of the Hopi Life Cycle. A young male is given a new path of life towards becoming a truly aligned Hopi person. We pray for all mankind that life will be pleasant, peaceful, and everlasting. We pray that we will continue to grow in this life.

**Kyaamuya (December) – The Moon of Respect**, is the beginning of the Hopi New Year. It is the winter solstice season and is the month of danger for mortal life. Everyone must respect this month, it is a time for total respect.

Other teaching strategies will include student-centered learning to create a student-teacher relationship, to recognize their learning needs, and to develop their respect. Most Hopi students learn in a unique respectable manner, the culture they live in helps to instill the characteristics of respect for others. Kyaptsi (respect) is valued throughout the Hopi reservation and the elders of the villages continue to imbed the practices of kyaptsi amongst all tribal members.

As very young children, Hopi students learn by doing. They grow up in an environment that thrives on kinesthetic learning. Reinforcing effort and providing recognition is very important for students of all ages. As with many students from a rich cultural background, praise and recognition is a determining factor between a student being correct and giving great effort.

Visuals will be important for the students who learn by seeing the steps from beginning to end. Throughout history, the Hopi people passed on their cultural practices by exposing tribal members to the various practices of the Hopi people. Every day is a new day for learning, to be able to see and learn is a valuable gift. Vocabulary will bridge the elements of student artwork with the Hopi Lavayi using descriptors to elaborate the details of their artwork. Sharing their artwork with others will help students with public speaking as well as the opportunity to use Hopi lavayi in the context of their creation.

### **Classroom Activities (The entire unit will cover 3 weeks)**

The unit can be implemented in the second quarter of a Geometry class, during Angakmuya (October) and Tömö'kyelmuya (November). Student experiences and exposure to cultural activities have ceased for the year, ending the cycle that includes social dances in the villages and schools. Each school across the Hopi reservation designates a day (usually in September) for all students to participate in Hopi social dances, either as a participant or spectator. This day exposes all students to Hopi social dances, songs that are sung, attire that is worn, including the meal that is served on that day. The day of social dances gives opportunity for all students to experience one of the many Hopi cultural activities, although it is a representation of the actual ceremonies that occur within the villages.

With the popularity of YouTube, some of these experiences can be intensified with the videos shared on YouTube. Because these students live in the Hopi culture of music and dance, they are more than willing to participate by dancing and/or singing at both school and their villages. I predict that YouTube will impact some tribal cultures, but the Hopi people have strong practices and there doesn't seem to be any impacts in the near future.

Day 1: Teacher will play songs that are used for social dances or videos that capture a social dance at a village or school, to set the mood and help students recollect, from their experiences and memories, some ideas that will help them identify Hopi art. As a class, students will brainstorm what things help them relate to Hopi art. All suggestions and ideas will be recorded

on post-it (poster size). Each student will create a bar graph on the “things” that help them relate to Hopi art. Non-Hopi students will receive the appropriate assistance needed to be successful with this part of the unit.

Within the first year of our life as a Hopi, we are exposed to cultural ceremonies & activities: katsina dances, clan gatherings, mens’ society dance, social dances, womens’ society dances, weddings, farming/gardening, ranching and daily household chores. At the various dances, one is able to hear the songs that are sung, and see the costumes that vary in color and complexity. Clan gatherings allows for one to become acquainted with clan relatives outside of the immediate family, showing how you are connected to each clan member as a mother, father, sister, brother, grandmother, grandfather, daughter, son, aunt, uncle, etc. The household chores are still very gender-specific, where the males tend to the farming & ranching and the females tend to the cooking and cleaning. The Hopi wedding occurs in phases and is also gender-specific in the roles that each individual has in the wedding. Most families include their children at a young age, as soon as they are able to walk and talk. Each of these Hopi cultural ceremonies & activities, creates its own distinct atmosphere that is unique in a social, emotional and physical sense.

Most Hopi students will have an extensive amount of ideas that will help them relate to Hopi art. If some students are having difficulty, I can share some of my earliest experiences and examples as a child that first helped me relate to Hopi art. Within the first months of my existence, I was exposed to the distinct songs of ceremonies at katsina and social dances. Children’s lullabies were sung to me daily by my mother and grandmother, those songs still resonate with me today as I sing them to my children and now, grandchildren. As children, we were given gifts from the katsina spirits to signify that we were “good” and the gifts were replicas of the katsina spirits in the form of a katsina doll for girls and the boys received bow and arrows. Again, the gifts were gender specific, the girls were to learn the responsibilities of nurturing and caring for another being and the boys were to learn to hunt with the bows and arrows.

Day 2:

Students will be asked to brainstorm about Hopi art that they have seen recently. Each student will share with the class: where they saw the art, when they saw the art, what were they doing when they saw the art, and what they think the art means or represents. The results will be recorded by the teacher on a chart which will be revisited later in the unit. Non-Hopi students will receive the appropriate assistance needed to be successful with this part of the unit.

Day 3 & 4:

Using an organizational chart, place the artwork in the middle of the page and use the four corners to state where they saw the art – dance, gathering, museum, in their home, on a gift; when they saw the art – in the last few days, in the last year; what were they doing when they saw the art - including any particular senses (smell, sounds, feelings, etc.) that reminds them of the art; and state what they think the artwork means or represents. Once all students are done, each student will share their artwork with the class, including the four areas that help to explain



their artwork. Non-Hopi students will receive the appropriate assistance needed to be successful with this part of the unit.

Day 5 & 6:

Using prior knowledge and class notes, the students will identify some vocabulary words that will help them describe their artwork they have chosen to model. The vocabulary list must include at least five vocabulary words from within their Geometry notes (i.e. line, plane, angle, circle). Next, students will write the Hopi Lavayi word that best describes their vocabulary word. If they are unfamiliar with Hopi Lavayi, they will have the opportunity to take the list home and ask someone outside the school to identify the Hopi Lavayi word that best describes their vocabulary words. If the student is unable to find anyone outside of the school, the Hopi dictionary will be provided for their use in class. Non-Hopi students will receive the appropriate assistance needed to be successful with this part of the unit.

Day 7:

Students will familiarize themselves with an online graphing application, Desmos. Students will open the application using an iPad and begin to explore the various functions that Desmos offers. Students will use the class period to explore the Desmos application.

Day 8 - 14:

Students will be given a detailed assignment, pointing out the expectations of the lesson. See attachment for the student handout for the assignment.

Step 1: Students will take a picture of their artwork and send to their school-student email account. If students do not have a phone, the teacher can assist in taking a picture of their artwork and email to their school-student email account.

Step 2: Students will retrieve their artwork from their school-student email account. Once retrieved, insert the artwork into the graphing software at Desmos.com. Students will need to leave the artwork where it was inserted. Students will need to change some dimensions that will allow for their artwork to remain within specific coordinates.

Step 3: Students will log into Desmos.com, by either making an account or using an existing google account. This will allow students to save their work.

Step 4: Create the design in Desmos, by creating a table and using the polygon function.

Step 5: Export you artwork, insert into a word document (use landscape layout), include your name on the document, and email your document to Mrs. Sahmea at [asahmea@hjsbs.org](mailto:asahmea@hjsbs.org) for printing.

Step 6:

Once student receives the printed image of their artwork, they will need to paste their artwork onto a poster-sized paper. Students will now begin to identify the Hopi Lavayi words that will be

used in representing their artwork. Students will also describe the geometry vocabulary and concepts from prior lessons within their artwork.

Step 7:

Students will include a summary of their project, including the various findings from Days 1-6.

Final Day:

Students will share with an elbow partner some of the challenges that they encountered with the Desmos application. Students will share with the class their challenges and successes throughout the entire project.

Final projects will be displayed throughout the school building and classroom.

### Student Assessment Plan

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<p><b>Content</b></p> <p>Poster contains appropriate items and information (information is appropriate to assigned topic).</p>	Content is accurate and all required information is presented.	Content is accurate but some required information is missing, but is still generally easy to follow.	Content is accurate but some required information is missing, making it difficult to follow.	Content is either questionable or incomplete, making it difficult to follow.	Content is inaccurate. Information is incomplete, inaccurate, making it difficult to follow.
<p><b>Presentation</b></p> <p>Poster is clean, neat, and creative. The information is well organized, accurate, and reflects an understanding of the topic.</p>	<p>Presentation is neat, clean, well- organized and presented in a creative way.</p> <p>Presentation is colorful and creative. Information is accurate.</p>	<p>Presentation is mostly neat and clean. Information is organized and shows some degree of creativity.</p>	<p>Presentation flows well and shows acceptable understanding.</p> <p>Information is represented and identified with their name.</p>	<p>Presentation is unorganized and not used in a relevant manner. Lacking information and/or information is not identified</p>	<p>Presentation has no flow. Insufficient information and lacking some information.</p>
<p><b>Pictures, Clip Art and Artwork</b></p> <p>Images, pictures, clip art and drawn artwork are colorful and appropriate to the assigned topic. The layout flows well and shows creativity. The overall result is pleasing to the eye.</p>	<p>Images, pictures, clip art and drawn artwork are colorful, and appropriate to the topic. Layout flows well, shows creativity, and is pleasing to the eye.</p>	<p>Images, pictures, and clip art and drawn artwork are mostly colorful and appropriate. Layout may show some degree of creativity.</p>	<p>Most images and/or artwork is are colorful and appropriate. The layout shows little creativity.</p>	<p>Images are inappropriate and artwork shows little, if any, creativity.</p>	<p>No images or artwork included.</p>
<p><b>Mechanics</b></p> <p>Spelling, grammar, and punctuation in any text on the poster is accurate.</p>	<p>No spelling, grammar, or punctuation errors in the text. Text is in the student's own words.</p>	<p>A few (2-3) errors in spelling, grammar or punctuation. Most text is in student's own words.</p>	<p>No more than 5 spelling, grammar or punctuation errors. Several instances where the text is not in student's own words.</p>	<p>No more than 7 spelling, grammar or punctuation errors. Most of text is not in authors' own words and/or no text included.</p>	<p>More than 7 spelling, grammar or punctuation errors. Text is copied or not included.</p>

<p><b>Overall Presentation</b></p> <p>The poster fulfills requirements of the assignment and shows the student's potential.</p>	<p>The poster fulfills all requirements of the assignment and represents the student's full potential.</p>	<p>The poster fulfills all but one of the requirements of the assignment and shows that the student put forth an honest effort to complete the assignment.</p>	<p>The poster fulfills at least three of the requirements of the assignment and shows that the student put forth some effort to complete the assignment.</p>	<p>The poster fulfills at least one of the requirements of the assignment and shows that the student put forth minimum effort to complete the assignment.</p>	<p>The poster fulfills none of the requirements of the assignment and shows that the student put forth no effort to complete the assignment.</p>
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Name \_\_\_\_\_

Score \_\_\_\_/25

Comments \_\_\_\_\_

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### Alignment with Arizona Mathematics Standards

#### Arizona Mathematics Content Standards

Students will explore Arizona Mathematics Standards for Geometry during this unit. In particular, they will *Experiment with transformations in the plane* (AZ Standard G.G-CO.A) and *Understand congruence in terms of rigid motions* (AZ Standard G.G-CO-B) while manipulating their artwork within the coordinate plane.

#### Arizona Mathematics Practice Standards

*Model with Mathematics:* Mathematically proficient students apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. The students will use their knowledge of transformations and apply to their artwork. Students will also use their knowledge about Hopi Lavayi to describe the various transformations of their artwork. The students will use the Desmos application tool to create various transformations from their pre-image to an image. The Desmos application will allow students to use geometrical concepts (symmetry, translation, reflection, dilation, etc.) to manipulate their pre-image to a final image. Students will describe the various transformations that have occurred both in English and Hopi Lavayi. Students will describe the details of their final image and share some of the cultural meanings and or stories of their final image.

*Using appropriate tools strategically:* The students have used the Desmos application for other lessons, they are familiar with the basic uses of the tool. Students will choose the appropriate tools within the Desmos application to fulfill the transformation requirements of the lesson. Students will also use prior knowledge to create the geometric computations necessary to describe the various transformations used in their lesson.

#### CRAIS Tool Principles (Castagno et al., 2021).

This unit reflects the following broad Culturally Responsive Assessment of Indigenous Schooling Tool Principles of *Relationality, relationships, and communities*, and *Representation*

*of Indigenous Peoples, and Critical understandings of diversity, and specifically race through the many ways that language is connected to culture, school, and content within the unit.*

### **Vocabulary**

Póngokni – circle, ring on a flat surface

Tuuwuhi – long, thin straight mark; stripe

Longna(‘at) – dashed ~ design

Nevevwutsqa – (in shape) square, rectangle

Tuvìipiveni – (design, shape) diamond

Tutuvengveni – a stepped pattern

Nahoyve’y|ta – have a pattern with mirror-image symmetry

(a)tsve(q) – above, over

Nan’ivo(q) – across; to/on either/both sides

(a)ngk – after; following behind

(èè)peq – alongside

Himu taytaqa – living creature, animal

Tuhisveni – visual artwork of ~

laho’ta – form the shape of an arch

(a)tpip(aq) – beneath, below

Povolhoya – any of the smaller butterflies

ngyam – clan

oomaw – of water vapor, cloud

poota – coiled plaque

kuwana – color

tsukuniwpu – cone-shaped

wíwakna – Connect

qaa’ö – dried, husked corn

uuyi – corn plant

ngölöshoya – bent, not straight; crooked

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