

Ethnomathematics: Unlocking the Wonders of Mathematical Ideas

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The Game of Dish

The Native American game of chance called Dish is played using a dish or basket and some small flat disks. The small disks (coins, buttons, peach pits, etc.) are colored or marked so that each has two faces that are distinguishable from each other. This game is usually played with six disks but the actual number of disks could vary depending on who is playing the game. For the game of Dish, there are two players. One player starts the game by putting the disks into the dish and then tapping or shaking the dish so that the disks are redistributed and mixed around. The number of points won and whether or not the player goes on again or surrenders the dish to his opponent is determined by the resulting configuration of the disks in the dish. If the tossed objects land with all six faces showing the same color, the player scores five points. If they land showing five faces of the same color, the player scores one point. In each of these cases, the player also earns another toss. The player scores no points and has to pass the dish to the opponent for all the other configurations. The Dish game is played to some predetermined point total, for example 100 points.¹

1. Do you think all the possible resulting configurations are equally likely? These configurations are:
 - All colored
 - 5 colored and 1 white (Plain)
 - 4 colored and 2 white (Plain)
 - 3 colored and 3 white (Plain)
 - 2 colored and 4 white (Plain)
 - 1 colored and 5 white (Plain)
 - 6 white (Plain)
2. Play the Dish game with a partner. Keep track of your results using a tally of the total number of times each configuration occurs.

| Configuration | Tally of Occurrences |
|-------------------------------|----------------------|
| All colored | |
| 5 colored and 1 white (Plain) | |
| 4 colored and 2 white (Plain) | |
| 3 colored and 3 white (Plain) | |
| 2 colored and 4 white (Plain) | |
| 1 colored and 5 white (Plain) | |

Do your results from #2 change your answer to #1. Explain.

Hidden-Ball Game or Moccasin Game

A number of different American Indian tribes historically have played a guessing game that involves hiding a small object in one of several places, usually four, and having an opponent guess where it is hidden. Traditionally cane tubes or wooden cups and moccasins have been used to conceal a small item such as a ball, pebble, bean, etc. In some cultures the game was played for recreation, in others for gambling, in still others as a part of a ceremony that celebrates arbitration between the gods so as to determine which will prevail and thus determine the weather/fertility that will ensue in the upcoming season. Stewart Culin in his book *Games of the North American Indians* describes variations of the Moccasin game in great detail and provides historical accounts of this game as played in a variety of Indian cultures.

The Moccasin game has long been a part of the Dineh' Nation (Navajo) who live on a reservation in parts of Arizona, New Mexico, and Utah. It is still played today but now frequently shoes or cowboy boots are used instead of the traditional moccasins. The word Dineh' means *the people* and for the Dineh', the Moccasin game was a game to be played during the wintertime. The wintertime was an appropriate time to tell the traditional mythical stories of the Dineh'. In the Dineh' language the Moccasin game is called kesh je' and this game provided a time to remember the stories and sing the songs of the first animals' game. Since humor is an important element of the Dineh' culture, there is much laughter and teasing among the families and friends who gather to play the game. The Dineh' believe that humor should be a basic part of one's life. It reduces tensions and worries and allows one to maintain harmonious balance both physically and mentally.

Although kesh je' is played in winter and usually only at night, it sometimes can be played in the late springtime or in daytime. According to Dineh' traditions, to play it in the daytime and in the spring time there should still be some snow on the mountains and some snow should be brought and placed in the house. This snowball represents the winter. The doors, windows, and chimney holes are sealed so that the game room is dark as in night.

According to the Dineh' tradition the story of the first kesh je' (Moccasin) game as told by Katherine Powless (1995) goes as follows:

A long time ago the animals of the night could see better at night, hunt easier at night and were very comfortable living in the dark. They thought that they could live without another sunrise. The animals of the day were also happy to have the sun shine all the day long and could live without the sun setting. Animals from both sides came to resolve and discuss this matter in a council that was held at twilight. The council decided a way to resolve the matter was to play the game by hiding a yucca ball in a moccasin and see whose wish would succeed. The yucca ball is made from the yucca root or could be a stone found near the yucca plant.

As the night fell they built a fire and set up two rows of moccasins. Among the many participants and spectators were Bear, Gopher, Badger, Owl, Turkey, Pheasant and Crow. The Bear and Porcupine contributed their moccasins for the night animals, while the Mole and Badger supplied their moccasins for the day animals. Four moccasins were used on each side. In the Dineh' culture the numeral four has significance- the four directions (south, west, north, and east), the four seasons (fall, winter, spring, and summer), the four sacred mountains which represent the boundaries of the original sacred Dineh' land.

It is said the night animals sat on the north side and the day animals were on the south side. To determine who would start, a wood chip was tossed, one side black with charcoal and the other side grey or white. The black represented the animals of the night and the other light side represented the day animals. The black side landed up first and the

animals of the night began the game. A blanket was held up to conceal the four moccasins and the screen song was sung. Today the screen song is still sung in remembrance of that.

The first game began with 102 counters. The smaller 100 yucca counters were called ket-aaz, which represent the younger generation. The two longer yucca counters are called bi-cho-e' (maternal grandmothers); they represent the older generation. These counters are longer and marked to distinguish them. The two long yucca counters are the last to be won over. The 102 yucca counters also reflect the Dineh' life span. It was said then that the Dineh' shall live to one hundred or more years and each new generation will replenish and enrich the Dineh' culture. An indicator is used to point to the shoes. The game ends when the winner gets all the yucca counters. The winner gets to take home the bi-cho-e' and hang it up in their hogan.

The Yei'-tso (monster destroyer) was the best guesser for the night team and they would always send him over to guess where the token was hidden. Therefore, when the daylight animals retrieved the token it was easily taken back. The day light animals in their turns to find the token were unable to retrieve it and began to lose many points. This is where deceit evolved from, during the first animal moccasin game. The day animals were desperate so they sent the na-ah-sizz-e' (the gopher) to dig underneath the ground and inspect each of the moccasins of the opposing team. He did so and found no token in any of the moccasins. The day team knew that they had been cheated. The wind whispered into their ears and told them the Owl held the token in his claw. So the day animals sent over the guesser. He tapped each of the moccasins and then with a warning struck the owl's claw and out rolled the token. One of owl's five claws was severely injured, so, to this day he has only four fingers on each claw. The coyote went back and forth between the night and day teams, depending on who was winning at that time. That is why to this day he can hunt and travel in the night and day, because he couldn't make up his mind which side to be on.

The moccasin game was played late into the night. The players grew tired and unaware of the time. The wind whispered into the ear of the magpie and said sing a song of the dawn. The magpie sang "It dawns" "It dawns." All the animals realized the sun was coming up and they quickly picked up their counters and fled to their homes. Since the bear lent his moccasins to the game, he rushed to put on his moccasins. In his haste to put them on, the moccasins were put on in reverse. The right side of the moccasin was on the left and vice a versa. That is why the bear's feet are in reverse to this day. The game was never finished and neither of the two teams won. For this reason we have both day and night.

To Play the Dineh' Moccasin Game

Implements for the modern version of the Dineh' moccasin game:

- Four shoes for each team (high top shoes are best).
- A token, a small round ball or rock.
- 102 counters, use popsicle sticks, marbles. Be sure to mark two for the grandmothers.
- Counters represent points earned/lost and are 4, 6, or 10.

- A blanket for the screen.
- A wood chip marked with charcoal on one side or a coin to flip to see who goes first.
- A stick to use as a indicator or pointer to select the shoe or moccasin.

To win the game the team has to win all 102 points or counters.

Four shoes are used on both sides of the teams and they are placed in a line from east to west. (Cowboy boots are best to use on carpeted floors) The team that wins the toss will begin the game. Each group has a blanket that is used as a screen behind which each team hides the token ball. This is so that, the opposite team does not see the token ball being hidden. When the group that is hiding the ball is done, the opposing team sends a guesser with the pointer/indicator and he/she will have the opportunity to point out where the ball is hidden. If he/she chooses correctly, then that person's team wins the opportunity to hide the ball/token for the other team.

The exact rules and process for gaining/losing points and your turn for the moccasin game vary in different cultures. For the Dineh' the process and rules are:

- If the ball/token is in an end shoe/moccasin and the guesser guesses correctly on the first try, the guessing team gets 10 points and also wins the opportunity to hide the token/ball.
- If the ball/token is in either inner shoe/moccasin and the guesser guesses correctly on the first try, the guessing team gets no points but wins the opportunity to hide the ball/token.
- If the ball/token is three shoes away from where the guesser chooses, the guessing team loses 10 points. Also the hiding team gets to hide the ball/token again.
- If the ball/token is two shoes away from where the guesser chooses, the guessing team loses 6 points. Also the hiding team gets to hide the ball/token again.
- If the guessing team chooses a shoe that is adjacent to where the ball/token is hidden, then they lose 4 points. The hiding team retains the right to hide the ball/token.
- In order for the turn to pass to the guessing team, they must guess correctly where the ball/token is hidden.

The Game of Mu Torere

Marcia Ascher in her book *Ethnomathematics* describes in detail the game of Mu torere, a game that is popular with the indigenous people of New Zealand, the Maori. This game is simple and requires few materials. Two players using an eight-pointed star and four markers each play it. The markers can be shells, beans, pebbles or any other small distinguishable items. The star game board can be drawn on paper, scratched into the sand or dirt, or marked on any flat surface with any type of marking device. A simple drawing of the typical Mu torere star with the two players, designated as A and B, is shown in Figure 1. The starting positions for each player are marked with an *. Initially the markers are placed as shown in the labeled game illustration. Players take turns moving a marker, one marker per move. A move can be made to the center if it is empty or to an empty adjacent star point. Only the outer markers (identified by asterisks on the game illustration) can be moved by the players on the first two moves for each player. This is done so that the game can become established and so no player is quickly blocked. The game is won when a player blocks the opponent so that he/she cannot move.²

Ascher uses a board descriptor code to designate any of the 92 configurations for the game Mu torere. Of these 92 configurations, there are six winning configurations, three for each player. In addition, there are also six configurations that can never be attained. The board descriptors contain a sequence of ten letters. The first letter is the player with the next move (A or B); the second letter is the letter of the player that occupies the center (A, B, or O for unoccupied); and the next eight are the markers of the star points (A, B, or O) read consecutively.

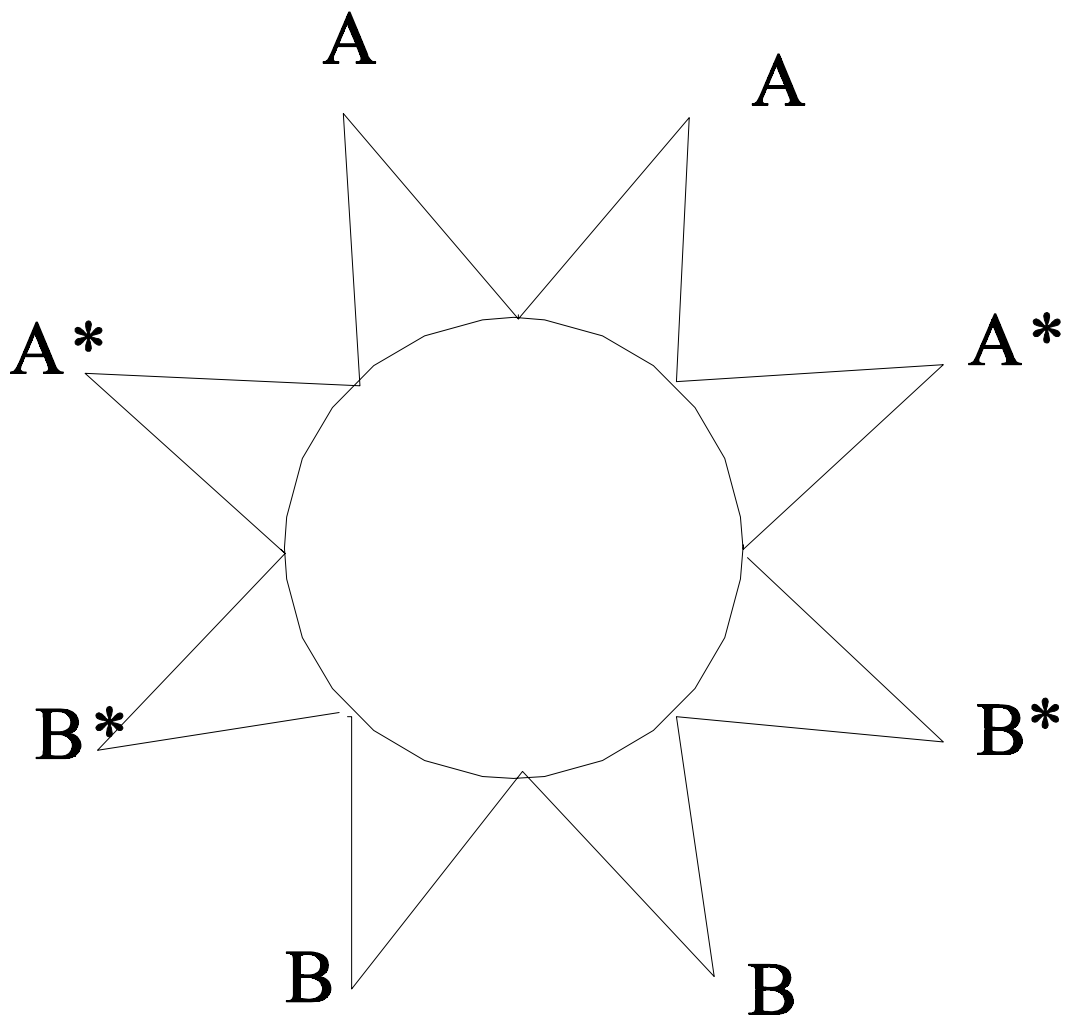


Figure 1 Mu torere game star with starting positions for players A and B

The Hmong

Approximately 4000 years ago the Hmong lived in China. About this time the Chinese tried to conquer the Hmong and tried to force them to adopt the Chinese culture. However, the Hmong did not want to give up their own culture and the fiercely fought the Chinese oppression. The Hmong were able to successfully ward off their Chinese enemies and continued to live within China where they remained free. The word "Hmong" means *free men* and for many years the Hmong people did remain free and ruled themselves in China.

However, about 200 years ago the Chinese again tried to conquer the Hmong who were living in China. Rather than continuing to oppose the Chinese, many of the Hmong left China and migrated to the high mountainous parts of the neighboring country of Laos. Here in the high mountains these Hmong could continue in their traditional Hmong ways, speak their own Hmong language, and live as free people away from the oppression of the Chinese. The high mountains of Laos offered safety to these people. The Striped Hmong settled in northern Laos, the Black Hmong and the Green Hmong settled in central Laos, Xieng Khouang, and the Blue Hmong settled in the southern part of Laos. Mostly their traditional dress, colors, and differences in rituals, lifestyles, values, beliefs, and dialects identify these different subgroups. In Laos, the Hmong continued to hunt and farm using their traditional Hmong methods. They became hill farmers living in small scattered villages at an altitude of 3000 to 6000 feet. This altitude was good for the cultivation of opium poppies, which was their major cash crop and trade crop for supplies, food and silk thread. The Hmong themselves used opium for medicine and frowned upon its addiction. A succession of monarchs ruled Laos until 1893 when Laos became a neutral nation, free of foreign rule.



Figure 3 Lee Her, May Lor, and See Lor
In Laos, 1974.

During the recent 20th century IndoChina/Vietnam War, many Hmong men and boys fought on America's side against the communists. These Hmong soldiers are sometimes referred to as America's secret army because their role in the war was not revealed until after the Vietnam war ended. These Hmong

warriors served a critical need for America during the Vietnam war. They attacked and fought the communists, gathered intelligence information for the U.S., rescued American soldiers who had been shot down and helped our troops survive in the foreign terrain. Many thousands of Hmong lost their lives in this war; others who survived found their families, homes, and villages gone after the war ended. In 1975, the United States made a hasty exit from Southeast Asia, leaving behind many Hmong who had provided support during the war. Quickly, the communist troops overran the entire country of Laos. The communists controlled Laos and exacted a vicious revenge on the Hmong people who were still in Laos, killing them, poisoning their villages, and burning their crops and villages. Again, the Hmong had to flee their homeland to try to maintain their freedom.

Many Hmong were forced to flee from Laos and the communists. Their escape from Laos was fraught with danger. The end of the difficult escape from Laos to Thailand, and hopefully freedom, involved crossing the Mekong River, part of which serves as the border between Laos and Thailand.

Crossing the Mekong River was perhaps the most dangerous part of the Hmong people's escape to freedom because the Communist soldiers closely patrolled the river border and tried to stop the Hmong from escaping. Frequently the Hmong tried to buy their passage across the Mekong River. Many Hmong built makeshift bamboo rafts to try to cross the river. Some tried to swim across the wide river. About half of the Hmong who tried to escape from Laos to Thailand never made it. The ones who did make it ended up in crowded refugee camps in Thailand. The refugee camps no longer exist. The Thai government beginning in 1992 closed them, and the last camp was closed in 1995. Many of the Hmong who were still in the camps were sent back to Laos where those who were active participants in the secret war faced persecution by the communist government in Laos.

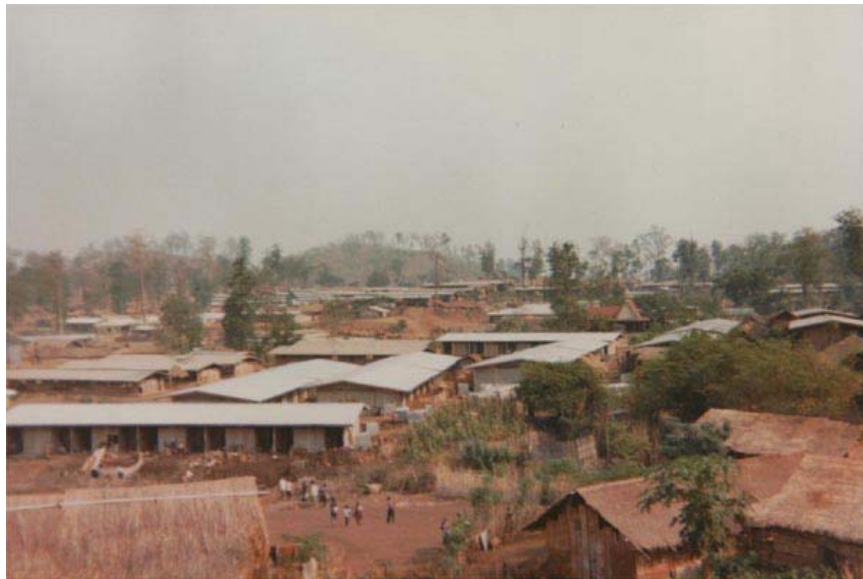


Figure 5 Overlooking Center 4, Ban Vinai Refugee Camp, Thailand.



Figure 6 Getting water at Center 3, Ban Vinai Refugee Camp, Thailand
Ka Ying Thao, 1979.



Figure 7 Pa Sing Thao and Dang Vang getting rice for the family at Center 3,
Quarter 2, Ban Vinai Refugee Camp, Thailand.

Many Hmong are still in Thailand. Those who remained in Thailand became Thai citizens and live in Thai cities and villages. Thousands of Hmong refugees are also living in France, Australia, South America as well as in the United States through various sponsorships.

As immigrants in various U. S. cities and towns, the Hmong strive to maintain their own traditional culture and survive as free people in a totally new and vastly different Western culture. The family is the foundation element for the Hmong because traditionally many individuals live together as a family, an extended family, and a community. The Hmong are organized into clans. When a child is born, the child takes on the father's family name and becomes a member of the father's clan. People with the same family name belong to the same clan. There are approximately 12 Hmong clans common to Wisconsin. They are Thao, Lo, Vang, Yang, Vue, Lee, Her, Moua, Kong, Cha, Fang, and Xiong. Other minor clans also exist. Membership in a clan is important in the Hmong culture and clan allegiance helps the Hmong maintain their

culture. It also governs such things as marriage, rituals, ceremonies, and other practices which are essential to the Hmong.



Figure 8 See Lor in Denver Colorado,1980. Figure 9 See Lor in Green Bay, Wisconsin, 1997.

The Hmong traditionally were a farming culture and passed along their traditions and language orally. It is believed that the Hmong had a written language when they lived in China. For fear of being persecuted by the Chinese government for possessing talents, knowledge, and skills, they abandoned their writing skills and transferred their knowledge, skills, and ability onto cloth through their embroidery and artwork. It was only recently (in the 1950's) that the Hmong language was formally written down. Now many Hmong who have come to the United States learn to read and write English before they learn to read or write Hmong.

Through their textiles the Hmong keep part of their culture alive. Storycloths, embroidered with intricate pictures tell the history of the Hmong. Paj ntaub (pondow), flower cloth, is the traditional needlework of the Hmong. Women and girls learn to make flower cloths to decorate their clothing and frequently Hmong women use the techniques of applique, reverse applique, and embroidery in their textile creations. Here are some beautiful examples.



Figure 10 Paj ntaub (Pondow) courtesy of May Chao Lor



Figure 11 Paj ntaub (Pondow) by May Chao Lor

Girls learn their textile skills at an early age (7 or 8) and learn to create the intricate designs without using patterns or measuring tapes. Traditionally, a girl's best needlework is sewn on her New Year's costume. The New Year festival is a very important celebration for the Hmong and great pride is taken in the needlework worn for this festival.

Unfortunately, the fast-paced American culture is taking its toll on the traditional Hmong culture. Like many other traditions, Hmong needlework is changing and will continue to change as the Hmong people strive to find their niche in contemporary society. We already see that many Hmong textile creators have abandoned their traditional cutting and folding processes using reverse appliqué. Instead, they are more frequently restricting their design process to counted cross stitch methods with embroidery.

Creating the beautiful Hmong textile works is a skill that is learned with much patience and practice. Hmong women are really textile designers and artists. They put much care into their needlework, beginning with the first step of planning their work and choosing appropriate colors as well as throughout the entire process of the meticulous stitching. Their work with textiles requires many virtues such as persistence, endurance, and vision. An examination of most traditional Hmong textile pieces reveals a high degree of symmetry and balance in the overall design. Frequently, borders show a repetitive strip of triangles that may symbolize the mountains of Laos, mountains that at one time surrounded the Hmong and helped secure their safety. Often the borders of paj ntaub show a repetitive snail pattern (spiral) while a central figure may represent an elephant foot. The elephant was a very important work animal for the Hmong when they lived in Laos.



Figure 12 Paj ntaub (Pondow) with a central figure representing an elephant foot and the traditional snail or spiral border pattern.

The traditional costumes of the Hmong worn for celebrations are superb examples of mathematical art. Repetitive strip patterns abound on sashes, sleeves, and hemlines. The remarkable thing is that these intricate designs are created in the mind of the seamstress and executed via a process of cloth-folding and cloth cutting that produces designs that exhibit a great deal of mathematical symmetry and interest.



From the collection of Bernadette Berken

**Flower Cloth
Tapete con Flores
Paj ntaub (Pon dow)**

Flower Cloth

Paj ntaub (pondow), flower cloth, is the traditional needlework of the Hmong. Women and girls learn to make flower cloths to decorate their clothing and frequently Hmong women use the techniques of appliqué, reverse appliqué, and embroidery in their textile creations.

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An examination of most traditional Hmong textile pieces reveals a high degree of symmetry and balance in the overall design. Frequently, borders show repetitive strips of triangles or spirals. Repetitive strip patterns abound on sashes, sleeves, and hemlines. Remarkably, these intricate designs which are created in the mind of the seamstress and executed using only cloth folding, cloth cutting, and stitching, produce designs that have a great deal of mathematical symmetry and interest.

Tapete Floreado

Paj ntaub (pondow), el tapete floreado, es el trabajo tradicional de bordado de los Hmong. Las mujeres y las niñas aprenden a hacer tapetes floreados para decorar su vestimenta y con frecuencia las mujeres Hmong usan la técnica del apliqué, apliqué inverso y bordado en sus creaciones textiles.

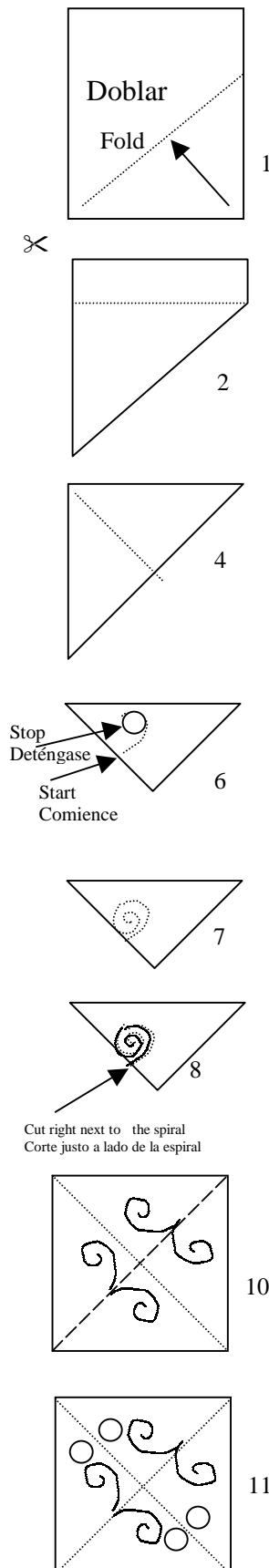
Las niñas aprenden la habilidad textil a muy temprana edad (7 u 8) y aprenden a crear diseños complicados sin usar moldes o cintas de medidas. Por tradición, el mejor trabajo hecho con aguja por una niña se lo cose a su traje de Año Nuevo. El festival de Año Nuevo es una celebración muy importante para los Hmong y se considera un gran orgullo usar el trabajo hecho con aguja para este festival.

El trabajo de crear los bonitos textiles Hmong es una habilidad que se aprende con mucha paciencia y práctica. Las mujeres Hmong son realmente diseñadoras de textiles y artistas. Ellas ponen mucho cuidado en su trabajo con aguja, comenzando por el primer paso de planificar su trabajo escogiendo colores apropiados a través de todo el proceso de las meticulosas puntadas.

Un examen de las piezas más tradicionales de textiles Hmong revela un alto grado de simetría y balance en el conjunto del diseño. Frecuentemente, los bordes muestran fajas repetitivas de triángulos o espirales. Los moldes de franjas repetitivas abundan en fajas, mangas y en dobleces. Lo notable es que estos diseños son creados en la mente de la costurera y son ejecutados usando un proceso de tela doblada y corte de tela que produce diseños que tienen mucho de simetría e interés matemáticos.

Pondering Paper Pondow

- Using a standard piece of 8 1/2 x 11 inch paper, carefully fold up the narrow side to make a diagonal. The part folded up will be a triangle.
- Cut along the edge of the paper to separate the top rectangle from the triangle below. When you open the triangle, you should have a square.
- Refold the square on its diagonal fold line remaking the triangle.
- Take your triangle and fold it in half again, so you have an even smaller triangle.
- Place a quarter or other small object 1/4 inch from one of the folded edges. (Trace quarter)
- Starting at the edge of the paper, cut toward the traced quarter, around the top and stopping once you get to the other side. Do not cut out the entire circle.
- Continue to cut inward to create a spiral.
- Cut a second spiral right next to first spiral so you may remove a small bit of paper.
- Remove the excess paper swirl.
- Open it up to show the multiple swirls in the pattern. Refold the triangle again and make as many spirals as you can.
- Remember to try other shapes besides spirals.



Complicado Tapete Floreado de Papel (Pondow)

- Usando una pieza corriente de papel de 8 1/2 x 11 pulgadas, cuidadosamente doble hacia arriba la parte angosta para hacer una diagonal. La parte doblada hacia arriba será un triángulo.
- Corte a lo largo de los extremos del papel para separar el rectángulo de arriba del triángulo de abajo. Cuando usted abra el triángulo, usted tendrá un cuadrado.
- Vuelva a doblar el cuadrado sobre su línea diagonal rehaciendo el triángulo.
- Tome el triángulo y vuelva a doblarlo por la mitad otra vez, de manera que usted obtenga un triángulo aún más pequeño.
- Ponga una moneda de 0.25 \$us u otro pequeño objeto de 1/4 de pulgada desde uno de los extremos doblados (trace la moneda de 0.25 \$us).
- Comenzando al extremo del papel, corte hacia la moneda trazada alrededor de la parte de arriba y deténgase cuando llegue al otro lado. No corte todo el círculo.
- Continúe cortando hacia adentro para crear una espiral.
- Corte una segunda espiral exactamente a lado de la primera espiral de manera que usted quite un poquito de papel.
- Quite el exceso de papel enroscado.
- Abralo para ver los múltiples remolinos en el molde. Vuelva a doblar el triángulo una vez más y haga todas las espirales que usted pueda.
- Recuerde de hacer la prueba otras formas además de la espirales.

TEMARI

The traditional art form of temari probably originated in China approximately five or six hundred years ago. In China, temari, beautifully decorated spheres, were often used in conjunction with lions who were thought to be mythological animals having a fun loving and friendly disposition. Sometimes, in the architecture in China, stone lion statues are used at entrances on the sides of gates. Frequently these stones guard lions have an ornately patterned ball in their paws: a temari. The Chinese even have a ceremonial dance called "Exercising the Lions" or "Shua Shih Tzu" whose purpose is to expel demons. In this ceremonial dance, the dance and the temari, in this case a huge version of a beautifully decorated sphere, simultaneously represents the sun, a precious gem of great value, happiness, and the two forces of nature--yin and yang.

There are numerous legends associated with temari as well. One such legend describes the mythological lion as a provider of milk. People placed hollow beautifully decorated balls out in the hills of the countryside hoping that the mythological lions would find the balls, play with them and leave some milk inside the balls. This milk was thought to possess magical properties and the people hoped to collect the milk and gain possession of its magical force.

In Japan, temari were originally toys. The word *temari* means "hand ball" but it probably originated from the word "kemari" which means "kick ball". The game of kemari was introduced in Japan from China sometime around the 7th century A.D. The original kemari balls were more flat than round and were made from deerskin. The game, played by 4, 6, or 8 people, involved keeping the ball in the air and preventing it from hitting the ground within a given square playing field. The players took turns kicking the ball and earned points from kicking the ball high and from kicking the ball with grace and agility. Our contemporary game of hacky sack probably has its origins in the game of kemari. Originally the noble class played the game of kemari. Its popularity spanned many centuries but through time it evolved from a game of kick ball to a game of handball or *temari*. Temari was probably first played by children of the wealthy noble class, probably as a game of catch. Originally, mothers or grandmothers made the balls as New Year's gifts for their children from the remnants of old kimonos. Pieces of the fabric of the old silk kimonos were wadded up into a little ball that was wound around with thread salvaged from the old kimonos. Then silk thread was used to stitch the ball firmly together. As time went by the functional stitching became decorative and eventually the balls evolved into works of art with all their beautiful embroidered designs.

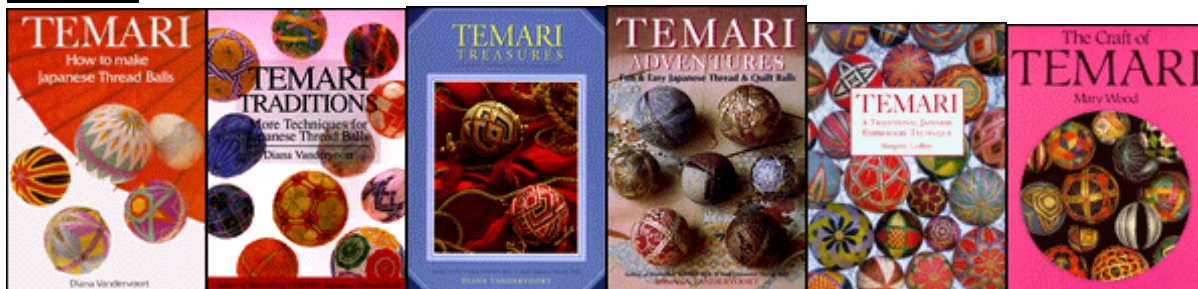
Cotton cultivation was introduced in Japan about the 15th century. With cotton, the temari evolved to "Ito-Mari" or "thread ball" and became popular with the masses. As more and more people began playing, many different types of temari games developed. The game was played both indoors and out-of-doors and the games were played both by tossing and bouncing. Little chants developed among the children who played temari games. These little chants and rhymes are much like our contemporary "jump rope" chants or nursery rhymes.

Over the centuries, the popularity of temari has continued. The construction of these balls has evolved utilizing a variety of materials. Likewise, the patterns on temari have also evolved from the more traditional patterns from nature (flowers, pine needles, waves, water, etc.), to complex mathematical designs consisting of a wide variety of geometric shapes, (triangles, squares, pentagons, diamonds, etc.), frequently interlocking.

Temari combine mathematics and art in a creative way. To create the complex geometric patterns the thread-wrapped ball is partitioned in such a way to achieve the desired geometric design. A thin paper strip is used to do this and the temari maker indicates the desired partitions with pins. Thread is used to mark the design on the spherical surface, after which the designs are embroidered on the surface with a variety of threads. The results are breath taking and the patterns seem limitless.

Although some traditional temari made as rattles for children had rice in their centers, modern temari may contain a jingle ball in their center. Additionally, modern day temari makers utilize a wide variety of materials to make their kaleidoscopic creations. Most modern day temari are three to five inches in diameter. However, any size is possible and smaller-sized examples are utilized as Christmas ornaments, crafted into jewelry, displayed in bowls or baskets, hung from ceilings, door jams, or window frames, or hung alone or in groupings from mobiles or table trees. Today these beautiful mathematical art objects are highly treasured and a gift of a temari represents deep friendship and loyalty. Oh, to be so lucky to have such a treasure!^{3, 4, 5, 6}

BOOKS



These are the books published in English. Japanese books are available through Sophia Books.

1. Vandervoort, Diana. *Temari: How to Make Japanese Thread Balls*. Japan Publications, 1991.
2. Vandervoort, Diana. *Temari Traditions: More Techniques for Japanese Thread Balls*. Japan Publications, 1995.
3. Vandervoort, Diana. *Temari Treasures*. Japan Publications, 1996.
4. Vandervoort, Diana. *Temari Adventures: Fun and Easy Japanese Thread and Quilt Balls*. Japan Publication, 1996.
5. Ludlow, Margaret. *Temari: A Traditional Japanese Embroidery Technique*. Sterling Publishing Company, 1999.
6. Wood, Mary. *The Craft of Temari*. Search Press, 1991.

WEBSITES

www.temari.com

www.temaripatterns.homestead.com

<http://jshorten.bravepages.com/temari/temari.htm>

<http://home.cinci.rr.com/craingspage/>

<http://ww82.tiki.ne.jp/~chu-chu/English/Englishopen.htm>

<http://home.pacbell.net/patgf>

temari-embroidery-by-ai.com

temari by Sally Cubitt



Interlocking Diamonds
Multi on red



Woven Basket
Rose, sage on green



Crossed Spindles-6
Watercolors on blue

Double Chrysanthemum
Rose, sage on dark green



Parasols
Multi on white

Poinsettia
Red, green on black



Rose Garden
Multi on red

Chrysanthemum
Red, green on white



**Rose Garden
6 Divisions**
Rose, sage on white

Woven Chrysanthemum
Roses on dark green



Snowflake
Blues on dark blue

Princess Egg
Pastels on ecru



Basic Temari Instructions



STEP 1: Wind a styrofoam ball with 400 yards of sewing thread in the base color desired. Make sure you keep moving the ball so that no two threads run parallel. This will keep the ball circular.



STEP 2: Designate a north pole and mark with a pin. With a strip of paper wrapped around the circumference, find the south pole by folding the paper in half. Divide in half again to find the equator (obi line). Divide again in the number of times you wish to divide the ball (fourths, eighths, tenths, etc.) and mark with pins.



STEP 3: Using a matching or accent thread, wind around the ball from north pole to south pole using the division pins around the equator as a guide. If an obi line is desired, wrap around the equator. Tack each intersection with thread or use the existing pin.

You are now ready to start stitching a pattern on the temari.

Temari Cards

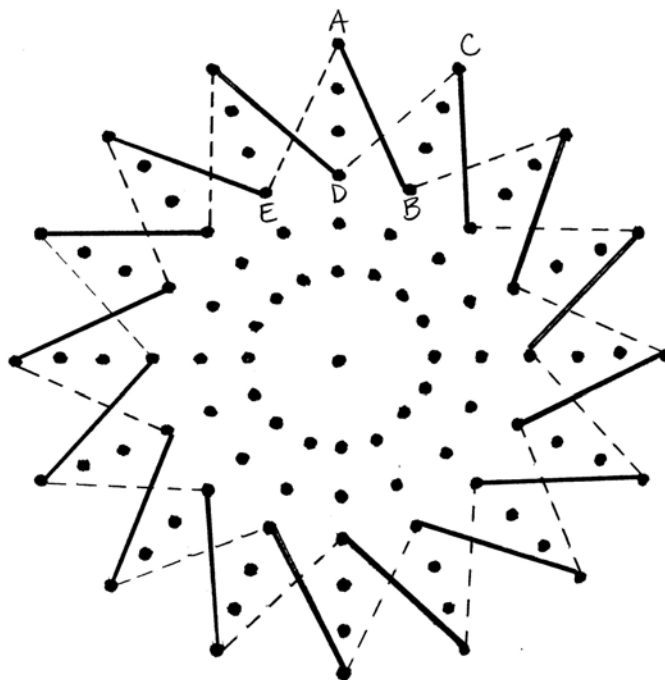
Materials Needed: temari stitching diagram (below), card stock, needle, craft thread, tape or tabs, paper clips, magazine or cushion.

TO PREPARE CARD FOR STITCHING

1. Center a card under the temari stitching diagram below. Use paper clips or tape to hold the card in place under the temari stitching pattern.
2. Place a pad or magazine under the card.
3. Pierce each dot on the diagram so that a hole appears in the card. When finished, remove card. The pattern of holes in the card will be used to stitch a temari pattern.

TO STITCH THE PATTERN

4. Thread needle with 18"- 30" length of thread. Insert needle through the back of the card, come up at **A** (see below) and pull until almost to the end of the thread. Secure the end to the back with tape or a tab. (When you have reached the end of the thread, secure it to the back with tape or another tab. Rethread the needle, secure the end of the new thread to the back of the card, and continue.)
5. Insert needle at **B**, pull thread taut, and come up at **C**.
6. Repeat around the card, following the solid line, until **D** is reached.
7. Come up at **A** again, but this time work around the card in the opposite direction, going to **E**. Follow the dashed line around the card, until you have reached **D** again.
8. Repeat the above directions for two more rows. The next row will begin directly under **A** and continue around the card one row underneath the previous row. The third and last row will continue under the previous rows. At the finish, all holes in the card will be filled.



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1. Marcia Ascher, *Ethnomathematics*, (New York: Chapman& Hall/CRC, 1998), 87-88.
2. Marcia Ascher, *Ethnomathematics*, (New York: Chapman& Hall/CRC, 1998), 95-109.
3. Diana Vandervoort, *Temari Treasures*. Japan Publications, 1996.
4. Diana Vandervoort, *Temari Adventures: Fun and Easy Japanese Thread and Quilt Balls*. Japan Publication, 1996.
5. Margaret Ludlow, *Temari: A Traditional Japanese Embroidery Technique*. Sterling Publishing Company, 1999.
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