Saffron Threads

Grades 7 to 9 | Mathematics

Activity Plan: Finding the Math in South Asian Design

SOUTH ASIAN CANADIAN LEGACY PROJECT

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Visit the Saffron Threads website for more educational resources:
www.saffronthreads.ca

Overview

Big question

How are spatial relationships represented in South Asian design?

Activity description

South Asian designs will be explored in a variety of ways to meet grade specific learning standards:

- Grade 7 students look at 2-D transformations in South Asian designs and demonstrate their learning by creating their own design.
- Grade 8 students create a net for a South Asian building.
- Grade 9 students create a South Asian inspired design by scaling it up or down.

Grades and curricular area(s)

- Grade 7 to Grade 9
- Mathematics

Big ideas

	Mathematics
Grade 7	The constant ratio between the circumference and diameter of circles can be used to describe, measure, and compare spatial relationships.
Grade 8	The relationship between surface area and volume of 3D objects can be used to describe, measure, and compare spatial relationships.
Grade 9	Similar shapes have proportional relationships that can be described, measured, and compared.

Curricular competencies

	Mathematics
Grade 7	Use tools or technology to explore and create patterns and relationships, and test conjectures
	Develop, demonstrate, and apply mathematical understanding through play, inquiry, and problem solving
	Visualize to explore mathematical concepts
Grade 8	Use tools or technology to explore and create patterns and relationships, and test conjectures

	Represent mathematical ideas in concrete, pictorial, and symbolic forms
	Visualize to explore mathematical concepts
Grade 9	Use tools or technology to explore and create patterns and relationships, and test conjectures
	Develop, demonstrate, and apply mathematical understanding through play, inquiry, and problem solving
	Visualize to explore mathematical concepts

Materials/Resources

- Computer and projector
- Student computers, tablets or other devices
- Graph paper
- Blank paper
- Ruler
- Compass
- Protractor
- Scissors
- Pencils and erasers
- Coloured pencils

Online Resources on South Asian Design

Using a search term and viewing the Images tab will provide a great variety of visual examples of South Asian design.

Search term for Images tab	Information about design term
Indian Textile Designs	Victoria and Albert Museum, Google Arts and Culture
Rangoli	• Swastik Rangoli Kalakar Group • Fun Learning Workshops
Manjusha Art	Borders in Manjusha Art
Mandala	History and Tips for Mandala Design (Adobe)
Mehndi (Henna)	Cultural India

Templates

- 2-D Transformations
- Mathematicool Search
- Mathematicool Answer Key

Kick Off and Connect

Grade 7: Identifying Transformations

Step 1
Start by explaining to students that visual patterns are constants in our daily lives.

Those swirls you doodled on your notes are a perfect example of using patterns to create a design.

If we take a closer look, we can find mathematical properties in many different types of art and design from cultures around the world.

We'll be looking at South Asian designs, and you might be familiar with some of the shapes and patterns we'll be discussing.

Step 2
Using a projector, share images of various South Asian designs (from table above). Ask students to identify different shapes and repeated patterns. It's helpful to bring objects with South Asian designs on them into class too, if possible. Textiles are a good source. Students may also have examples to bring to class.

Step 3
Introduce students to the 2-D Transformation resource.

Step 4
Have students work in small groups to find examples of each type of transformation and symmetry in the online South Asian design resources. Students can take screen shots or photos to save their examples.

Step 5
Each group creates a presentation (using PowerPoint or Prezi, etc.) to collect and label their examples.

Step 6
Each group looks at another group's presentation and discusses the examples. A student and teacher co-created rubric could be used to peer assess the presentation.

Grade 8: South Asian Architecture

Using a computer and projector, show students a variety of images of South Asian architecture. You may choose to show images from the site: 15 Famous Buildings from South Asian Countries however the site has ads, so is not ideal to share with students directly.

Searching on the term South Asian Architecture and viewing the ‘image’ tab will also provide a wealth of buildings to share with students.

Discuss with students what common shapes they see in the buildings (prisms, pyramids, cylinders, circles, etc.).

Grade 9: South Asian Designs

Using a projector, share images of various South Asian designs (in table above). Have students discuss where designs such as these can be found (carpets, fabric, tiles, jewellery, tattoos, wall murals, product labels, etc.)

Explore and Engage

Grade 7: Design Challenge

Step 1
Have students create a coloured tessellation that includes at least two of the transformations: translation, reflection, rotation.

Step 2
Distribute graph paper and scissors for students to use to plan their design. (The design challenge could also be done using drawing software on a computer.) Students will need to experiment before creating and colouring their final design.

Step 3
Students create and colour their final design on a new piece of paper.

Step 4
Students exchange their designs with each other. Each student explains the transformations they used in their design.

Step 5
Designs could be peer or teacher assessed by a co-created rubric.

Grade 8: Design Challenge

Step 1
Working individually or in small groups, students choose a building from South Asia to model. They can search on the building’s name for images and information on the building. Some suggestions are below.

Step 2
Hand out graph paper for students to draw different views of the building (all four sides and the top). If measurements are not available, students may estimate.

Step 3
Students then draw nets for the building. They may choose to do so in sections for complex buildings. Students may need to simplify some of the building's features to known shapes (prisms, pyramids and cylinders) in order to draw their nets.

Step 4
Students exchange their drawings with each other.

Step 5
Drawings could be peer or teacher assessed using a co-created rubric.

Grade 9: Design Challenge

Step 1
Students will create a design and recreate it at a different scale. It could be much larger for a wall mural, or much smaller for a henna design.

Step 2
Have students find a South Asian design they'd like to use as inspiration for this challenge.

Step 3
Distribute graph paper for students to use to plan their design. (The design challenge could also be done using drawing software on a computer.) Students draw out their design on the paper, filling the 8.5" x 11" sheet.

Step 4
Students determine what the design will be used for (wall mural, landscape arrangement, henna or jewellery design, etc.) and the final size it will need to be. It should be at least twice as large or half as small as the original drawing.

Step 5
Students draw out their design at the appropriate scale.

Step 6
Students exchange their two drawings with each other.

Step 7
Drawings could be peer or teacher assessed using a co-created rubric.

Wrap-Up and Assess

Written/Oral Reflection

Have students explain, verbally or in writing, their processes from analysing and designing to creating to presenting. They could address questions such as:

- What design did you choose and why?
- What are the major shapes you used?
- Which transformations did you use?
- What colours did you use in your design and why?
- What do you like best about your design?
- What might you do differently next time?

Summative Assessment

- With students, co-create a single point rubric for their designs.
- Assess students' oral/written reflection using a single-point rubric.

Extend and Transform

- Invite a community member to the class to show the students how they create South Asian designs.
- Explore artwork from local South Asians (such as Sandeep Johal) and try to identify elements they discovered in their research.
- Use the Mathematicool Search as an icebreaker or wrap-up activity for the lesson.

Grade 7

- Ask students to bring to class an artifact that represents one or more of the transformations.
- Have students look at designs from other cultures, such as First Nations, for patterns and shapes that use transformations.
- As an ADST option, students could create prints of their designs using cut potatoes, sponges, linoleum or other materials.

Grade 8

Students cut out their nets to create a 3-D version of their building. Suggested buildings:

- Taj Mahal, India
  - 3-D Model
- National Parliament House of Bangladesh
  - 3-D Model 1
  - 3-D Model 2
- Brihadisvara Temple, India
- Lotus Temple, India
  - 3-D Model
- Habib Bank Plaza, Pakistan

Grade 9

As an ADST option, students could create their designs in henna, paint, metal or other materials.

2-D Transformations

Translation

A shape moves from one place to another without being transformed in any other way (it looks exactly the same, just in a new place).

original *translated*

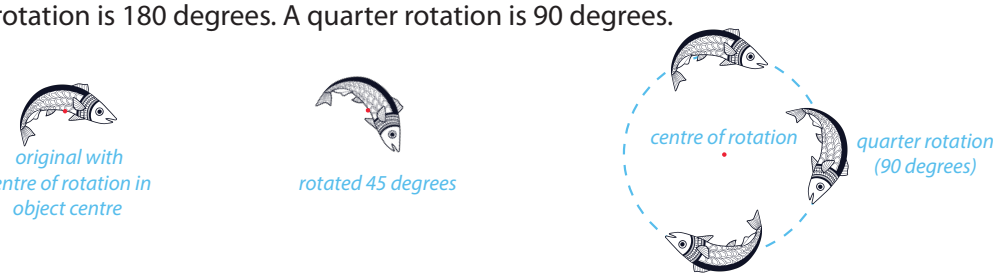
Reflection

A shape is flipped over an invisible line, becoming a mirror image of itself.

original *reflection over a vertical line* *reflection over a horizontal line*

Rotation

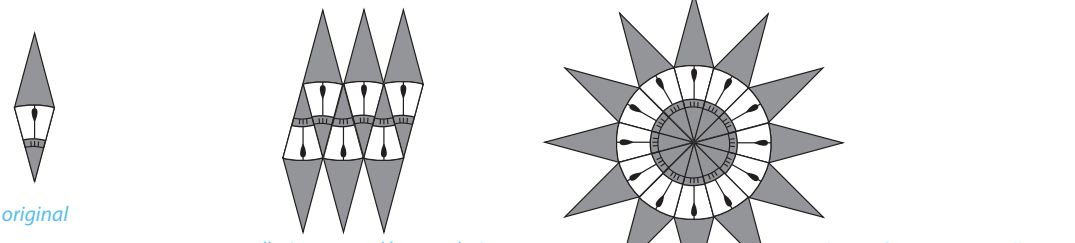
A shape is moved in a circular motion around a fixed central point. This central point is called the centre of rotation. A circle is 360 degrees and represents a full rotation.
Half a rotation is 180 degrees. A quarter rotation is 90 degrees.



original with centre of rotation in object centre *rotated 45 degrees* *quarter rotation (90 degrees)* *half rotation (180 degrees)*

Tessallation

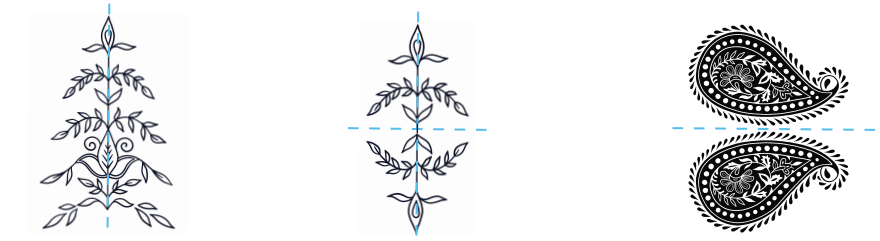
A pattern made up of shapes that fit together without any gaps.
Tessallations are created by repeating and transforming shapes.



original *tessallation created by translation and horizontal reflection of repeated shape* *12 shapes forming a tessallation, each was rotated 30 degrees from the shape beside it*

Symmetry

Many of the designs created by transformations are symmetric.
A shape or pattern is symmetric when all the parts on either side of an invisible line are identical to one another. The invisible line is called the line of symmetry.



vertical line of symmetry *vertical and horizontal lines of symmetry* *reflection symmetry*

Mathematicool Search

Name: _____

Ask the respondent to print their name and write down the answer on this sheet. Please do NOT use any electronic devices to find the answers.

Find someone who...

Question	Name	Answer
1 Knows why five is a significant number in some South Asian cultures		
2 Knows where the concept of zero was discovered		
3 Knows how much one lakh and one crore is		
4 Knows the name of a South Asian mathematician or scientist		
5 Can calculate how much 1 INR (Indian rupee) is worth in CDN dollars, if 60 INR are worth CDN$1		
6 Can identify/count the number of circles in this design: 		
7 Likes to eat pie (find out their favourite flavour) or knows the value of π (pi) to 10 decimal places		

Mathematicool Search Answer Key

Question		Answer
1	Knows why five is a significant number in some South Asian cultures	Sikhs have five sacred symbols 5K's *panj kakar;* there are five elements in the universe according to Hindu cosmology; there are five Pillars of Islam, and prayers are recited five times every day.
2	Knows where the concept of zero was discovered	The modern equivalent of Zero comes from the Hindu astronomer and mathematician Brahmagupta in 628.
3	Knows how much one lakh and one crore is	• 1 lakh = 100,000 • 1 crore = 10,000,000
4	Knows the name of a South Asian mathematician or scientist	Examples: • Srinivasa Ramanujan (mathematician, 1887-1920) • C.V. Raman (physicist, 1888-1970) • Har Gobind Khorana (biochemist, Nobel Prize laureate, 1922-2011) • A.P.J. Abdul Kalam (aerospace scientist, 1931-2015) • Shakuntala Devi (mathematician, 1929-2013)
5	Can calculate how much 1 INR (Indian rupee) is worth in CDN dollars, if 60 INR are worth CDN$1	CDN$0.017 or 1.7¢
6	Can identify/count the number of circles in this design: 	12
7	Likes to eat pie (find out their favourite flavour) or knows the value of π (pi) to 10 decimal places	3.1415926535