

## **REAL LIFE REAL WORLD Activity: Archeologist Frieze Patterns**

**Topic:** Reflections and Translations

**Grade Level:** 7 - 12

**Objective:** Use Cabri Jr. to create examples of frieze patterns

**Time:** 30-60 minutes

### **Introduction**

A frieze pattern is a pattern that repeats itself along a straight line. The pattern may be mapped onto itself with a translation. Wallpaper borders are practical applications of frieze patterns.

Friezes are often seen as ornaments in architecture. Frieze patterns can be found around the eaves of some old buildings. Archeologists study them to identify and classify the objects and structures that they find.

### **Discuss with Students**

Putting together a jigsaw puzzle is an example of motion geometry in action and can be used to illustrate transformations. After you dump the box, what do you do with the puzzle pieces? You flip, slide, and rotate them. Reflections, translations and rotations are three transformations that may be used to create frieze patterns.

Activity 1: Build a frieze pattern using a translation.

Activity 2: Build a frieze pattern using a rotation.

1. How can we adjust the translation to fit more images on the screen?
2. Did anyone create a frieze pattern using a shape other than a triangle?

### **Discuss With Student Answers**

1. There are many ways to adjust the pattern. The students may change the translation scale by shortening the translation segment or making the angle of rotation smaller. They may also try to make the pre-image smaller or change its shape by dragging certain points.
2. Answers may vary. Shape to try could be squares or other quadrilaterals and circles.

### **Technology Reference**

This activity uses the following Cabri Jr. functions:

F2	Point	F4	Translation
	Segment		Rotation
	Triangle		
	Circle		

Refer to "Getting Started with Cabri Jr." for more details.

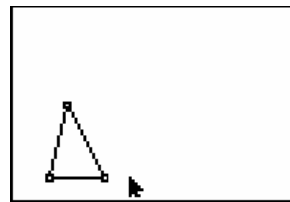
Name \_\_\_\_\_ Date \_\_\_\_\_

## **REAL LIFE REAL WORLD Activity: Archeologist Frieze Patterns**

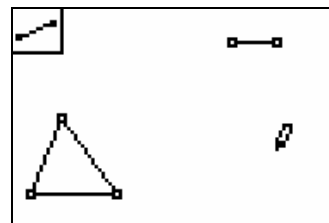
Archeologists, when classifying artifacts, often take note of the physical properties or attributes of artifacts, such as the materials from which the artifacts are made, and their size, shape, function, and decoration. Friezes are often seen as ornaments in architecture. Frieze patterns can be found around the eaves of some old buildings. Translations can be used to create these patterns. In this activity, you will use Cabri Jr. software to create some frieze patterns.

### **Activity 1**

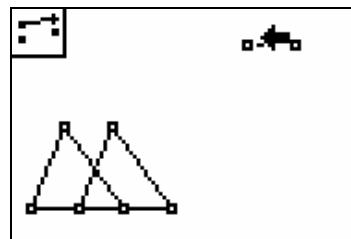
1. Create a triangle. To draw a triangle, press **WINDOW** for the F2 menu. Move to **Triangle** and press **ENTER**. Move the pencil to the desired location of one of the vertices and press **ENTER**. Move to a second vertex and press **ENTER**. Move to the third vertex and press **ENTER**. Press **CLEAR** to turn off the **Triangle** tool.



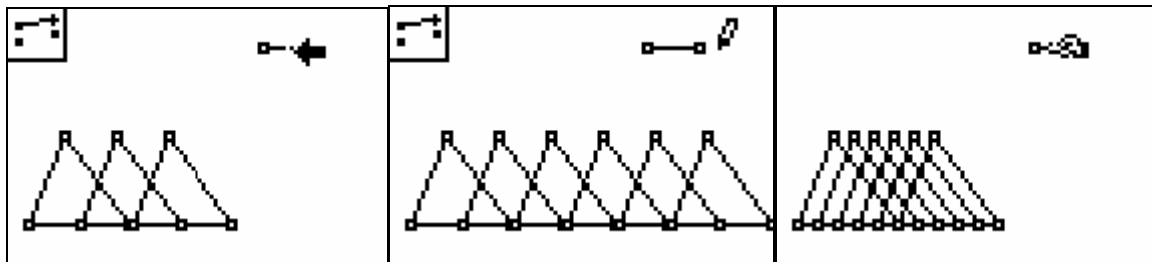
2. Create a segment to translate the triangle. Press **WINDOW** for F2 and select **Segment**. Move the pencil to desired location of one endpoint and press **ENTER**. Move to the other endpoint of the segment and press **ENTER**. Press **CLEAR** to exit the Segment drawing tool. Move the segment near the right corner on the display.



3. Activate the **Translation** tool. To translate the triangle, use the arrow keys to move the cursor to the triangle to select it (it should flash) and press **ENTER**, then move the cursor to the segment to select it, then press **ENTER**. You should now see a translated image of the triangle.



- Translate the new image by selecting it and the translation segment as you did in Step 3. Repeat this several times to create more triangles to make a frieze pattern. You can drag the translation segment to manipulate the frieze pattern. To drag the translation segment, press **CLEAR** to exit the Translate tool, move the cursor to an endpoint of the segment. As the endpoint flashes, press the **ALPHA** key. The cursor now becomes a hand. Move the hand using the arrow keys to drag the endpoint of the translation segment. You can use the segment to resize and adjust the images to create space for more images.

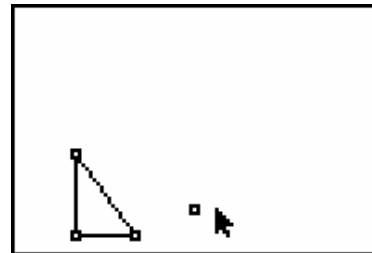


- Try to generate another frieze pattern with the Translation tool using a quadrilateral, a circle, or some other object.

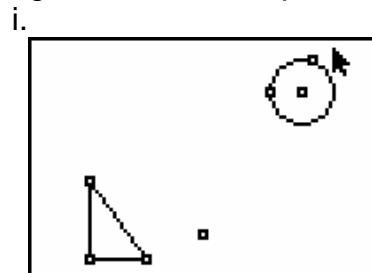
## Activity 2

We can also generate a frieze pattern using rotations.

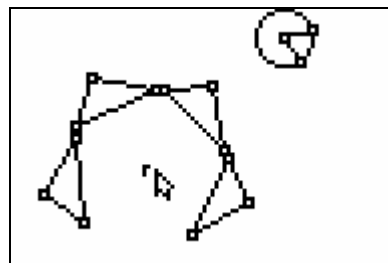
1. Create a triangle (see Activity 1, step 1) and a point not on it (sometimes called the **rotocenter**). Press **WINDOW** for the F2 menu. Move to **Point** and press **ENTER**. Move the pencil to a location right of the triangle and press **ENTER**.



2. In the upper right corner of the screen, draw a small circle. Press **WINDOW** for F2, move down to **Circle** and press **ENTER**. Move to the desired location of the center and press **ENTER**. Move to indicate the length of the radius and press **ENTER**. Press **CLEAR** to turn off the **Circle** tool. Place an additional point on the circle along with its radius point to form the angle of rotation. To do this, press **WINDOW** for F2, select **Point on** and press **ENTER**. Move the cursor to highlight the circle and press **ENTER**.



3. Generate the rotated image by selecting the triangle, the point, and the angle of rotation. Press the **TRACE** key, select the Rotation tool and press **ENTER**. Move the cursor to select the triangle, press **ENTER**, then select the point and press **ENTER**. Then select the angle of rotation by selecting the three points on the circle. Note that the points flash as the angle is drawn. Press **ENTER** to generate the rotated image. As in Activity 1, you can repeat this with the image as well. You can adjust the pattern by dragging the point of rotation. Be careful, this can get messy!



### **Extensions & Resources**

#### **Extension 1**

Generate a frieze using the reflection tool.

#### **Extension 2**

Create a frieze that uses multiple translations to create a pattern (i.e. translation followed by a reflection)? It has been shown that only seven varieties of frieze patterns exist. Why?

#### **Websites to explore:**

<http://mathforum.org/workshops/unioncity/2000/frieze.html>

[http://www.earthmeasure.com/index\\_earth.html](http://www.earthmeasure.com/index_earth.html)