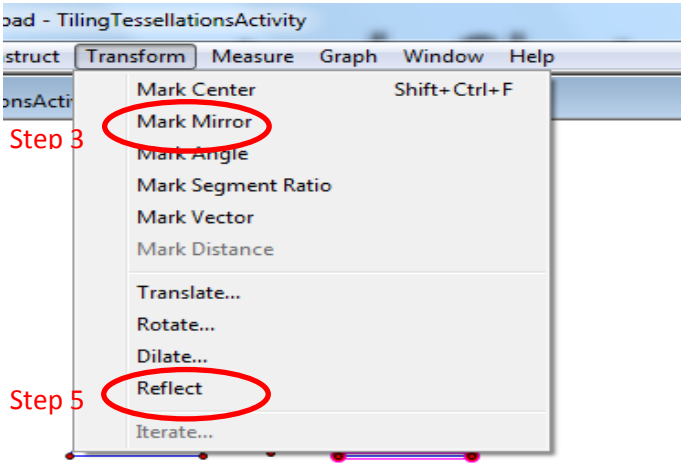
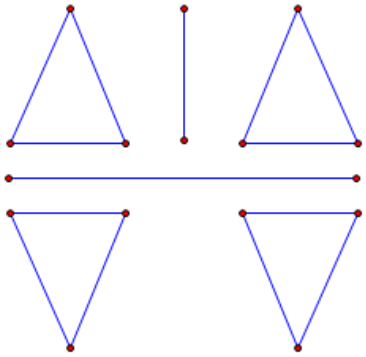
Presentation #16895, McAninch, **Tilings and Tessellations: Using Geometer's Sketchpad for Investigation and ProofReflections of a Triangle**

1. Use the segment tool to create a triangle.
2. Use the segment tool to create a vertical segment to the right of your triangle.
3. While this segment is still selected, go to the TRANSFORM menu and select the option **Mark Mirror**. (A screenshot to the right shows what the menu will look like. You should see some animation as Sketchpad marks the segment.)



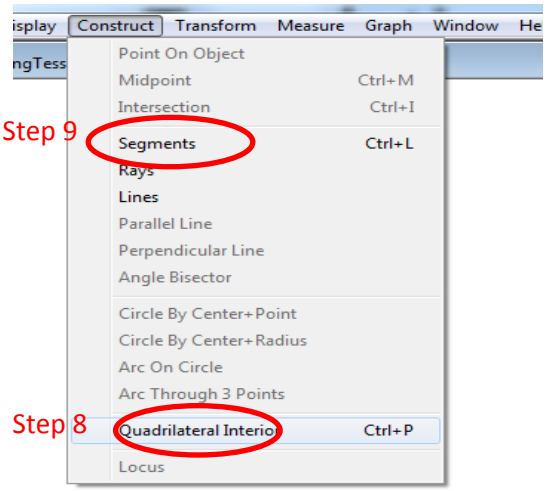
4. Now select the entire triangle (segments and points). The easiest way to select it is with a selection rectangle – with your selection tool, click somewhere above and to the left of your triangle and drag downward and to the right while holding your mouse button. Unclick when the entire triangle is shown as selected.
5. With the triangle selected, go to the TRANSFORM menu and choose **Reflect** (shown in screen shot at the right**)**. You should now see a mirror image of your first triangle on the other side of your vertical segment.



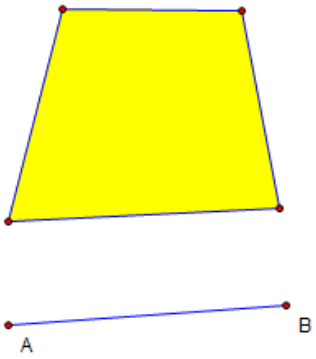
6. Construct a horizontal segment above your triangles. Mark it as a mirror and reflect both bottom triangles over it. Now you should see four triangles on your screen, as shown to the right.

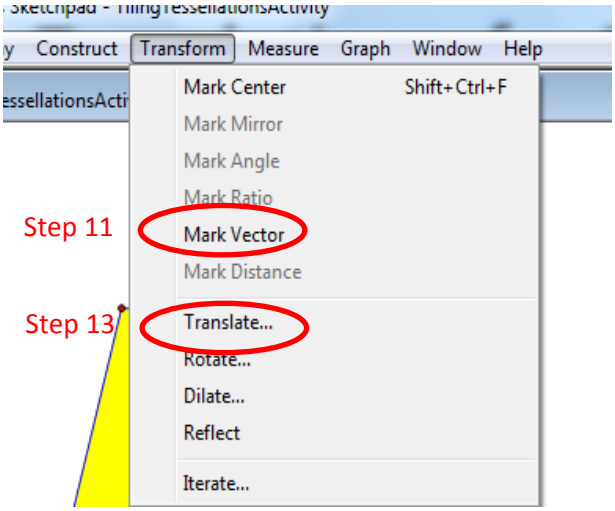
Translation of a Quadrilateral

7. First, you will construct the interior of a quadrilateral. With your point tool, make and select four points. Make sure that your quadrilateral is **NOT** a parallelogram.
8. With the four points selected, go to the CONSTRUCT menu and choose **quadrilateral interior**.
9. Now construct the four sides of your quadrilateral by selecting all vertices, go to the CONSTRUCT menu, and choose **construct segments**.

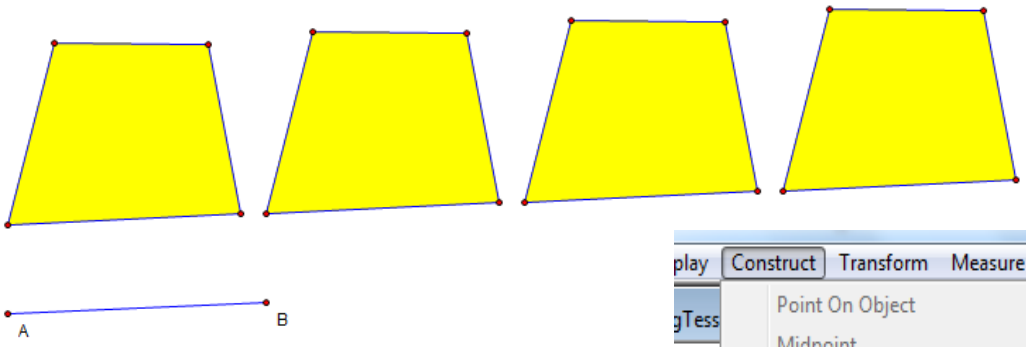


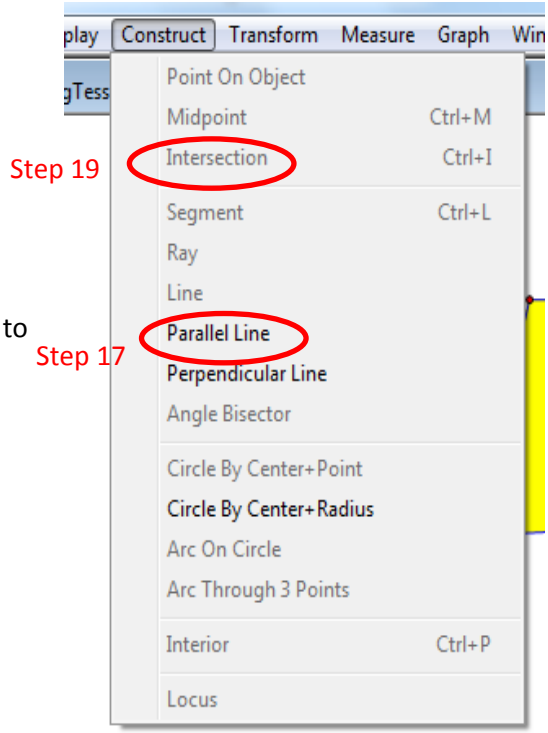
10. Now, use your segment tool to construct a segment outside of your quadrilateral. (It works best to construct the segment below your quadrilateral.) Label the endpoints A and B, then select each endpoint in order.





11. Now go to the TRANSFORM menu and choose **mark vector**. You should see some animation of point A and then B as the vector is marked.
12. Select the sides and interior of your quadrilateral with the selection tool. Using a selection rectangle is probably the easiest way to make sure you have selected everything you need.
13. In the TRANSFORM menu, choose the **translate** option. A dialog box will open. You want to click "translate" to translate by the marked vector. (Note that the radio button for **marked** is selected in the top section of the dialog box.)
14. Select the translated image (segments, endpoints, and interior) and go to TRANSFORM, **translate** again. (You don't need to mark the vector again.) Do this until you have 5 to 8 translated images in a row.

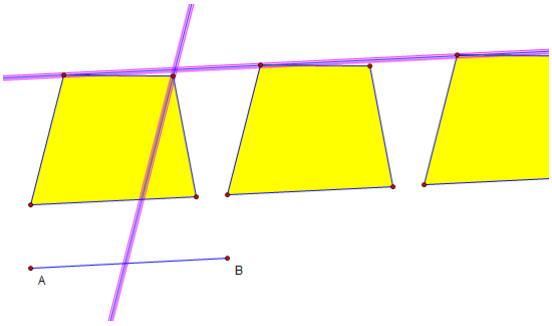


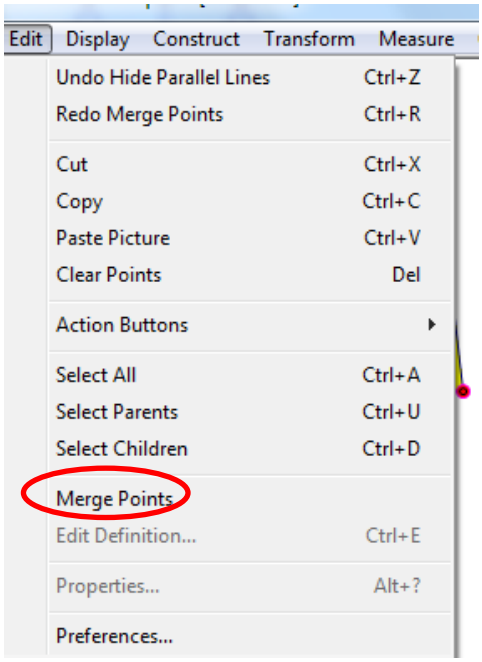


Tiling Parallelograms

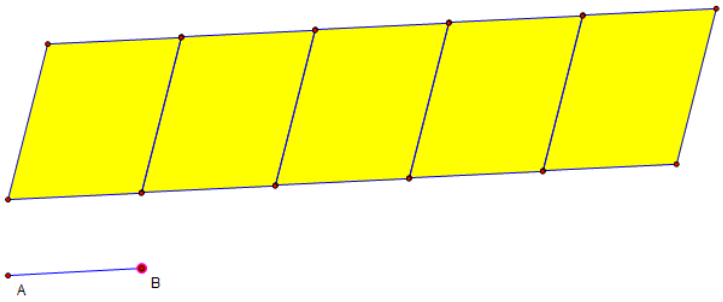
15. Oops! We goofed, and we actually needed to have a parallelogram. The good news is that we don't have to start all over! The **merge** command will help us out. Drag point B so that your images are spread farther apart.
16. We're going to change our quadrilateral into a parallelogram by redefining one of its vertices.

17. Choose one side of your quadrilateral and one of the opposite vertices and CONSTRUCT a **parallel line**.
18. Now choose a side adjacent to the first side you chose, and an opposite vertex, then CONSTRUCT another **parallel line** so that your two parallel lines will intersect at the location of your new fourth vertex.
19. Select both of your new parallel lines and go to CONSTRUCT **intersection**. You now have a fourth vertex to make a parallelogram!





20. Hide your parallel lines by selecting them, then under DISPLAY you'll chose "hide parallel lines."
21. Select your *old* fourth vertex and your *new* fourth vertex, then go to EDIT and choose **merge points**. Now you should see a parallelogram. Test it by dragging points to see that it holds its shape.
22. Now drag your segment AB until your parallelograms are pretty close together.
23. Mark a new vector from the bottom left vertex to the top left vertex of your original parallelogram. (Select the vertices in order, then go to TRANSFORM, **mark vector.**
24. Translate everything in your sketch except for segment AB and its endpoints by the marked vector. Repeat this 5-8 times.
25. Now drag point B until your parallelograms are touching. Now you should be able to see that parallelograms can tile the plane! In other words, they can fill the whole plane with no overlaps or holes.



26. Now we're going to fix our sketch so that our parallelograms will always tile the plane. Using EDIT, and choosing **merge**, you need to first merge point A to the bottom left vertex of your first parallelogram and then merge point B to the bottom right vertex of your first parallelogram.
27. Now test your construction. Do your parallelograms always tile the plane?

Creating Regular Polygons

To create a regular polygon with GSP, you only need a segment, rotation, and knowledge of the number of sides of your polygon and that a complete rotation is 360°.

This tutorial will walk you through steps for creating a regular hexagon, but these steps only need to be altered slightly (based on interior angles of the polygon you need) to work for any regular polygon.

1. Create a segment using the segment tool.
2. Using the selection tool, double click on one of the endpoints to mark it for rotation.
3. Select the entire segment, including endpoints. Then under the TRANSFORM menu, choose rotate. A dialog box will open and prompt you for an angle of rotation. Type 60° because a hexagon has six vertices and the full rotation (360°) needs to happen in six rotations.
4. You should now see two segments. Repeat step 3 four more times.
5. Now select all the vertices for your hexagon and go to CONSTRUCT **segments**.
6. Hide the original segment, the rotated segments, and the center point.
7. You should see a regular hexagon!