

A Sketchpad Ferris Wheel

Aim of this activity:

To use translations and geometric constructions to solve a problem

Problem:

How do we attach “seats” to our Ferris wheel and have them move whilst remaining upright and attached to fixed pivots?

Skills required prior to beginning the Ferris wheel:

- Sketches/Constructions using “Sketchpad” version 4: drawing a circle, sketching polygons, selecting/de-selecting & hiding objects, constructing interiors, marquee selections
- An understanding of the purposes and properties of translations
- An understanding of what perpendiculars are, and how they are constructed with “Sketchpad”

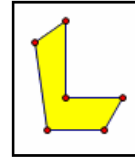


fig. 1

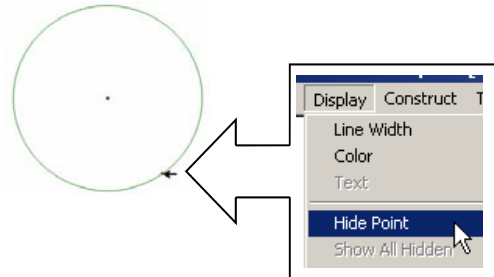


fig. 2a

1: Sketch and color the interior of one “chair” (fig. 1):

- Open a new, blank sketch
- On one side of your sketch, near the edge, sketch a chair-shaped polygon
- Construct the interior of the chair: for the time being, leave it at the default color

2: Draw a circle for the Ferris wheel:

- Draw a circle; de-select the completed circle
- Click on the point on the circle’s circumference, then from the menu bar: **Display > Hide Point** (fig. 2a)
- Click on the circumference of the circle, then using the menu bar: **Construct > Point on Circle** (fig. 2b)

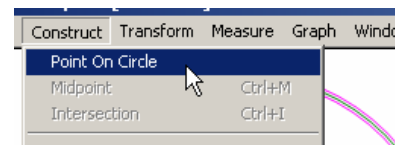


fig. 2b

3: Begin animating one part of the Ferris wheel:

- Click on the point you constructed in the step above
- In the menu bar, click **Edit > Action Buttons > Animation**
- For now, accept the default in the dialog box and click “OK” (there should be only one line of text in the box)
- A gray “animate point” button will appear: click it to animate the point, then click a second time to stop (you can also tap the “ESC” key once to stop the animation)

Animate Point

- **Note: only the point should move;** if the circle moves as well, undo back to the point where you constructed the point on the circle, and repeat these steps — it is essential that this step works properly in order that all of the following steps also work properly.
- Be sure to de-select the animation button before step 4.

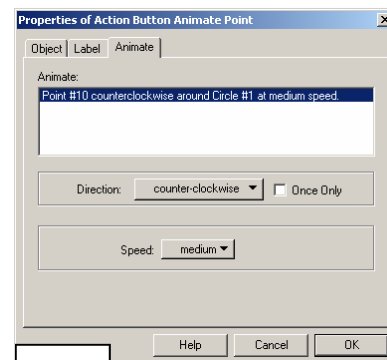
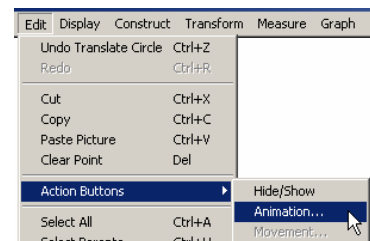


fig. 3b

4: Begin building the parts of the Ferris wheel:

- a. Add one spoke (fig. 4a)
 - i. Click the center of the circle, and click your point, then from the menu: **Construct > Line** (you will get a spoke that crosses through the center and through both sides)
 - ii. De-select everything
- b. Add another spoke, perpendicular to the first one (fig. 4b)
 - i. Click the point in the center of the circle, and the line you just constructed, then from the menu: **Construct > Perpendicular line** (you will get a spoke that crosses through the center and through both sides)
 - ii. Check that the spokes will move in unison by clicking the animate button you made in step 3
- c. Clean up your spokes:
 - i. Click one of the straight lines and click the edge of the circle (not on the point), then from the menu: **Construct > Intersections** (this will give you points at the exact spots where the line crosses the circle)
 - ii. Repeat this step for the other line - you should end up with 4 points exactly 90° apart around the circle (fig. 4c): these should move in unison when you animate
 - iii. Click both of the lines that cross beyond the circle, then from the menu: **Display > Hide** (you will now have just a circle with a center point and 4 points spaced 90° apart around the circumference, fig. 4d)
- d. Construct two diameters that will become the spokes within the wheel: (fig. 4e)
 - i. Click opposite points, then **Construct > Segment**
 - ii. Repeat with the remaining pair
 - iii. Check that these move in unison when animated.

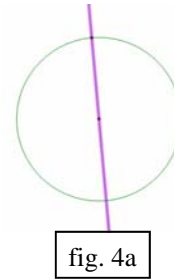


fig. 4a

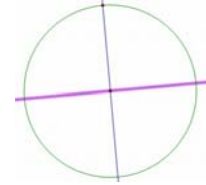


fig. 4b

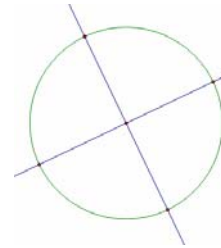


fig. 4c

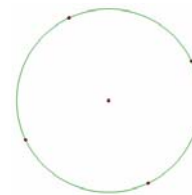


fig. 4d

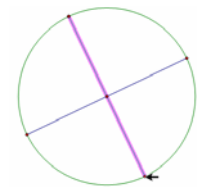


fig. 4e

5: Attach the seat to one point:

- a. Click the top of the seat (that is, the point that will attach to the Ferris wheel)
- b. Click the point on the Ferris wheel to which you want to attach the seat (both of these points need to be clicked in this order, and remain highlighted)
- c. From the menu, click: **Transform > Mark Vector** (you should see a series of dashes travel from the first point clicked towards the second point clicked) (fig. 5a)
- d. Now select the entire seat with a marquee select, so that all points, segments, and the interior of the seat are selected (fig. 5b)
- e. From the menu, click: **Transform > Translate** (a translation of the seat should attach to the point you selected on the Ferris wheel.)
- f. Animate your wheel: the seat should move with the wheel, and stay in the same position (vertically)

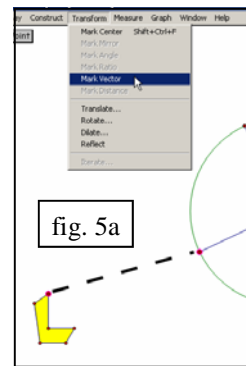


fig. 5a

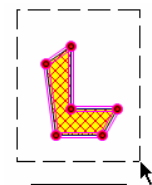


fig. 5b

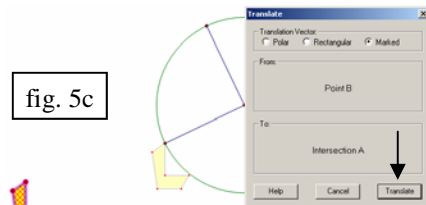


fig. 5c



6: Complete the Ferris Wheel:

- a. Repeat all of the fifth step to attach translations of the seat to the other three points on your Ferris wheel
 - b. After all seats have been attached (and move with the Ferris wheel as it turns), click the interior of one seat, then from the menu, click: **Display > Color > [choose a color]**; repeat for each of the other seats.
 - c. Your Ferris wheel is more or less complete at this stage: save it before trying any of the embellishments or challenges.
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Embellishments:

- The edge of a Ferris wheel is usually thicker than its spokes. What tool in the “Display” menu would allow you to show that?
 - Right now, this Ferris wheel is floating in space. Add a supporting frame so it stands on the ground.
 - Your original seat is no longer needed, so you can hide it (marquee select, then Display > Hide).
 - Right-click on the “Animate” button, then select “Properties”: this will allow you to change the speed and direction of the wheel. Experiment with different combinations.
 - Clicking any object on your Ferris wheel then clicking Display > Color permits you to change its color: experiment with different colors to obtain a color scheme appropriate for the carnival atmosphere in which a Ferris wheel is usually found.
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Challenges:

- Sketch a little person to sit in your seat, then use translations to place copies of that person in all of the seats (consider hiding your original person once this is done).
 - Make an 8-seater Ferris wheel with the seats equally spaced around the wheel.
 - Make a 3-seater Ferris wheel, then a 6-seater.
 - As the wheel turns, use the original seat or person drawing and adjust it: can you change the seat so it faces the other way? Can you make your people seated on the Ferris wheel wave?
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Questions:

1. What construction ensured that the points on the circle (to which the seats attached) were exactly 90° apart?
 2. What part of the construction ensured that the other points on the Ferris wheel moved in unison with the first point animated?
 3. Why did we translate the chair to its points rather than simply copy and paste copies of the chair?
 4. One of the challenges was to make an 8-seater: even if you didn't make the 8-seater, how can you figure out the number of degrees needed to space the seats out equally (regardless of the number of seats).
 5. When doing this construction, what one thing stands out as a skill to which you most needed to pay attention? Explain your reasoning.
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