- Two large diagonals can make any parallelogram.

- A large diagonal & a short diagonal can make any type of rhombus or kite.

- Any group of diagonals that produce a rhombus or kite may also be used to produce any trapezoid or trapezium.

- That you cannot stick any two diagonals together via their end points.

- Diagonals used in producing kites, rhombus, trapezoid or trapezium can not produce square, rectangle but they can produce a parallelogram.
With 2 large diagonals you can make any rectangle, square or parallelogram.
Produced by using 2 large diagonals crossed at each other midpoints but the mp do not form 90° ∠.
- A parallelogram is constructed with the use of a long diagonal connected to a short diagonal.

- Although most common shape is a trapezoid.
The trapezium is the easiest shape to produce.

- It can be produced using any combination of diagonals.
Different Trapezoid
Why is it that a rhombus can produce a trapezoid, trapezium, kite, & a parallelogram but why can't a kite?

What other types of shapes can we produce that we might have missed?
I think that I did extremely well in documenting our process or observations.

I think that I noted my observations carefully, so that my work “evolved” through my observations in a clear way.

I believe I could have improved my English quality a little bit because they seem a little sloppy.
1) Make a polygon rigid?

2) Sticks on sides?

3) 

4) 

5) 

6) Trapezoid

- Rotated diagonals
- One side always parallel
- Any point will do

7) Rhombus:

- Select center of one stick, place new stick on top (in center);
- Despite diff in lengths of sticks, the midpoint must create 2 congruent segments out from intersection.
- Sides will be parallel always.
- Placed at right angles, sides =

8) Parallelogram:

- One short stick, one long stick, connect both @ center.
If the diagonals bisect each other, and the diagonals are not perpendicular, and the lengths are the same, then the quadrilateral is a rectangle.

Rectangle: A parallelogram in which all Ls equal 90°.

Rhombus: A parallelogram in which all sides are equal.

If the diagonals bisect each other, and the diagonals are not perpendicular, and the lengths are the same, then the quadrilateral is a rhombus.

1) The diagonals DE and AC are the same length.
2) The diagonals' bisectors are congruent (AE, DE, BE, EB)
3) ΔAEB, ΔAED, ΔBAC, ΔDAC are isosceles

Prove 90°: A quadrilateral's angles = 360°
Addition of same angles = same angles
360° ÷ 4 = 90°

This material accompanies a videotaped lesson on Inside Mathematics (www.insidemathematics.org): Decimal Place Value: Public Lesson. Austin, Texas: the Charles A. Dana Center at The University of Texas at Austin.
**Rectangle:**

1. \( \overline{AD} \equiv \overline{CB} \)  
2. \( \overline{AE} \equiv \overline{ED} \equiv \overline{CE} \equiv \overline{BE} \)  
3. Division Property of Segments  
4. \( \angle AEB \equiv \angle CED \)  
5. Vertical angles are \( \equiv \)  
6. \( \angle AEC \equiv \angle BDE \)  
7. \( \triangle AEB \equiv \triangle CED \)
Parallelogram:

Proving triangles congruent... won't prove the conjecture.
Mar. 3, 2004

How is it possible to place sticks so that they make rigid quadrilaterals and can be described as one special type or another?

What I think I did well: state my questions, conjectures and made diagrams as I went along.

What I think I need to improve on: Recording my first observations which lead to my conjectures.
This material accompanies a videotaped lesson on Inside Mathematics (www.insidemathematics.org): Decimal Place Value: Public Lesson. Austin, Texas: the Charles A. Dana Center at The University of Texas at Austin.
<table>
<thead>
<tr>
<th>Statements</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. $E$ is the midpoint of $AC$</td>
<td>Given</td>
</tr>
<tr>
<td>2. $E$ is the midpoint of $BD$</td>
<td>Given</td>
</tr>
<tr>
<td>3. $\angle AEB \equiv \angle DEC$</td>
<td>Vertical angles</td>
</tr>
<tr>
<td>4. $\angle AED \equiv \angle CEB$</td>
<td>Vertical angles</td>
</tr>
<tr>
<td>5. $\triangle DEC \equiv \triangle BEA$</td>
<td>SAS</td>
</tr>
<tr>
<td>6. $AB \parallel DC$</td>
<td></td>
</tr>
</tbody>
</table>

Alternate interior angles prove two lines to be parallel.
1. Use a compass to draw several circles. Each circle must have the same radius and the center of any new circle drawn must be on the circumference of an already existing circle. See what design you can create.

<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td>( AD \cong BC )</td>
<td>( \text{Given} )</td>
</tr>
</tbody>
</table>

2. Using the circles you’ve drawn construct an equilateral triangle (note: you may need to add more circles).

Criteria: The circles need to be carefully constructed so that the radius does not change, even a little bit. Keep your pencil sharp, and make sure the intersections are precise. And the straight lines must be constructed with a straightedge! Keep practicing!
• How many shapes do we need to do?
• How can we explain the diagonals on a trapezoid?
• Do we have a lot of information or little?

I think I did well when I was drawing the diagonals of each polygon, and finding the position of them.

I think I can improve by taking more notes and ideas so that I don’t lose track of what I’ve done.
All sticks have 9 holes; $2(9^3)$ possibilities

2(81)

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Blk 1 3/3/09
If the diagonals bisect each other

and the diagonals are not perpendicular

and the diagonals have same lengths

then the quadrilateral is a rectangle.

Rectangle: A parallelogram in which all angles are equal to 90°.

- \( \triangle ABE \cong \triangle CED \) (SAS)
- \( \overline{CD} \cong \overline{AB} \) (CPCTC)
How do you solve for a trapezoid only with the diagonals?

I think I did well in drawing the shapes. But I think I can improve on writing down my thoughts.
kite
- only one stick can be in the center
- two lines always perpendicular

Sh
- lo

Square
- fastened middle of each line
- lo • Same amount of holes on each side of line
- lo • lines perpendicular

Rectangle
- fastened middle of each line
- doesn’t have to be perpendicular

Parallellogram
- square rect
- long stick short

Rhombus
- short long - has to be perpendicular
- long long

Trapezoid
- can’t use center
- long short
- long long
- angle doesn’t matter

Trapezium
- any two sticks in any hole

All - can’t use top or bottom hole because that forms a triangle
Kite

Non Iso Trap
- fastened at the same number hole
- can't be fastened in center

Proof Parallelogram

<table>
<thead>
<tr>
<th>Statement</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ( \triangle CED \cong \triangle AEB )</td>
<td>1. SAS</td>
</tr>
<tr>
<td>2. ( \triangle BEC \cong \triangle AED )</td>
<td>2. SAS</td>
</tr>
<tr>
<td>3. ( \angle BDC \cong \angle BCD )</td>
<td>3. CPCTC</td>
</tr>
<tr>
<td>5. ( AB \parallel DC )</td>
<td>5. alternate interior angles</td>
</tr>
<tr>
<td>6. ( AD \parallel BC )</td>
<td>6. alternate interior</td>
</tr>
<tr>
<td>4. ( \angle BCA \cong \angle CAD )</td>
<td>4. CPCTC</td>
</tr>
</tbody>
</table>
How can we prove the rectangles' corners are 90° angles?

I think I did well in organizing my thoughts because each shape has its own section with observations. I think I can improve by using lines to separate the work so that two shapes' observation won't look like one. Write more notes.
center point on both can create a rhombus see below

center point on one can create a kite see below

center point on none, but same distance

square
rectangle
rhombus
(parallelogram)

center points on both sticks, any combination of sticks

center points on one stick, any combination of sticks

center points on both sticks, both long sticks, 90° angles

center points on both sticks, any combination of sticks

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Trapezoid

both points equidistant to end points, both long sticks
Statements | Reasons
--- | ---
$m_{BC} = \frac{2}{5}$ | slope formula and points
$m_{AD} = \frac{3}{5}$ | slope formula and points
AD \parallel BC | slopes are =
$m_{AB} = -3$ | slope formula and points
$m_{CD} = -3$ | slope formula and points
AB \parallel CD | slopes are =
\[\Box ABCD \text{ is a parallelogram}\]

Statements | Reasons
--- | ---
$m_{FD} = 0$ | slope formula and points
$m_{FG} = 0$ | slope formula and points
FD \parallel FG | slopes are =
\[\Box DEFG \text{ is a trap}\]
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Which sticks have the most shapes that can be made?

Why doesn't the kite make custom orders?
What I think I did well:
getting information on the paper about the shapes we made.

What I think I could improve next time:
being specific yet clear in my data.
1. Trapezoid (?)

Using the two big pieces, you can make a trapezoid as long as they both have the same distance (in holes)
2. Rhombus (?)

using the center of the little piece and any length of the big piece you'll get any type of kite

Any of the diagonals that produce a rhombus / kite can also make any trapezoid or trapezium.

Small and big diagonals can't be used to make a square or rectangle. But they can produce a parallelogram.
4. Parallelogram
   (Made with one big and one small piece.)
   Both in the center at an angle.
I wonder if we can produce any other quadrilaterals using all three of the pieces other than a trapezoid.
I think that we did good as a group because when ever we found out about something that was new we shared it with the group and wrote it down.

I think I can improve by thinking more about the work geometrically over too much tinkering.