Name: _____ Date: _____

MORE PROPERTIES OF LINES
COMMON CORE GEOMETRY

Given that most geometric figures that we study will be comprised of straight line segments, it is important for us to review some basic assumptions that we make about lines. These are known as **axioms** or **postulates.** They are facts that we take as being true *without being able to prove or disprove them*.

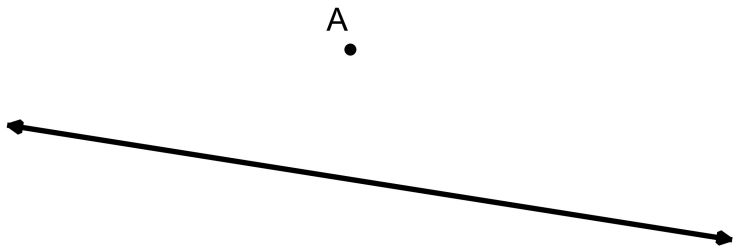
***Exercise* #1:** For each of the following axioms about straight lines, try to draw a picture to disprove the fact. Discuss. Keep in mind that we are talking about straight lines that extend forever in two directions.

(a) Through any two points, only one straight line can be drawn.

(b) The shortest distance between any two points is comprised of the length of the straight line segment connecting them.

(c) Two **different lines** will either share (intersect at) one point or share none at all (known as parallel lines). Any two lines that share two or more points are the same line.

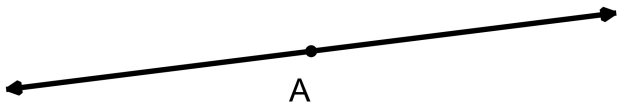
(d) Through any point *not* on a given line, there is exactly one line that can be drawn parallel to the given line (this is famously known as **Euclid's Parallel Postulate**).



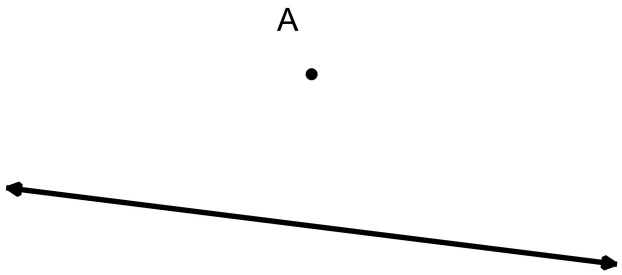
Every one of these axioms is used in geometric proof and it is important to understand that we take them to be self-evident properties that need no proving. Other facts we will prove based on these properties. The next exercise continues with axioms that we will assume to be true.

***Exercise* #2:** For each of the following axioms, try to draw a picture to disprove the fact. Discuss. Keep in mind that we are talking about straight lines that extend forever in two directions.

(a) Through any point on a given line, exactly one line can be drawn perpendicular to the given line.



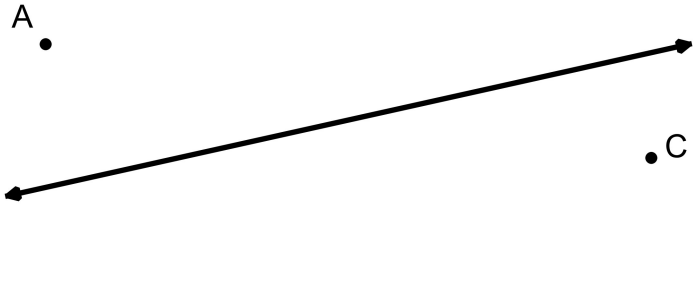
(b) Through any point *not* on a given line, exactly one line can be drawn perpendicular to the given line.



(c) A given line separates the plane into two halves (known as **half-planes**):

(i) Any point in the plane lies in only one of the half-planes or on the line.

(ii) Two points are on opposite halves if and only if the segment connecting them intersects the given line.



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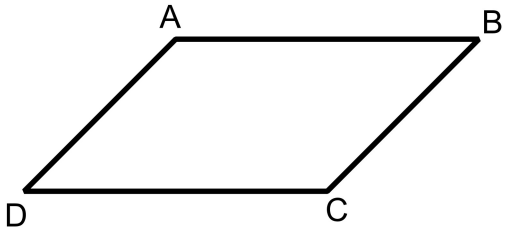
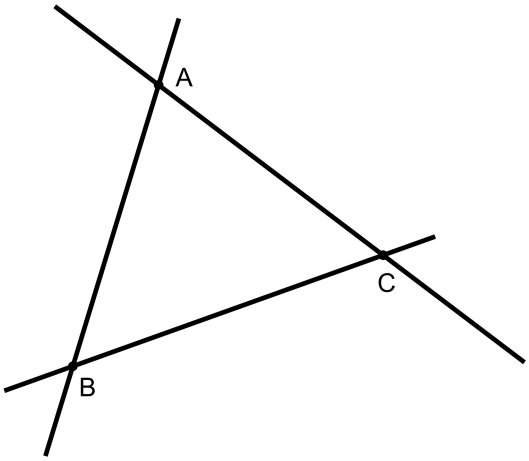
MORE PROPERTIES OF LINES
COMMON CORE GEOMETRY HOMEWORK

REASONING

1. A parallelogram is a four sided figure that has two pairs of parallel, opposite sides. Parallelogram $ABCD$ is shown below. If another line was drawn parallel to $\overleftrightarrow{CD}$ passing through A, explain why it must fall on $\overleftrightarrow{AB}$.



2. In the following diagram which is not drawn to scale, why can't both $\overleftrightarrow{AB}$ and $\overleftrightarrow{AC}$ be perpendicular to $\overleftrightarrow{BC}$?

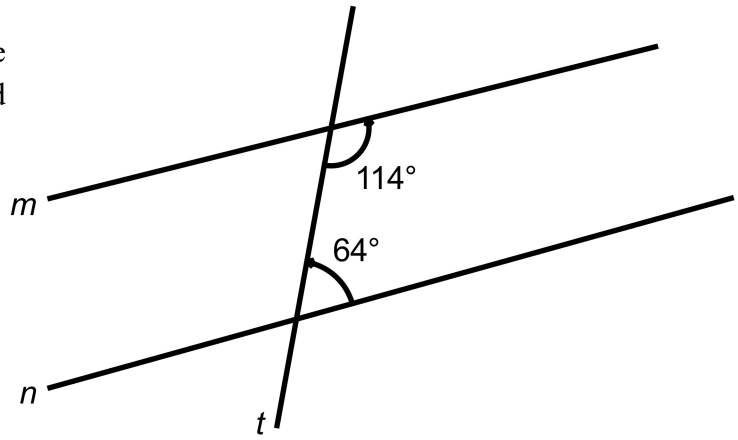


3. In Exercise #2(c) from the class work we saw that a segment connecting two points on opposite sides of a given line must intersect that line. Is it always true that a line connecting two points on the *same* side of given line will be parallel to that given line?

4. Euclid's Parallel Postulate (read it again from the class work) is sometimes phrased as the following:

   Two straight lines that are crossed by a transversal will only be parallel if the sum of the two interior angles formed on the same side of the transversal is equivalent to the sum of two right angles.

   (a) In the diagram shown, lines *m* and *n* are crossed by transversal line *t*. Why are *m* and *n* not parallel?



   (b) On which side, the right or left, of the transversal will *m* and *n* intersect?

   (c) Can you determine a way to know, based on (b), on which side of a transversal two non-parallel lines will intersect?

5. Geometry can be full of patterns. In the very first axiom about straight lines we assume that through any two points, there can be only one straight line drawn. But, what if we have three points? Four points? 11 points?

   (a) Assuming you have three non-collinear points, how many unique straight lines can be drawn?

   (b) Assuming you have four points, no three of which are collinear, how many unique straight lines can be drawn?

   (c) There is a pattern you can exploit to predict how many straight lines can be drawn through any number of points. Fill in the table below based on (a) and (b) and see if you can predict the number of straight lines with 5 points.

Points	2	3	4
Lines	1		

   (d) Test your conjecture on the five points shown