

# GEOMETRY

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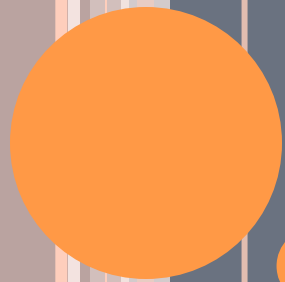
**Boise State University**



# THE STRUCTURE OF GEOMETRY

- Space (Describing the world around us)
  - Measuring
  - Maneuvering
    - Transformations
    - Locations
  - Boundaries
    - Defining or Describing Space (including visualization)
    - Dimensions
    - 2-d, 3-d
- Shapes
  - Attributes and properties
  - Composing/Decomposing
  - Congruency and similarity
    - Growing and Shrinking
    - Transformation





# PAPER AIRPLANE ACTIVITY

# BUILDING A PAPER AIRPLANE

- Build one of the two paper airplanes (see templates) and then complete the tasks on the next page.

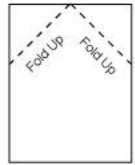


# GLIDE RATIO

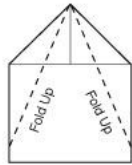
- Before flying your airplane, answer the following questions as best as you can (without conducting any measurements).
  - How far can your airplane fly if it thrown from an altitude of 8 feet?
  - What is the steepness of the flight path?



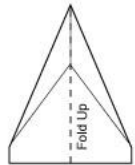
# TRADITIONAL AIRPLANE & PL-1



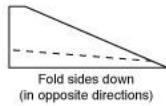
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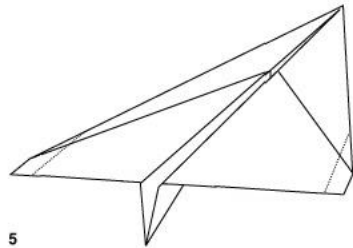
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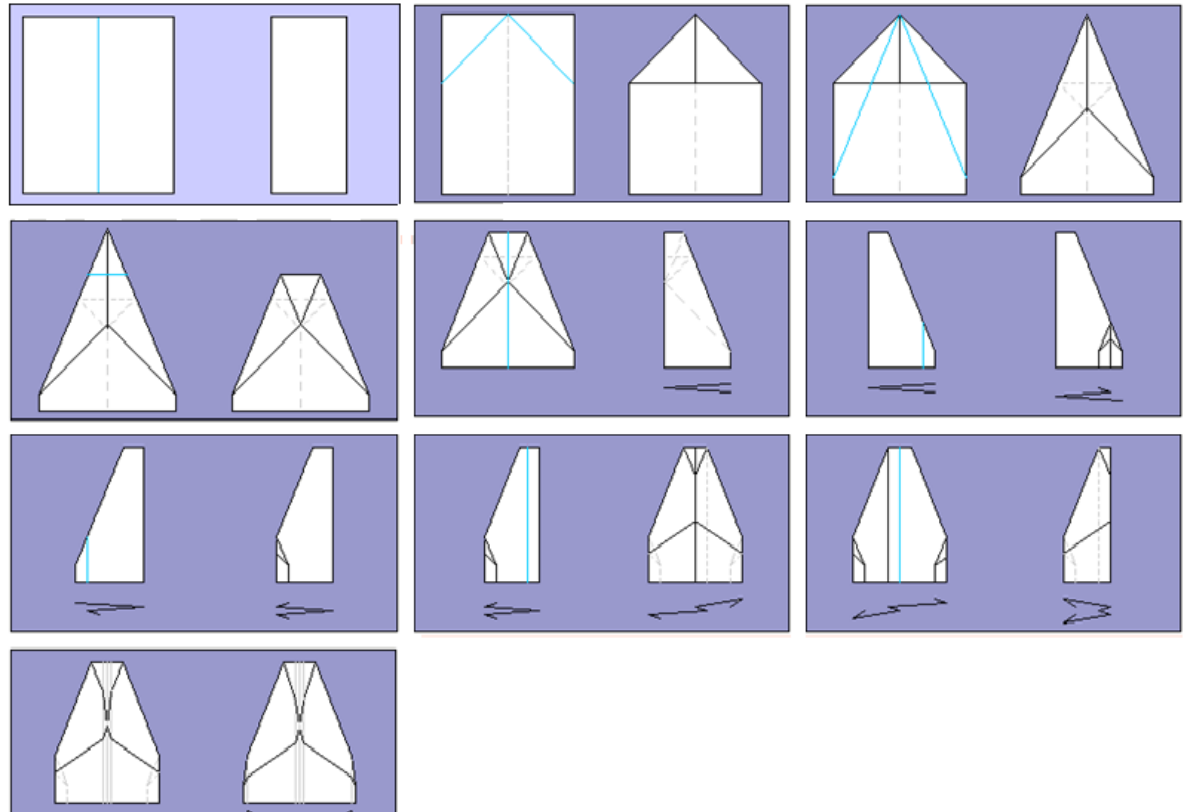
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4



5



# FLIGHT TEST

- Toss your airplane 3 to 5 times from some given altitude (or height). Write it down.
- Measure the horizontal or “ground” distance your airplane flew.
- Use your best flight and determine your glide ratio (height:distance)



# FLIGHT TEST

Group	Glide Ratio	Picture of flight Path	Angle
1			
2			
3			
4			
5			
6			



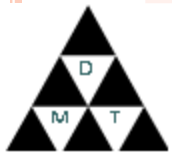
○ Whose airplane flew the farthest?



# HANG GLIDER

- Pretend your airplane is a hang glider that has the same glide ratio as your airplane.
- How much ground distance does the glider cover from jumping off a cliff of . . .
  - 12 meters, 25 meters, 53 meters, 187 meters
  - Build a ratio table to organize your data.

Ratio Table					
Height					
Distance					



# VISUAL FLIGHT PATTERN

- One hang glider we measured could cover 96 meters on the ground when jumping off a 12 meter cliff.
- Draw a side view of the flight path for this glider.



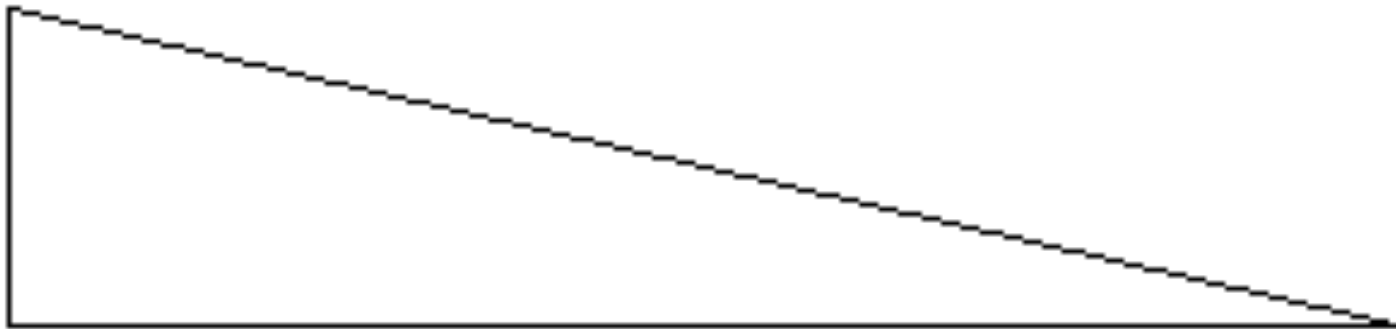
- Complete the following ratio table with the data from the new glider:

Ratio Table					
Height		24	96		
Distance				228	1000



# RACHEL'S PAPER AIRPLANE

- Here is the flight path of Rachel's airplane.
- What is its glide ratio?
- Does it fly farther than yours? Mathematically explain why/why not?
- How far does Rachel's airplane fly if launched from an altitude of 3 meters?



# GLIDE RATIOS

- If a glider has a ratio of 1:8 and flew 120 meters on the ground. What altitude did it take off from?
- Make a scale drawing of the following glide ratios:
  - 1:1      1:2      1:4      1:10      1:20
- Use the circle compasses to determine the angle measure of each.



# TANGENT AND STEEPNESS

- *Steepness in the case of airplanes and gliders is the ratio or comparison of the height and the ground distance. If you divide these two numbers you get the tangent.*
- Use the tangent table on the next page or your calculator to convert the ratios on the previous page to an angle measure in degrees.



# TANGENT TABLE

Angle	Tangent	Angle	Tangent	Angle	Tangent
0	.000	3	.052	6	.105
9	.158	12	.213	15	.268
18	.325	21	.384	24	.445
27	.510	30	.577	33	.649
36	.727	39	.810	42	.900
45	1	48	1.111	51	1.235
54	1.376	57	1.540	60	1.732
63	1.963	66	2.246	69	2.605
72	3.078	75	3.732	78	4.705
81	6.314	84	9.154	87	19.081



# TANGENT

- Find the glide angles for each of the glide ratios below:

Ratio Table					
Glide Angle (alpha)					
Glide Ratio (h:d)	1:1	1:2	1:4	1:10	1:20

- Glide ratios can also be expressed as percents. Create another row to your ratio table and add the percentages.
  - In road construction this is called the road's "grade".



# TANGENT AND STEEPNESS

- If your airplane is thrown from an altitude of 15 feet and has a glide ratio of 1:22, then . . .
  - What is the steepness of your airplane's glide path?
    - Use a circle compass
    - Use the ratio and tangent table
  - What is the grade of your flight path?
  - How far does your airplane fly on the ground?
  - How far does your airplane actually fly?



# THE SAFEST GLIDER

- Which of the following gliders is the safest or can fly the farthest?
  - Glider 1                      1:27
  - Glider 2                      0.05
  - Glider 3                      3/78
  - Glider 4                      5 degrees
  - Glider 5                      4% Grade
  
- Write a conjecture regarding the glide angle and the safety or quality of the glider?



# OTHER TASKS

- If the angle is 35 degrees, how much ground distance does a glider cover from a height of 100 meters?
- Why does  $\tan 45 \text{ degrees} = 1$ ?
- What angle has a tangent of 2? Of 3? Of 4?
- How much does the measure of the angle change when the tangent value changes from:

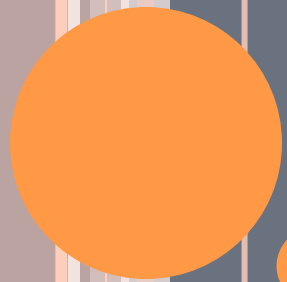
0 to 1	1 to 2	2 to 3	3 to 4	4 to 5



# FINAL TANGENT TASK

- A glider with a glide ratio of 1:28 is launched after being pulled by an airplane to 1,200 meters above Lake Havasu City in Arizona. Indicate on the map how far the glider can fly if there is no wind.
- How far did the glider fly in the air?





# STRUCTURAL IDEAS

# RETURNING TO THE DMT 5 BIG IDEAS

- Centrality of students' ideas
  - using students' strategies to build models
- Encouraging multiple solution strategies
  - using contextual, open-ended tasks to elicit students' ideas
- Pressing students conceptually
  - developing models of students' strategies
- Addressing misconceptions
- Maintaining a focus on the structure of the mathematics
  - keeping the mathematical 'big ideas' in the forefront



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