



Activity 1
Industrial Design: The Geometry of Bicycle Designs

A. Road Bike or Racing Bike (Cannondale™ Saeco Team Replica)

1.

| | |
|------------|-----------------------------------|
| Frame Size | 2.7 cm or 1 1/8 in |
| Chain Stay | 2 cm or 3/4 in |
| Seat Angle | 76 degrees (between 73 and 79 ok) |
| Head Angle | 73 degrees (between 70 and 76 ok) |
| Back Angle | 76 degrees (between 73 and 79 ok) |

2.

$$\frac{2.7 \text{ cm}}{2 \text{ cm}} = 1.35$$

$$1\frac{1}{8} = \frac{9}{8} = \frac{9}{8} \cdot \frac{4}{4} = \frac{3}{2} = 1.5$$

B. Mountain Bike or Trail Bike (Cannondale™ F700)

1.

| | |
|------------|-----------------------------------|
| Frame Size | 2 cm or 3/4 in |
| Chain Stay | 2 cm or 3/4 in |
| Seat Angle | 90 degrees (between 87 and 93 ok) |
| Head Angle | 85 degrees (between 82 and 88 ok) |
| Back Angle | 47 degrees (between 44 and 50 ok) |

2.

$$\frac{2}{2} = 1$$

$$\frac{\frac{3}{4}}{\frac{3}{4}} = 1$$

C. BMX Bike (Huffy™ BMX)

1.

| | |
|------------|-----------------------------------|
| Frame Size | 1.2 cm or 1/2 in |
| Chain Stay | 1.8 cm or 3/4 in |
| Seat Angle | 84 degrees (between 81 and 87 ok) |
| Head Angle | 87 degrees (between 84 and 90 ok) |
| Back Angle | 41 degrees (between 38 and 44 ok) |

2.

$$\frac{1.2}{1.8} = 0.67 \qquad \frac{\frac{1}{2}}{\frac{3}{4}} = \frac{1}{2} \cdot \frac{4}{3} = \frac{2}{3}$$

D. Questions about all three bikes.

1. Road bike has the highest ratio, followed by Mountain bike, then BMX. Road bikes are designed for speed and long, continuous rides. The higher ratio makes peddling in high gears easier and makes for more comfortable leg movement. The low-ratio bikes have a lower center of gravity making them more stable, less likely to tip over on rough terrain on a Mountain bike or while doing tricks on a BMX. Also, bikes with low ratios are capable of bursts of speed whereas high-ratio bikes are better suited for steady speeds.

2. A large back angle produces a large frame size (the side opposite the large angle in the back triangle). The smaller back angle produces a bike that is shorter and closer to the ground giving it a lower center of gravity and making it more stable (less likely to tip over).

The head angles for the three bikes were nearly the same (within a few degrees of each other). The head angle is related to the position and comfort of the rider (about the same for all bikes).

The seat angle on each bike is nearly the same too. The seat angle is designed for comfort and to match how the legs fit to the pedals.

3.

a. The thickness of each tube is different from that of the others. The main tube is very thick to provide support. Also, the tube holding the seat is very thick.

b. New, stronger metal has become available (titanium and chromium). These metals are light but very strong and can support unusual designs. Designs using triangles produce the greatest support. If the metal is strong enough, the design can involve other shapes.