



Full Name: \_\_\_\_\_ Date: \_\_\_\_\_ Block: \_\_\_\_\_

## Are you Leonardo da Vinci's Vitruvian Man?

### Procedure

- Work with a partner as you will need help measuring each other's body structures.
- Measurements are needed for each partner.
- Use centimeters (cm) for all your measurements with an accuracy to 0.1 cm (i.e. 1 mm).
- Record all your information in the provided table.
- Continue the measuring process for each of identified body structures.
- Answer the following questions, show your work for any necessary calculation.

Measurement Accuracy:  $\pm$  \_\_\_\_\_

### Part I: Body Structure Measurements

What to measure	Measurement (cm)
<b>Height:</b> top of your head to the floor when standing up straight against a flat surface. (No Shoes On)	
<b>Arm Span:</b> the distance from fingertip to fingertip with your arms outstretched	
<b>Palm Width:</b> the distance across your first row of knuckles.	
<b>Face Length:</b> the distance from your hairline (where your forehead stops, and the hair begins) to the bottom of your chin.	
<b>Hand Length:</b> the length of your hand from the bottom of your palm to the tip of your longest finger.	
<b>Forearm Length:</b> The distance from your elbow to the tip of your longest finger.	
<b>Shoulder Width:</b> the width of your shoulders with your arms straight against your side.	
<b>Humerus Length:</b> the distance from your elbow to your armpit.	
<b>Foot Length:</b> the distance from the back of your heel to the tip of your longest toe.	
<b>Head Length:</b> the distance from the top of your head to the bottom of your chin.	
<b>Head-to-Sternum Length:</b> the distance from the middle of the chest to the top of the head.	

According to the Da Vinci the “ideal” proportions of the Vitruvian Man are as follows:  
(Calculate as Percent)

- a) Your Body Height = Arm Span
- b) Your Body Height = Palm Width  $\times$  24
- c) Your Body Height = Face Length  $\times$  10
- d) Your Body Height = Hand Length  $\times$  10
- e) Your Body Height = Forearm Length  $\times$  4
- f) Your Body Height = Shoulder Width  $\times$  4
- g) Your Body Height = Humerus Length  $\times$  8
- h) Your Body Height = Foot Length  $\times$  7
- i) Your Body Height = Head Length  $\times$  8
- j) Your Body Height = Head-to-Sternum Length  $\times$  4

#### Vitruvian Man Measurements

- k) A **palm** is the width of four fingers and a **foot** is the width of four palms (i.e., 12 inches or 30.5 cm).
- l) A **cubit** is the width of six **palms** and a **pace** (i.e. a step) is four cubits.

## Part 2: Body Structure in Relation to Other Body Parts

What to measure	Measurement (cm)
<b>Head-to-Belly Button:</b> the distance from top of head to belly button.	
<b>Belly Button-to-Feet:</b> the distance from belly button to the bottom of feet (together)	
<b>Fingertip-to-Shoulder:</b> the length from fingertip to the opposite shoulder.	
<b>Head-to-Fingertip:</b> the length from top of head to fingertip with your arms straight against your side.	
<b>Fingertip-to-Feet:</b> the length from your fingertip to the ground with your arms straight against your side.	
<b>Shoulder-to-Elbow:</b> the length from your shoulder to your elbow	
<b>Elbow-to-Wrist:</b> the length from your elbow to your wrist.	
<b>Elbow-to-Fingertips:</b> the length from your elbow to your figure tips.	
<b>Wrist-to-Fingertips:</b> the length from your wrist to your figure tips	
<b>Knee-to-Foot:</b> the length of shin from feet to knee.	
<b>Belly-Button-to-Knee:</b> the length of your knee to belly button	
<b>Hand Structure</b>	
<b>Wrist-to-1<sup>st</sup> Knuckle:</b> the length from your wrist to first knuckle of middle finger.	
<b>1<sup>st</sup> Knuckle-to-2<sup>nd</sup> Knuckle:</b> the length from your first knuckle to second knuckle of middle finger.	
<b>2<sup>nd</sup> Knuckle-to-3<sup>rd</sup> Knuckle:</b> the length from your second knuckle to third knuckle of middle finger.	
<b>3<sup>rd</sup> Knuckle-to-Fingertip:</b> the length from your third knuckle to fingertip of middle finger.	

Calculate the following proportions to an accuracy of four (4) decimal places.

- a) The ratio of Body Height to Fingertip-to-Shoulder:
- b) The ratio of Belly Button-to-Feet to Head-to-Belly Button:
- c) The ratio of Head-to-Fingertips to Fingertip-to-Feet:
- d) The ratio of Belly Button-to-Knee to Knee-to-Foot:
- e) The ratio of Elbow-to-Fingertip to Shoulder-to-Elbow:
- f) The ratio of Elbow-to-Wrist to Wrist-to-Fingertip:
- g) The ratio of Wrist-to-1<sup>st</sup> Knuckle to 1<sup>st</sup> Knuckle-to-2<sup>nd</sup> Knuckle:
- h) The ratio of 1<sup>st</sup> Knuckle-to-2<sup>nd</sup> Knuckle to 2<sup>nd</sup> Knuckle-to-3<sup>rd</sup> Knuckle:
- i) The ratio of 2<sup>nd</sup> Knuckle-to-3<sup>rd</sup> Knuckle to 3<sup>rd</sup> Knuckle-to-Fingertip:

Question:

1. Does there appear to be a "common range" for your ratios? If so, what is this value?
  
2. Calculate an average value for your ratios above. If you have any ratios that are 'outliers' in the data, you can omit these value(s) from your average if you want.

### Part 3: Facial Structure

What to measure	Measurement (cm)
<b>Head Length:</b> the distance from top of your head to bottom of your chin.	
<b>Head-to-Eyebrows:</b> the distance from the top of your head to your eyebrows	
<b>Hairline-to-Eyebrow:</b> the distance from your hairline to your eyebrows.	
<b>Eyebrow-to-Nose:</b> the distance from your eyebrows to bottom of your nose.	
<b>Eyebrow-to-Chin:</b> the distance from your eyebrows to bottom of your Chin.	
<b>Eye Width:</b> the distance from pupil-to-pupil looking straight forward.	
<b>Eye-to-Chin:</b> the distance from center of eye to bottom of chin.	
<b>Nose-to-Chin:</b> the distance from bottom of your nose to bottom of your chin.	
<b>Chin-to-Lips:</b> the distance from bottom of your chin to center of your lips.	
<b>Nose-to-Lips:</b> the distance from bottom of your nose to center of your lips.	
<b>Eyes-to-Lips:</b> the distance from center of your lips to center of your eyes.	
<b>Nose Width:</b> the distance across the base your nose (nostrils)	
<b>Lip Width:</b> the distance across your lips (resting face)	
<b>Head Width:</b> the distance across your face at ear level	
<b>Ear Width:</b> the distance across your face from ear-to-ear	
<b>Eye Length:</b> the distance across one (l) eye	

Calculate the following proportions to an accuracy of four (4) decimal places.

- a) The ratio of Head Length to Head Width:
- b) The ratio of Eyebrow-to-Chin to Head-to-Eyebrow:
- c) The ratio of Chin-to-Lips to Nose-to-Lips:
- d) The ratio of Lip Width to Nose Width:
- e) The ratio of Eye-to-Chin to Eye Width:

Question:

1. Does there appear to be a “common range” for your ratios? If so, what is this value?
2. Calculate an average value for your ratios above. If you have any ratios that are ‘outliers’ in the data, you can omit these value(s) from your average if you want.

Face symmetry also shows:

- f) Your Hairline-to-Eyebrow = Eyebrow-to-Nose = Nose-to-Chin:
- g) Your Eye Length = Nose Width
- h) Your Eye Width = Lip Width
- i) Your Ear Width = Nose Width  $\times$  5

## Part 4: Attempting the Impossible “Squaring a Circle”

Since ancient times the idea of creating a circle whose area matches that of a square is theoretically impossible because of the nature of pi. Da Vinci attempted to solve this problem with his Vitruvian Man. According to Vitruvius he believed the centre of a human being is the belly button and known that “Man’s” height and arm span are nearly identical, hence creating a perfect square. By overlaying these two images on top of another Da Vinci was able to solve the Squaring a Circle problem metaphorically and philosophically.

You are now going to determine your Vitruvian Area, and see you are at balance with natural world.

### Step 1: Area of your Square:

Using your previous measurements for height and arm span calculate your square area.

### Step 2: Area of your Circle:

Using your belly button as your centre, spread your feet slightly apart and raise your one arm about head height. With your other hand holding a string at your belly button slowly measure and adjust your leg and arm position so the distance from the belly button to your fingertip and belly button your feet are the same. At this point measure your radius. Tip: This is likely easier to do lying down on the floor as opposed to standing up!

Now with your radius measured, calculate your circular area.

### Question:

How do your square and circular areas compare? Was Da Vinci valid in his assumption about being able to ‘Square a Circle’ or was his solution purely metaphorical and philosophical?