Vitruvian Man Data Collection

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Grade Level 6-8, 9-12, 13

Lesson Plan Description
Students are naturally curious about their own bodies, this will be a strong way to start the Anatomy course. The students will compare their own personal measurements to that of the Vitruvian Man theory - such the shoulder width will be 1/4 of height, the measurement from the elbow to the bottom of the hand will be exactly that of the length of the foot, etc. Leonardo DaVinci created Vitruvian Man, who is usually seen in/on most Anatomy text books. After collecting data, students will form possible questions, such as: Are athletes more closely related to the Vitruvian Man theory than non athletes? Are females more closely related to the Vitruvian Man theory than males? The students will select the one measurement they find most interesting and collect data from their classmates. The students will learn to form and test a hypothesis using simple human body measurements and compare to the Vitruvian Man theory from DaVinci. The collected data will then be entered into an Excel document, and a graph will be formed. The students will use the graph to determine the R-square number to determine if the hypothesis should be accepted or rejected.

Primary Learning Objective(s):
The students will learn to form and test a hypothesis, collect and analyze data and prove / disprove the Vitruvian Man theory.

Additional Learning Objective(s):
The collected data will then be entered into an Excel document, and a graph will be formed. The students will use the graph to determine the R-square number to determine if the hypothesis should be accepted or rejected.

Procedures/Activities:
Hypothesis lab
Leonardo da Vinci's Vitruvian Man
Leonardo da Vinci's Vitruvian Man shows how the proportions of the human body fit perfectly into a circle or a square. With these proportions, your arm span (distance from fingertip to fingertip) should be equal to your height (distance from head to heels). In this laboratory exercise, you will see if this is true! In this activity you will explore the legitimacy of Vitruvius' theory by developing a hypothesis regarding the Vitruvian Man.

Background Information
Leonardo da Vinci, a famous Italian renaissance inventor and painter, was greatly influenced by a man named Vitruvius. Vitruvius was a Roman engineer and architect during the first century B.C. Vitruvius discovered a formula to model what he thought were ideal proportions for a man. Da Vinci used this ideal model when drawing the Vitruvian Man in about the year 1490.

The drawing shows a man standing in a square, which is inside a circle. The man has two pair of outstretched arms and two pair of outstretched legs. These are some of the
proportions given for the Vitruvian Man:
• The span of the man’s arms is equal to his height.
• The width of his shoulders is one-fourth of his height.
• The distance from the top of his head to the middle of his chest is one-fourth of his height.
• The distance from the middle of his chest to the top of his leg is one-fourth of his height.
• The distance from the top of his leg to the bottom of his knee is one-fourth of his height.
• The distance from the bottom of his knee to the bottom of his foot is one-fourth of his height.

Laboratory Exercise Objective
You will learn and practice the scientific method by measuring human dimensions.
A hypothesis is a possible explanation for a set of observations or an answer to a scientific question. A hypothesis is useful only if it can be tested. Testable hypothesis are generally written in a formalized format using an if/then statement.

The subject of the exercise is Leonardo da Vinci’s drawing Vitruvian Man. You will focus on the primary proportion of the drawing, "The span of the man’s arms is equal to his height."
You will test a hypothesis regarding Vitruvius' theory on human proportions.

The scientific method consists of the following steps:
1. From observations, state a question
2. Write a hypothesis
3. Design an experiment to test the hypothesis
4. Gather data by doing the experiment
5. Analyze and graph the data.
6. reject or accept the hypothesis. Write conclusion.

Laboratory Resources
Your classmates         Meter sticks         Excel program

Laboratory Procedure   Remember to use metric units (centimeters)
1. Write an if-then hypothesis based on Vitruvius' theory relating arm span and height.
Record your hypothesis on the student answer page.
   Your hypothesis:
   If the Vitruvian Man ratio is (correct/incorrect) circle one, then the arm span and height will be (same/ different) circle one
2. Working with a partner, measure your arm span by standing against a flat surface and 
spreading your arms out as far as possible. Have your partner measure the distance from 
the longest finger on one hand to the tip of the longest finger on the other hand.

**Record the measurements in Data Table 1.**

3. Repeat step two on your partner.

4. Remove your shoes and have your partner measure your height as you stand against a 
flat surface. Measure the distance from the top of your head to the floor. Record your 
measurements in Data Table 1.

5. Repeat step 4 on your partner.

6. Calculate the difference between your arm span and your height (arm span-height)

7. If the difference is within +/-2 cm -- we will say that it is close enough.

8. Go back and make a conclusion on your original hypothesis-- Was it right or wrong??

**Vitruvian Man Student Data Sheet**

Write your if-then hypothesis:

I. If the Vitruvian man ratio is_________ then, the arm span and height will be 
_________.

**Data Table 1: (with partner)**

<table>
<thead>
<tr>
<th>Name</th>
<th>Arm span (cm)</th>
<th>Height (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Difference:** NAME 1= ______ cm      NAME 2 = ______ cm

**Conclusion:** Based on the data; my hypothesis was ________________(correct/incorrect)

II.

Some people have observed that the length of their foot is the same as the length of their 
forearm. Others disagree saying there is no relationship between the two. We will now 
examine whether the other Vitruvian measurements are accurate.

**Data Table 2**

Fill in for your measurements only: (round to nearest 0.1 cm)
<table>
<thead>
<tr>
<th>Measure</th>
<th>Your measurement</th>
<th>¼ of height</th>
<th>Difference between?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your height</td>
<td>cm</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Width of shoulders</td>
<td>cm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top of head to middle of chest</td>
<td>cm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top of leg to bottom of knee</td>
<td>cm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottom of knee to bottom of foot</td>
<td>cm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Conclusion: (Is the Vitruvian Man hypothesis correct?)

Part 3:
- From the elbow to the top of the hand will be 1/5 of height.
- From the elbow to the angle of the armpit will be 1/8 of the height.
- The whole hand will be 1/10 of the height.
- The foot to the longest toe will be 1/7 of your height.
- The foot is equal to the length from the wrist to the elbow
- The distance from the bottom of the chin to the nose and from the roots of the hair to the eyebrows is, in each case the same, and like the ear of third of the face.

Data Table 3:

Your height? ______cm

<table>
<thead>
<tr>
<th>Measure</th>
<th>Your measurement</th>
<th>Fraction of your Height</th>
<th>Difference between?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1/5</td>
<td></td>
</tr>
</tbody>
</table>
Elbow to the top of the hand
Elbow to the angle of the armpit | 1/8
The whole hand | 1/10
The foot to the longest toe | 1/7
The foot is equal to the length from the wrist to the elbow | x
The distance from the bottom of the chin to the nose and from the roots of the hair to the eyebrows is, in each case the same, and like the ear a third of the face | 1/3 total face

**ASSIGNMENT:**
Observe the people in your class. Does gender affect the results? Who is more accurate to Vitruvian man concept?? Does age matter?

**Create a hypothesis:** (If height v arm span is measured, then it will be more accurate for females than males) This is for EXAMPLE purposes. Yours might be 18 year olds v. 17 year olds, or athletes v. non athletes, and you might compare the foot and forearm!

**Draw up a table and collect the data from the people in the room.** If you can, survey other students as well – as this would make the lines more accurate! Or if your data is more specific (like basketball players v non-basketball players), you may need to go out and harvest the raw data.

**Analysis of data:**
1. Open an Excel doc.
2. Type in the collected class data. Make sure to label each column before starting - column A Independent variable (ex. Height) Column B Dependent variable (ex. Male wingspan) Column C dependent variable (female wingspan) Obviously for the males, leave the female column blank, and vice versa.
3. Highlight the data and headings and click on the chart wizard from the tool bar (looks like graph)
4. Choose XY scatter AND the sub-type without the connected lines. CLICK next
5. Click next until you get to Step 3. Title your graph, and the axes. THEN pretty up your graph. Click on gridlines to get rid of the lines.
6. Click next, and click the bottom chart: as object in sheet 1. Click FINISH.

**Now find the linear regression of the lines.**
7. click on one of the female plot points, go up to chart and click ADD TRENDLINE.
8. choose linear, THEN CHOOSE OPTION and click display R-square on Graph.
9. Drag this over into the legend area. Go to the FORMATTING PALETTE (the “A” box next to the red tool box). Choose the add objects, go over to the W and then label it your R-square value.
10. Repeat for the other sets of data.

**WRITE-UP (This is what you will turn in, so make sure you understand all directions)**

1. Open up a google doc. Title it immediately, so you can find it later! Include all names.
2. Type first paragraph:
   - Purpose (explain Vitruvian Man) and your hypothesis. Overall procedure.

3. DATA:
   - Copy the table of information from Excel into the Google doc. (highlight, and copy)
   - Next, get the graph into your Google doc. You need to save it as a picture, then insert the picture into the Google doc. (right click, and choose save as picture onto the desktop)

4. Last paragraph: conclusion of the data you collected and answer the hypothesis. Are you going to reject or accept your hypothesis? (Huh? How do you know? An R2 value of 1 is perfect! This means that 100% of the time, height and wingspan were correlated!) About 0.9 is considered acceptable. If it is below this 0.9 value, the data is considered NOT RELATED. This information should be incorporated into your conclusion sentences. Think of this as $0.9 = 90\%$ which would be an "A". $0.8= "B", \text{etc.}$. Offer an explanation of why / why not your hypothesis was rejected! Also offer any sources of error.

Reread your document. Does it make sense? Does it look good?

**Materials/Equipment:**

- Your classmates
- Meter sticks
- Masking tape
- computer w/ Excel

**Assessment Guidelines:**

**Assessment**  Students will be assessed NOT on a correct hypothesis, but by the analysis of their results. The graph will need to be clearly labeled, the lab write-up will include 3 main parts - introduction, data and analysis and conclusion (reject/accept).