

# Transformation 2013 Design Challenge Planning Form Guide

Design Challenge Title: One Measurement to Another

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School: Pflugerville High School

Subject: Integrated Physics and Chemistry & Biology

Abstract: Students will consider that the same things often come in a variety of shapes and sizes. They will investigate the Vitruvian Theory to explore relationships between different measurements. Finally, the students will apply the idea of using one measurement to determine another in a simulated, real world crime scene.

MEETING THE NEEDS  
OF STEM EDUCATION  
THROUGH DESIGN CHALLENGES

# Step 1: Begin with the End in Mind

- Does this design challenge meet the criteria for STEM student needs (21st century skills, TEKS, TAKS)?

## Section 1

Summarize the theme or “big ideas” for this design challenge.

*Students will investigate the concepts of measurements, patterns, hypotheses, and the scientific method.*

## Section 2

Identify the TEKS/SEs that students will learn in the design challenge (two or three).

*What are the targeted TEKS student expectations (planned)?*

*High school science:*

*(1) Scientific processes. The student, for at least 40% of instructional time, conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to: (A) demonstrate safe practices during field and laboratory investigations; and*

*(2) Scientific processes. The student uses scientific methods during field and laboratory investigations. The student is expected to: (A) plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting equipment and technology; (B) collect data and make measurements with precision; (C) organize, analyze, evaluate, make inferences, and predict trends from data; and (D) communicate valid conclusions.*

*(3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to: (A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information; (D) describe connections between physics and chemistry, and future careers; and (E) research and describe the history of physics, chemistry, and contributions of scientists*

*Algebra I:*

*(A.1) Foundations for functions. The student understands that a function represents a dependence of one quantity on another and can be described in a variety of ways.*

*The student is expected to: (A) describe independent and dependent quantities in functional relationships; (B) gather and record data and use data sets to determine functional relationships between quantities; (D) represent relationships among quantities using concrete models, tables, graphs, diagrams, verbal descriptions, equations, and inequalities; and (E) interpret and make decisions, predictions, and critical judgments from functional relationships.*

*(A.2) Foundations for functions. The student uses the properties and attributes of functions.*

*The student is expected to: (A) identify and sketch the general forms of linear ( $y = x$ ) and quadratic ( $y = x^2$ ) parent functions; (B) identify mathematical domains and ranges and determine reasonable domain and range values for given situations, both continuous and discrete; (C) interpret situations in terms of given graphs or creates situations that fit given graphs;*

### Section 3

Identify key performance indicators students will develop in this design challenge.

*What are the targeted TEKS student expectations (planned)?*

*The students will demonstrate an understanding of basic scientific skills including the scientific method, measurement, data collection and graphical analysis. In addition, students will practice technical and creative writing skills to report on the crime scene.*

### Section 4

Identify the 21st century skills that students will practice in this design challenge (one or two).

- *Critical thinking and problem solving*
- *Life and Career skills (including leadership, flexibility, and adaptability)*

### Section 5

Identify STEM career connections and real world applications if content learned in this design challenge.

*This activity incorporates the use of the scientific method, measurement and patterns, and the graphing calculator. Discussions include forensics career connections and real world applications of math and science concepts.*

## Step 2: Craft the Design Challenge

- *Have you posed an authentic problem or significant question that engages students and requires STEM knowledge to solve or answer?*

This morning, a famous music producer was found dead in his bathtub. It appears that the victim died from drowning, but foul play has been suspected. Smearred footprints were found leading to and from the bathroom window.

You and your team of Crime Scene Investigators (CSI) for the Pflugerville Police Department need to work to solve this case, but before you can begin it is necessary to determine whether you can utilize one body measurement to approximate a totally different body measurement. To do this, you must study Vetruvian Theory, gather and analyze mock data, and then work to solve the actual case. Work quickly so the killer can be brought to justice!

## Step 3: Map the Design Challenge

Look at the *major* product for the design challenge and analyze the tasks necessary to produce a high-quality product. What do students need to know and be able to do to complete the tasks successfully? How and when will they learn the necessary knowledge and skills?

Performance Indicators (Refer to Step I, Section 3)	Already Learned	Taught before the project	Taught during the project
1. <i>Write a hypothesis</i>		X	
2. <i>Use the scientific method</i>	X		
3. <i>Take measurements</i>	X		
4. <i>Graph data</i>	X		
5. <i>Use graphing calculator</i>			X
6. <i>Write a crime scene findings report</i>			X
7. <i>Create and complete a data chart</i>	X		

## Step 4: Plan the Design Challenge 5E Lesson

### TASK 1:

Enter the Design Challenge Title and TEKS/TAKS objectives for your 5E lesson in the template provided.

### TASK 2:

Describe the activities that occur throughout the 5E learning cycle. Provide explicit instructions in the 5E lesson plan, such that a first year teacher can easily understand what is expected and execute the design challenge lesson. Provide discussion facilitation questions if applicable. Use the planning forms provided on the following pages to complete each section of the 5E lesson. Refer to Step 3: Map the Design Challenge to help you identify relevant activities to include in the 5E learning cycle that focus on what students need to know and be able to do to complete the design challenge

### TASK 3:

Identify and define the products and artifacts for each phase of the design challenge 5E learning cycle. Artifacts are evidence of the student's thinking. Products could include

**culminating products or products that provide checkpoints for progress through the learning cycle. The table below shows some examples of artifacts and products. Many additional possibilities exist. Use the planning forms provided on the following pages to complete the 5E lesson.**

**ARTIFACTS**

- Notes
- Journal entries
- E-mail records
- Chat records
- Records of conversations, decisions, revisions
- Interviews using a structured set of questions
- Short, reflective paragraphs
- Library search record
- Telephone logs
- Purchase receipts
- Samples
- Minutes of meetings
- Discarded ideas
- Prototypes
- Group process reports

**PRODUCTS**

- Research papers\*
- Reports\*
- Multimedia shows\*
- Presentations within the school\*
- Exhibitions outside the school\*
- Proposals
- Outlines
- Plans
- Blueprints
- Drafts
- Edited drafts
- Revised drafts
- Models
- Product critiques
- Videos
- Final versions of papers
- Field guides
- Biographies
- Websites
- Flow charts
- Design Briefs

*\*indicates culminating projects*

<p><b>Design Challenge Title:</b> <i>One Measurement to Another</i></p>	
<p><b>TEKS/TAKS objectives:</b>  <i>High school science: 1A; 2A,B,C,D; 3A,D,E</i>  <i>Algebra 1: A.1A,B,D; A.2A,B,C</i></p>	
<p><b>Engage Activity</b></p> <p>Identify/focus on instructional task, connect between past &amp; present learning experiences, lay groundwork for activities (ex. Ask a question, define a problem, show a surprising event, act out a problematic situation)</p> <p><b>The particular subject area is introduced to the students with common examples that have meaning in their lives.</b></p>	<p>Have students compare their hands with each other. Are they the same size, shape, length? They should discover that they all vary)</p> <p>Show a picture of Leonardo DiVinci's Vitruvian Man and discuss the theory it represents, which states that arm span, from fingertips to fingertips with arms extended, is equal to height.</p> <p>Have the students consider the validity of this theory and write a paragraph discussing their findings.</p>
<p><b>Define the products and artifacts for the Engage Activity.</b></p> <p><i>Artifacts (KWL charts, journal entries, etc) are evidence of the student's thinking.</i></p> <p><i>Products (flow charts, data tables, models, etc) include checkpoints for progress through a design challenge.</i></p>	<p>Journal entry - Paragraph discussing views on the Vitruvian Theory.</p>
<p>Materials/Equipment:</p> <ul style="list-style-type: none"> <li>• Picture of Leonardo DiVinci's Vitruvian Man (can be a hard copy or a projectable copy)</li> <li>• Journaling materials</li> </ul>	
<p>Resources:</p> <p>Website resource –</p> <ul style="list-style-type: none"> <li>• <a href="http://en.wikipedia.org/wiki/Vitruvian_Man">http://en.wikipedia.org/wiki/Vitruvian_Man</a></li> <li>• <a href="http://leonardodavinci.stanford.edu/submissions/clabaugh/history/leonardo.html">http://leonardodavinci.stanford.edu/submissions/clabaugh/history/leonardo.html</a></li> <li>• <a href="http://altreligion.about.com/library/glossary/symbols/bldefsvitruvian.htm">http://altreligion.about.com/library/glossary/symbols/bldefsvitruvian.htm</a></li> <li>• <a href="http://www.bbc.co.uk/science/leonardo/gallery/vitruvian.shtml">http://www.bbc.co.uk/science/leonardo/gallery/vitruvian.shtml</a></li> </ul> <p><b>**If you have access you may refer to Experiment 2 in Laying the Foundations - Vitruvian Man Meets the Scientific Method. More information about this resource can be found at <a href="http://www.layingthefoundation.org">http://www.layingthefoundation.org</a></b></p>	

<p style="text-align: center;"><b>Explore</b></p> <p>Students get involved with phenomena and materials, students work in teams to explore through inquiry.</p> <p><b>Directed laboratories are conducted so the students can experience the principles in a controlled manner. This experience is crucial to success in solving design challenges.</b></p>	<p>Class data collection to test the Vitruvian Theory.</p> <ol style="list-style-type: none"> <li>1. Have the class work in partners (or three if the class is uneven in numbers).</li> <li>2. Have each group determine the arm span, height and difference between the two for each group member.</li> <li>3. Have the groups share their measurements by writing them on the board, overhead, computer/projector system.</li> </ol> <p>A possible source for this type of activity can be found at:  <a href="http://www.censusatschool.ntu.ac.uk/curriculum/englandandwales/detail/?title=The%20Theory%20-%20does%20it%20apply%20to%20you?&amp;level=11,12,13,14,15,16,17,18&amp;subject=Number%20and%20algebra%20(Maths%20/%20Stats)&amp;topic=ratios&amp;subjectfr%20and%20algebra">http://www.censusatschool.ntu.ac.uk/curriculum/englandandwales/detail/?title=The%20Theory%20-%20does%20it%20apply%20to%20you?&amp;level=11,12,13,14,15,16,17,18&amp;subject=Number%20and%20algebra%20(Maths%20/%20Stats)&amp;topic=ratios&amp;subjectfr%20and%20algebra</a></p> <p>You would need to edit "British students" to just "students".</p>
<p><b>Define the products and artifacts for the Explore Activity.</b></p> <p><i>Artifacts (KWL charts, journal entries, etc) are evidence of the student's thinking.</i></p> <p><i>Products (flow charts, data tables, models, etc) include checkpoints for progress through a design challenge.</i></p>	<p>Data table</p>
<p>Materials/Equipment:</p> <ul style="list-style-type: none"> <li>• Flat surface (such as a wall)</li> <li>• meter stick and/or tape measure</li> <li>• board, overhead, large chart paper, or computer with projector)</li> <li>• data charts to fill in (if you choose to provide them)</li> <li>• Graph paper (for graphing the data)</li> </ul>	
<p>Resources:</p> <p><a href="http://www.censusatschool.ntu.ac.uk/curriculum/englandandwales/detail/?title=The%20Vitruvian%20Theory%20-%20does%20it%20apply%20to%20you?&amp;level=11,12,13,14,15,16,17,18&amp;subject=Number%20and%20algebra%20(Maths%20/%20Stats)&amp;topic=ratio&amp;subjectfr=Number%20and%20algebra">http://www.censusatschool.ntu.ac.uk/curriculum/englandandwales/detail/?title=The%20Vitruvian%20Theory%20-%20does%20it%20apply%20to%20you?&amp;level=11,12,13,14,15,16,17,18&amp;subject=Number%20and%20algebra%20(Maths%20/%20Stats)&amp;topic=ratio&amp;subjectfr=Number%20and%20algebra</a></p>	

<p style="text-align: center;"><b>Explain</b></p> <p>Students discuss observations, ideas, questions and hypotheses with peers, facilitators, groups. Learners apply labels to their experiences – thus developing common language, clarification/explanation of key concepts</p> <p><b>Delivery of the content begins with a discussion of the principles illustrated by the Hands-On examples. In this way, the participants' intuition is tapped to introduce terms and concepts that they may have heard. This approach leads naturally to an in-depth discussion of the science and mathematics concepts underlying the particular subject area.</b></p>	<p>Discuss the data collected during the experiment. Did the students see any pattern of the individual have any influence on the results? Have them explain why or why not?</p> <p>Some questions that might be helpful in guiding the discussion:</p> <ul style="list-style-type: none"> <li>• Does your individual data for height and arm span lead you to accept or reject your hypothesis?</li> <li>• How do your height and arm span results compare to other groups in the class?</li> <li>• Does the class height and arm span data support Vitruvius' hypothesis?</li> <li>• When comparing males and females, does one group fit Vitruvius' hypothesis better than the other?</li> <li>• Why was it necessary to collect data from other students in the class?</li> </ul> <p>Lead the discussion to other possible applications of this type of theory (guiding the discussion we might be able to use one type of measurement to determine another measurement).</p> <p><b>**may want to tie in some career connections at this time. Some possible ideas might include: architecture, garden design, set design, vehicle design (car, motorcycle, boat, etc.), fashion design – see reference resources.</b></p>
<p><b>Define the products and artifacts for the Explain activity.</b></p> <p><i>Artifacts (KWL charts, journal entries, etc) are evidence of the student's thinking.</i></p> <p><i>Products (flow charts, data tables, models, etc) include checkpoints for progress through the design challenge.</i></p>	<p>Journal entry that reflects the information from the discussion(short reflective paragraph)</p>
<p>Materials/Equipment: board, overhead, large chart paper, or computer with projector Journal, pencils, data tables</p>	
<p>Resources:</p> <p>Architecture: <a href="http://www.greatbuildings.com/">http://www.greatbuildings.com/</a> , <a href="http://archrecord.construction.com/">http://archrecord.construction.com/</a> , <a href="http://dir.yahoo.com/Arts/Design_Arts/Architecture/">http://dir.yahoo.com/Arts/Design_Arts/Architecture/</a></p> <p>Set design: <a href="http://www.setbyruthneeman.com/">http://www.setbyruthneeman.com/</a> , <a href="http://www.artslynx.org/theatre/design.htm">http://www.artslynx.org/theatre/design.htm</a> , <a href="http://en.wikipedia.org/wiki/Set_design">http://en.wikipedia.org/wiki/Set_design</a> , <a href="http://en.wikipedia.org/wiki/Scenic_design">http://en.wikipedia.org/wiki/Scenic_design</a> , <a href="http://www.rfdesigns.org/">http://www.rfdesigns.org/</a> , <a href="http://videoexpert.home.att.net/artic2/236sets.htm">http://videoexpert.home.att.net/artic2/236sets.htm</a></p> <p>Vehicle design: <a href="http://www.ccardesignnews.com/site/home/">http://www.ccardesignnews.com/site/home/</a> , <a href="http://www.ccardesignonline.com/">http://www.ccardesignonline.com/</a> , <a href="http://www.autofieldguide.com/">http://www.autofieldguide.com/</a> , <a href="http://www.themotorbookstore.com/motorcycle-design.html">http://www.themotorbookstore.com/motorcycle-design.html</a> , <a href="http://www.core77.com/blog/object_culture/thoughts_on_motorcycle_design_9161.asp">http://www.core77.com/blog/object_culture/thoughts_on_motorcycle_design_9161.asp</a> ,</p>	

<http://www.greencardesign.co.uk/site/item.php?id=1210936143>

Fashion design: <http://www.fashion.net/howto/fashiondesigner/> ,  
<http://www.calmis.cahwnet.gov/file/occguides/FASHION.HTM> ,  
[http://www.collegeboard.com/csearch/majors\\_careers/profiles/majors/50.0407.html](http://www.collegeboard.com/csearch/majors_careers/profiles/majors/50.0407.html)

Garden design: [http://gardening.about.com/od/gardendesign/Garden\\_Design\\_Putting\\_It\\_All\\_Together.htm](http://gardening.about.com/od/gardendesign/Garden_Design_Putting_It_All_Together.htm)  
<http://www.bbg.org/gar2/topics/design/>

<p><b>Elaborate</b></p> <p>Expand on concepts learned, make connections to other related concepts, apply understandings to the world. (ex. Extend &amp; apply knowledge).</p> <p><b>At its heart, engineering is the application of science and mathematics to design solutions to problems for humanity. Thus, providing design opportunities to students is a key component of STEM education. Opportunities to be creative in open-ended situations peak the interest of many students, providing an answer to the ubiquitous question: “Why do we need to know this?”</b></p>	<p>Simulated Real World application: <u>Case file 1 - Tracks of a Killer: Using footprints to solve a crime</u></p> <p>This can be found on the Texas Instruments web site at: <a href="http://education.ti.com/educationportal/activityexchange/Activity.do?ald=6369&amp;cid=US">http://education.ti.com/educationportal/activityexchange/Activity.do?ald=6369&amp;cid=US</a></p> <p>Teachers should review the pdf file with the detailed instructions prior to assigning their project. Be sure to print pages 2-8 from the Forensics Case pdf file for the students. A data and student work pages. The appendices pdf files have calculator tutorials in them. Print those, as well.</p> <p>After reviewing the pdf file, make sure that you set up all of the stations according to the outline outlined in the document.</p>
<p><b>Define the products and artifacts for the Elaborate activity.</b></p> <p><i>Artifacts (KWL charts, journal entries, etc) are evidence of the student’s thinking.</i></p> <p><i>Products (flow charts, data tables, models, etc) include checkpoints for progress through the design challenge.</i></p>	<p>Evidence data and questions</p>

<p>Materials/Equipment:</p> <ul style="list-style-type: none"> <li>• Meter stick</li> <li>• Metric rulers</li> <li>• Bulletin Board paper (long sheets...black will work well)</li> <li>• Tape to secure bulletin board paper to the floor</li> <li>• Long walkway</li> <li>• Chalk</li> <li>• TI graphing calculators</li> </ul>	
<p>Resources: <a href="http://education.ti.com/educationportal/activityexchange/Activity.do?ald=6369&amp;cid=US">http://education.ti.com/educationportal/activityexchange/Activity.do?ald=6369&amp;cid=US</a></p>	
<p style="text-align: center;"><b>Evaluate</b></p> <p>Ongoing diagnostic process to determine if the learner has attained understanding of concepts &amp; knowledge (ex. Rubrics, teacher observation with checklist, student interviews, portfolios, project products, problem-based learning products, assessments) Leads to opportunities for enrichment through further inquiry and investigation.</p> <p><b>What is the culminating task?</b></p>	<p>Discuss the format and expectations for the “Crime Scene Findings Report”</p> <ol style="list-style-type: none"> <li>1. Summary of crime scene description: This should be a brief descriptive paragraph of the appearance of the crime scene.</li> <li>2. Evidence Analysis: In this section the student(s) should analyze the evidence and then determine if the suspect is included or excluded. Example: John Smith had a height of X and a stride of Y. Based on the evidence, Smith has been excluded (or included) as a suspect.</li> <li>3. Conclusion: Discussion, based on the evidence, of who the student believes committed the crime.</li> </ol>
<p><b>Define the products and artifacts for the Evaluate Activity.</b></p> <p><i>Artifacts (KWL charts, journal entries, etc) are evidence of the student’s thinking.</i></p> <p><i>Products (flow charts, data tables, models, etc) include checkpoints for progress through a design challenge.</i></p> <p><b>What is the final product (working model, portfolio, presentation,</b></p>	<p>Crime Scene Findings Report</p> <p>A journal entry for the project. It should include the following thoughts:</p> <ol style="list-style-type: none"> <li>1. What went well?</li> <li>2. What would you do differently?</li> <li>3. Did your group work well together?</li> <li>4. If not, what was the issue and how did you work to resolve it?</li> </ol>

*etc) you will require?*

Materials/Equipment: Journal, computers to type up crime scene findings report, printers

Resources:

## Step 5: Plan the Assessment

State the criteria for exemplary performance for each artifact/product of each section of the 5E lesson.

- *Do the products and criteria align with the standards and outcomes for the design challenge?*

<p>Engage Artifact(s)/Product(s): <i>Journal entry</i></p> <ol style="list-style-type: none"> <li>1. <i>States Vitruvian Theory</i></li> <li>2. <i>Discusses students' view of the validity of the theory with explanation of reasoning for view.</i></li> </ol>
<p>Explore Artifact(s)/Product(s): <i>Completed data table</i></p> <ol style="list-style-type: none"> <li>1. <i>All data is present, clear, and complete</i></li> </ol>
<p>Explain Artifact(s)/Product(s): <i>Short reflective paragraph</i></p> <ol style="list-style-type: none"> <li>1. <i>Accepts or rejects Vitruvian Theory</i></li> <li>2. <i>Uses data to support conclusion</i></li> <li>3. <i>Discusses other possible applications of the idea of indirect measurement.</i></li> <li>4. <i>Discusses career connections</i></li> </ol>
<p>Elaborate Artifact(s)/Product(s): <i>Evidence data sheet and questions</i></p> <ol style="list-style-type: none"> <li>1. <i>All data is present, clear, and complete</i></li> <li>2. <i>All questions are answered clearly and with thought (answers are relevant)</i></li> </ol>
<p>Evaluate Artifact(s)/Product(s): <i>Crime scene findings report</i></p> <ol style="list-style-type: none"> <li>1. <i>Discusses which suspects are excluded and offers clear data support for the exclusion.</i></li> <li>2. <i>Discusses which suspects are included and offers clear data support for the inclusion.</i></li> <li>3. <i>Written in a clear narrative format.</i></li> <li>4. <i>Proper spelling, grammar, format and punctuation are used.</i></li> </ol>

# Step 6: Create Rubrics

See rubric on next page.

Total possible points = 195

Grade ranges → A = 175 to 195  
B = 155 to 174  
C = 135 to 154  
D = 115 to 134  
F = 114 and below

## One Measurement to Another

CATEGORY	15 points	9 points	3 points	0 points
<b>Journal entry point 1</b>	Clearly states the Vitruvian theory	Mentions the Vitruvian theory but unclear as to what it is.		Does not state the Vitruvian theory
<b>Journal entry point 2</b>	Clearly states the students' view of the Vitruvian theory and offers an clear explanation of their reasoning.	Offers the students' view an attempts to explain, but is unclear.	Offers the students' view, but no reasoning is provided.	Does not discuss the students' view of the theory or offer any support.
<b>Vitruvian data chart</b>	All data is present, clear and complete.	3/4 of the data is present, clear and complete.	1/2 or less of the data is present, clear, and complete.	No data is present.
<b>Reflective paragraph point 1</b>	Accepts or rejects the Vitruvian theory.			Does not accept or reject the Vitruvian theory.
<b>reflective paragraph point 2</b>	Uses data to clearly support the conclusion.	Attempts to use the data to support the conclusion.		Makes no attempt to support the conclusion.
<b>reflective paragraph point 3</b>	Discusses several other possible applications of indirect measurement (3 or more)	Discusses at least two other possible applications of indirect measurement.	Discussed one other possible application of indirect measurement.	Does not discuss any other applications of indirect measurement.
<b>reflective paragraph point 4</b>	Discusses several possible career connections. (3 or more)	Discusses at least two possible career connections.	Discussed one possible career connection.	Does not discuss any possible career connections.

<b>Evidence data chart</b>	All data is present, clear and complete.	3/4 of the data is present, clear and complete.	1/2 or less of the data is present, clear, and complete.	No data is present.
<b>Evidence questions</b>	All 5 questions answered clearly and completely in a relevant fashion.	3 or 4 questions answered clearly and completely in a relevant fashion.	1 or 2 questions answered clearly and completely in a relevant fashion.	no questions answered clearly and completely in a relevant fashion.
<b>Crime scene findings report point 1</b>	Discusses all possible suspects excluded and the data that excludes them.	Some discussion of excluded suspects with data support, but is incomplete.	Some discussion of excluded suspects with data support, but is incomplete.	No discussion of excluded suspects at all.
<b>Crime scene findings report point 2</b>	Discusses all possible suspects included and the data that includes them.	Some discussion of included suspects with data support, but is incomplete.	Some discussion of included suspects with data support, but is incomplete.	No discussion of included suspects at all.
<b>Crime scene findings report point 3</b>	Written in clear narrative format.	Written in unclear narrative format.	Written as a bulleted list.	Nothing written.
<b>Crime scene findings report point 4</b>	All spelling, grammar, punctuation and format are correct.	2 or 3 slight errors in the spelling, grammar, punctuation and format.	4 to 6 slight errors in the spelling, grammar, punctuation, and format.	More than 6 errors in the spelling, grammar, punctuation and format.

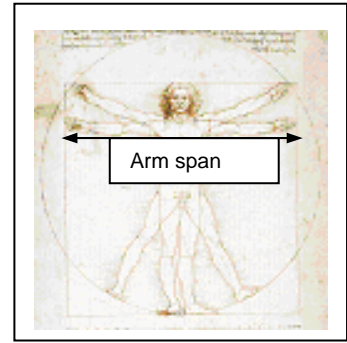
## Storyboard

	Day 1	Day 2	Day 3	Day 4	Day 5
<b>Week 1 Activities</b>	<ul style="list-style-type: none"> <li>▪ Engage activity (about 10 minutes)</li> <li>▪ Explore - Gather height &amp; arm span data</li> </ul>	<ul style="list-style-type: none"> <li>▪ Evaluate – discuss results and applications</li> <li>▪ Have students write conclusion.</li> <li>▪ Introduce crime scene</li> </ul>	<ul style="list-style-type: none"> <li>▪ Elaborate – have students perform experiment and answer questions.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Discuss the elaborate results.</li> <li>▪ Explain format &amp; expectations for Crime Scene Findings Report</li> </ul>	<ul style="list-style-type: none"> <li>▪ Crime scene findings report due</li> </ul>

# The Vitruvian theory—does it apply to you?

Leonardo da Vinci (1452–1519) was a scientist and an artist, one of the greatest painters of the Italian Renaissance. He left only a handful of completed paintings, one of which is the *Mona Lisa*. He was so secretive that he wrote backwards to disguise his ideas.

In 1492, Leonardo drew a picture of a man standing inside a circle and a square. This is known as the 'Vitruvian Man'. It was a study of the proportions of the human body as described by Vitruvius, a Roman architect from the first century B.C. Based on his observations of European people of his day, Leonardo believed that arm span was equal to height in a perfectly proportioned body.



Why do you think he was interested in working out body proportions?

Do you think the Vitruvian theory illustrated by Leonardo would work today?

## Problem



**Is the Vitruvian theory that height is equal to arm span true for students today?**

## Plan



Before you begin your investigation, what answer do you predict? Why? \_\_\_\_\_

Now test your prediction using data from your class.

## Data



Enter the data for 10 students from your class in this table.

How will you select the students for your sample?

Do not simplify the fraction for the arm span / height ratio.

Student	Gender	Arm span	Height	Ratio: arm span / height	
				fraction	decimal
	M or F	cm			
Student A					
Student B					
Student C					
Student D					
Student E					
Student F					
Student G					
Student H					
Student I					
Student J					

## Analysis



1. Have a look at the table of data. What does each row represent? What do you notice about the data?  
\_\_\_\_\_  
\_\_\_\_\_
2. Which students most closely fit Leonardo's theory? \_\_\_\_\_
3. How do you know that a student fits this theory? \_\_\_\_\_
4. Graph the information from the table, using graph paper. You might have to draw different kinds of graphs to show all the information.
5. Look at the graphs you have drawn. What words could you use to describe the shapes, range and spread of the information?  
\_\_\_\_\_  
\_\_\_\_\_

6. Not everybody has an arm span / height ratio that is equal to 1. Why do you think this is?  
\_\_\_\_\_  
\_\_\_\_\_

## Conclusion



You are now ready to answer the question we asked at the beginning of the worksheet:

**Is the Vitruvian theory that height is equal to arm span true for students today?** \_\_\_\_\_

Using some of the words below, give reasons based on what you found in your investigation:

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analysis	gradient	ratio
arm span	height	row
biased	investigate	sample
bivariate	justify	scatterplot
cluster	measure	selection
conclusion	middle	skew

data	outlier	slope
distribution	predict	spread
equal	problem	systematic
frequent	random	table