PLTW GTT DM Frameworks

PLTW Course: GTT Design and Modeling

Math Strand being addressed: Numbers & Operations

Overview:

Math Standard and Benchmarks: 6.1.3.4

Math Standard 6.1.3: Multiply and divide decimals, fractions and mixed numbers; solve real-world and mathematical problems using arithmetic with positive rational numbers.

Benchmark 6.1.3.4: Solve real-world and mathematical problems requiring arithmetic with decimals, fractions and mixed numbers.

Correlation to Common Core Math Standards:
MN 6.1.3 = CCSSI 6.NS.3

Essential Understandings/Big Ideas:

Being able to multiply and divide fractions and mixed numbers accurately is important at school, at home, at work and when pursuing hobbies. Solving real-world and mathematical problems using arithmetic is practiced in PLTW classes when students use precision measuring tools. Correct use of these tools is taught to ensure accurate measurements are taken. The need for very accurate measurements during the design process goes back at least to the time of the great pyramids. Clearly, the ancient Egyptians used the basics of math to solve real-world problems when they build the pyramids.

What should students know and be able to do [at a mastery level] related to these benchmarks?

- Understand numbers, ways of representing numbers, relationships among numbers, and number systems.
- Understand meanings of operations and how they relate to one another.
- Understand measurable attributes of objects and the units, systems, and processes of measurement.
- Apply appropriate techniques, tools, and formulas to determine measurements.

Misconceptions:

Student Misconceptions

- Often students will combine standard measuring with decimal measuring. ie. They will measure one section of a plan in 8th's or 16th's and another in 10th's using the same standard ruler.
- When students multiply and divide fractions, they get rules of denominators and numerators mixed up.
- When students multiply and divide mixed metric system numbers, they get the rules of conversion mixed up.
- Students sometimes think it is not necessary to study both measurement systems.

Teacher Resources:

Teacher Notes

- Students will experience opportunities to use measurement when making a sketch or drawing or a prototype and when using computer modeling systems
- Conversion between the systems may be eliminated if students are not comfortable with the measurement systems or time is an issue.
- Reinforce the concept that accurate measuring with precise tools and quality workmanship makes a more successful final product.
- Neatly and accurately use a plan sheet and measuring tool as you to draw your project.
- Obtain ten objects from your teacher to measure. For some objects you will measure the thickness, length and width. For others, you will measure diameter and depth.
- In this activity you will learn how to use a dial caliper to measure thickness, diameter, and depth.
- Fill in the name of the object in the column called "Item to be Measured" and write your dial caliper reading in the "My Measurement" column of the chart:

Item to be Measured	My Measurement	Correct Measurement

- Compare your measurements with a classmate's measurements. If your answers are not the same, re-measure the object to determine the accurate measurement and put this number in the "Correct Measurement" column.

- Complete the Conclusion questions below and turn in the activity to your instructor.

1. Dial calipers measure in English units, using inches, but with decimal numbers.
   Did you find this easier or more difficult than reading an English ruler that uses fractions?
2. Why do you think a dial caliper is often the precision measuring tool that is used for reverse engineering an object?
3. Describe three places that you think would be important to have a precise measurement.
   For example, gear ratios on a watch or clock must be exact or you won't know the correct time.
4. Name the four types of measurements that dial calipers can be used for.
   Hint: one type is the depth of a hole

What is it that students struggle with the most and how can the teacher most effectively help students learn the concepts?

- Differences between measuring systems.
  - Metric & Standard Measurement Systems
  - https://www.youtube.com/watch?v=DQPQ_q59xyw

- Steps in measuring with the Standard system.
  1. Count how many parts the inches are divided into.
     - This number will be the denominator. Write it down **below** the dividing line.
  2. Count the number of whole inches.
     - Write the number down to the **left** of the dividing line.
  3. Count the number of spaces after the last whole inch.
     - This number will be the numerator. Write it down **above** the dividing line
  4. Reduce fraction, if necessary.

Additional Instructional Resources

http://www.rickyspears.com/rulergame/

Additional help with reading dial calipers can be found at these websites:

http://www.wisc-online.com/objects/index_tj.asp?objID=MSR4303
http://www.wisc-online.com/objects/index_tj.asp?objid=MTL5102

Introduction to English and Metric Measurement PowerPoint : Google Docs GTT Resources / Design and Modeling.
Precision Measuring PowerPoint: Google Docs GTT Resources / Design and Modeling.
Precision Measuring worksheet: Google Docs GTT Resources / Design and Modeling.
Precision Measuring worksheet/answer key: Google Docs GTT Resources / Design and Modeling.

New Vocabulary

Caliper	A measuring tool with two usually adjustable jaws used especially to measure thickness or diameter.
Micrometer	A gauge that measures small distances or thicknesses.
Precision	The degree to which several measurements or calculations show the same or similar results.

Vignette:

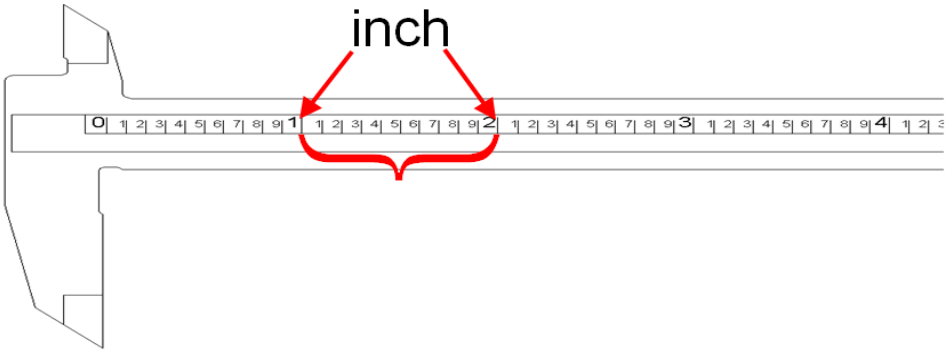
The class is learning how to use a dial caliper to measure thickness, diameter, and depth. The teacher has named this unit "Precision Measuring"

Teacher: These are examples of precision measuring tools are used for accuracy.

Teacher: We will be using a Dial Caliper to measure thickness, diameter and depth of ten objects.

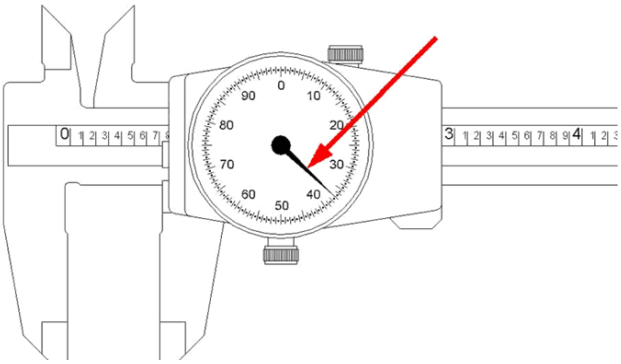
Student: What is a Dial Caliper?

Teacher: The dial caliper is a precision measuring instrument. The caliper's blade graduations are in inches and tenths (.1) of an inch. Each inch is broken into ten, for .1 of an inch.

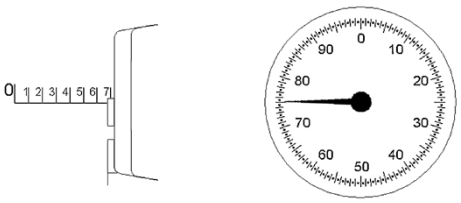


Student: Like our rulers that are broken into eights for 1/8 of an in inch?

Teacher: That's correct. But the Dial Caliper is much more of a precision measuring instrument. The red arrow on the diagram points to the dial graduations which are in thousandths (.001) of an inch.

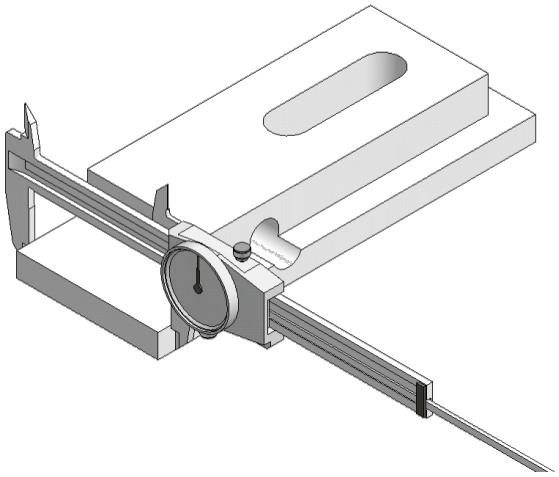


Teacher: One full revolution of the pointer on the dial equals one hundred thousandths (.100).



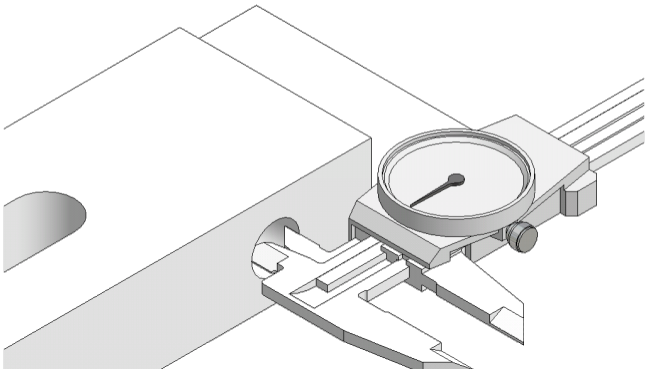
Student: How do I measure thickness with this tool?

Teacher: Thickness and outside diameter measurements are done like this.



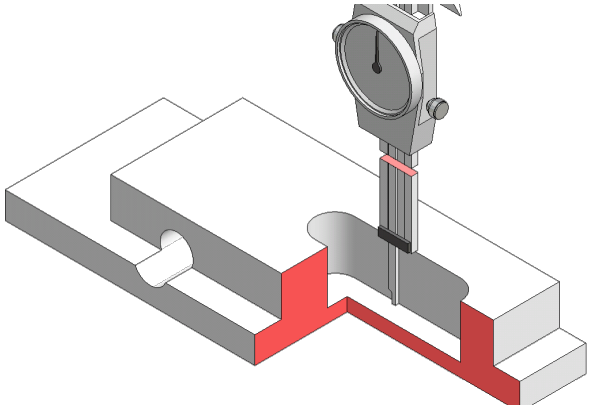
Student: What about inside diameter?

Teacher: This is how it's done.



Student: What is the way to measure depth?

Teacher: By holding the Dial Caliper like this.



Teacher: Explain which one of the tools (Steel Rule; Tape Measure; Dial Caliper; Meter Stick**)** would be best to use and why when measuring: 1.The hallway 2. Engineering Notebook 3. Pencil diameter 4. Height of your desk.

Student: 1. Tape Measure – because both are long. 2 Steel Rule – because both are similar size. 3. Dial Caliper – because it is designed to accurately measure diameter. 4. Meter Stick – because my desk stands straight and the Meter Stick can stand straight also.

Assessment:

Assessment Methods

Simplify 4(1/2 + 3/8) – 5/8 x 2 ~ **(2 1/4)**

- Which statement is true? ~ **(1/3 > 0.3)**
  - 1/6 = 0.16
  - 0.08 = 4/5
  - 0.25 < 1/4
  - 1/3 > 0.3

- Which is equivalent to 0.4%? ~ **(1/ 2500)**
  - 1 /4
  - 1/25
  - 1/400
  - 1/ 2500

- Divide 1 1/10 ÷ 1 1/5 ~ **(11/12)**

Differentiation:

Gifted and Talented

- Requiring students to use standard and metric measurement systems on the same project could expand this activity.
- Students could be required to design a project that uses measurements that require more calculations ex: something with angles or arcs.

Special Education

- Students on an IEP and those who struggle could have extra handouts and related materials (computer simulations, videos and Internet links) made available to them.

English Language Learners

- Much of the vocabulary used in this area can be difficult for the ELL student. Using pictures shown in build sheets could help. Completed measurement examples could be looked at would also be of assistance to the ELL students.
- This information needs to be reinforced through the help of the ELL teacher.

Parents and Administration:

Administrative/Peer Classroom Observation

Students Are:	**Teachers Are:**
Using tools to measure	Questioning students
Recording results	Monitoring progress
Analyzing data	Reinforcing success
	Redirecting problems

Professional Learning Communities:

Reflection – Critical Questions regarding the teaching and learning of these benchmarks:

- In what areas did students perform best and what weaknesses are evident?
- How can this content be connected to other benchmarks in learning?
- Do students see the connection between this and other measurement techniques?
- Are students interpreting information correctly?
- What areas did students perform best and what weaknesses?

Materials, suggested articles and books for book study with PLC's: Measurement tips and tricks.

Parent Resources:

- Parents can help their child with solve real world math problems by measuring common household objects and multiply and divide their numbers using a fun approach.
  - Measure the length of all of the knives in the kitchen drawer.
  - Divide this length by the number of coffee mugs in the cupboard.
  - Multiply this by the number of windows in the house.
  - Divide this answer by the number to doors in the house.
  - Multiply by the number of people who live in the home.
- http://www.mathsisfun.com/

References:

- Project Lead the Way, Gateway To Technology, Design and Modeling course curriculum.
- Minnesota Academic Standards - Mathematics K - 12 2007 version.
- Common Core Standards for Mathematics.
- http://www.corestandards.org/
- Minnesota Comprehensive Assessments-Series III Mathematics Item Sampler Grade 6.