**Unit 1: Optional Measurement Activities**

**Instructional Notes**

The following collection of activities is drawn from Modeling Physical Science activities and can be used with students if necessary to develop proportional reasoning skills and basic units of linear measurement.

## **Optional Section 1A: Linear Measurements**

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## **3. Activity A – Measuring the Measuring Tool**

### **Purpose**

This activity is designed to provide an introduction to the concept of length and standard units of measure.

### **Apparatus**

paper clips (two or more sizes can further enhance the idea of different standards)

tongue depressors

new unsharpened pencils

ball point pens

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### **Pre-activity discussion**

* The students are going to be measuring with non-traditional measuring devices (such as paper clips, tongue depressors, unsharpened pencils and pens), so a brief statement about safety may be in order.

### **Performance notes**

* Lengths or distances should be measured in straight lines.
* Teamwork is important for good results, one student measuring, another recording data, etc.
* The students should answer all questions, even if they are not sure of their answers.
* All measurements should have the proper label or unit. Example: 12 pencils long.
* Each individual measuring device must be measured against the other measuring devices

(i.e. 1 tongue depressor = 1.5 pencil lengths).

* This activity could easily be done outdoors. Just substitute outdoor things to measure rather than classroom objects.

### **Post-activity discussion**

* Discuss the importance of a standard measure.
* Discuss why the measuring standards may be different for different groups and why it may be preferable to have a universal standard of measure.
* Discuss and show examples of unit conversion using their data and using other conversions.
* From this activity the students should see the importance of a measuring standard. For example show that the length of a pen or paperclip can be different depending on the manufacturer.
* Communication of measures is fully dependent on using a standard, and this standard is often different if the communication is done within a particular country or internationally. For example the standard unit for measuring the amount of grain in the United States is the bushel, while the international unit for measuring grain is the metric ton.

**Development of the Idea of unit conversion**

* Show that one unit can be converted to a different unit using simple algebra techniques. Show examples of unit conversion.
* Discuss the meaning of the word “per” as division in mathematics. Sections 1.8 and 1.9 in Arnold Arons’ book *Teaching Introductory Physics* gives a thorough treatment of why it is crucial for students to discuss the meaning of the ratios such as these. He writes, “…such a ratio tells us how much of the numerator is associated with *one* unit of whatever is represented in the denominator.” Later, in section 1.9 he writes:

“A word of warning: If a teacher accepts the casual use of the word “per” – particularly the incorrect and meaningless “mass per volume”, which was quoted in the previous section- he or she falls into a trap. Even though it contains only three letters, “per” is a technical term, and very few of those students who are having trouble with arithmetic reasoning know what it means. They inject it into a response only because they have a vague memory that “per” frequently turns up for some obscure reason in division, but they do not explicitly translate it into simpler words such as “in,” “for each,” “corresponds to,” “goes with,” “combines with,” “is associated with.”

Below are some recommended ways of interpreting '47 paperclips/door' :

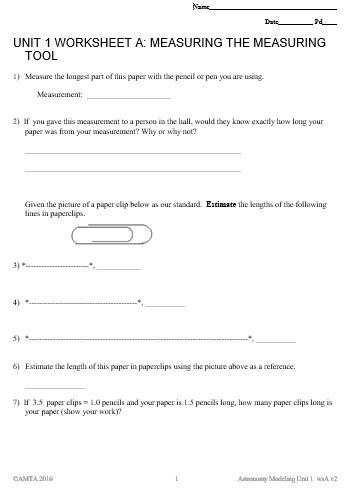
* 47 paperclips would reach from the top of the door to the bottom
* One door is 47 paperclips long
* 47 paperclips corresponds to the length of one door

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## **4. Worksheet A—Measuring the Measuring Tool**



**Purpose**

Students make measurements using non-traditional tools and making conversions between these units.

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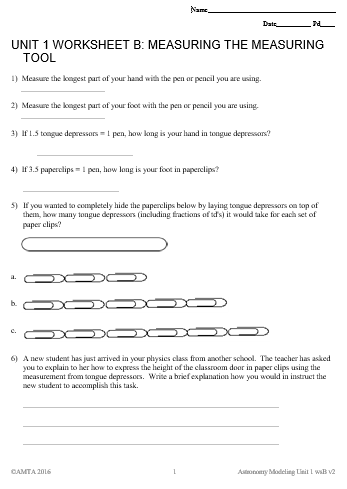
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## **5. Worksheet B—Measuring the Measuring Tool**



**Purpose**

More practice with the same concept.

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## **6. Activity B—Meter Stick Measurements**

**Purpose**

This activity is designed to provide an introduction to the concept of length and standard units of measure and requires little to no pre-activity discussion.

### **Apparatus**

meter sticks or meter tapes

objects of different sizes to be measured.

### **Performance notes**

* There are no written instructions to accompany this activity. It is designed to give the students experience using the measuring devices in your classroom and apply the skills developed in activities 1 and 2.
* Give the students a number of things to measure. Be sure to give both large and small object to measure. The measurements should be given with a proper unit. Example: The length of the hall in meters, the length of an eraser in mm, etc.
* The students are going to be measuring with traditional measuring devices, but they still may have some trouble reading the meter sticks.
* This activity could easily be done outdoors. Just substitute outdoor things to measure rather than classroom objects.
* Lengths or distances should be measured in straight lines.
* Teamwork is important for good results, one student measuring, another recording data, etc.
* The students should have measured a number of objects, both large and small.

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### **Post-activity discussion**

* Discuss the importance of a standard measure and the use of proper units. For example the proper unit for the height of a pop bottle may be centimeters, while the proper unit for the height of the ceiling may be meters.
* Reinforce the idea that metric units are based on powers of 10. There are 10 mm in a cm, 100 cm in 1 m, 1000 m in a km and so on.
* Discuss the importance of uncertainty and estimation. For example a measure of 12 meters for the diameter of a penny would not be sensible.
* Discuss why the measuring standards may be different for different groups and why it may be preferable to have a universal standard of measure.

## **7. Worksheet C—Units of Standard Measure**

**Purpose**

Estimation and conversion between standard units of measurement.

## **8. Section Quiz (**From MPS 01\_11 Quiz 1)