<table>
<tr><td>6th Grade</td><td colspan="2">Thinking Like a 21st Century Scientist / Engineer:
My Science Classroom: Scale Diagrams</td></tr>
<tr><td>SAFETY</td><td colspan="2">1. Discuss appropriate behavior/expectations as students will be moving around the classroom measuring the class.</td></tr>
<tr><td>ADVANCED PREPARATION</td><td colspan="2">• Centimeter or inch grid paper/graph paper
• Rulers, meter sticks, tape measures
• Copies of Student Sheets</td></tr>
<tr><td rowspan="2">ACTIVITIES (3 days)</td><td colspan="2">Objective: The objective of the following activities is to give students the opportunity to explore the classroom space, practice measuring techniques, evaluate appropriate units of measure, and to create a scale model diagram.</td></tr>
<tr><td>What is the teacher doing?
Measuring the Classroom (Day 1)
• Instruct students about scale, scale models, and scale drawings…see teacher page and provide students with the student worksheets.
• Discuss appropriate scale sizes for the classroom (i.e. 25cm=1cm
• Facilitate student groupings
• Facilitate and assist students as they make measurements and correct errors.

Developing the Diagrams (Day 2)
• Distribute grid/graph paper and facilitate as student construct their scale model diagrams with labels. (both centimeter and inch grid paper template sheets are included).

Why the Metric System? (Day 3)
• Additionally, teachers should debrief the students on the drawing. Discuss how can you determine if your model is accurate?
• Faciliate a close reading of the

• Assist students as they try to direct another student to a location in the room using the diagram and converted measurements.</td><td>What is the teacher doing?
Measuring the Classroom (Day 1)
• Students learning about scale, scale models, and scale drawings
• Students determine appropriate scale sizes for the classroom
• In assigned groups, student making measurements of the classroom
• Complete student worksheet.

Developing the Diagrams (Day 2)
• Students use the grid paper to draw the classroom to scale using the scale factor they choose (i.e. 25cm=1cm) as well as label the major items in the room that maybe important during science lab/class (i.e. eye wash, fire blanket, sinks, safety glasses, aprons, SMARTBoard, etc.)

Why the Metric System? (Day 3)

• Students reflect on their models/chosen units of measurement.
• Students read the article “
• Students evaluate their models to determine if their diagram is an accurate representation of the classroom.</td></tr>
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Teacher Page

1. The websites below are for reference. They provide information about scale, scale models, and scale drawings.
   - www.tuslaw.sparcc.org/pages/uploaded_files/**Lesson**%206-3.ppt
   - http://www.phschool.com/iText/mgmath_course2/Ch05/05-07/PH_MSM2_ch05-07_Obj1.html
   - www.sde.ct.gov/sde/lib/.../Making_a_**Scale_Drawing**.doc

2. My Science Classroom: Scale Diagrams…Ask the students if they were going to make a map of the city, would it be a good idea to have the map be the same size as the city. Would they want the map to be bigger or smaller than the city? How could you let someone else know how much bigger or smaller the map is than the city? That difference between the size of the city and the size of the map is called scale. Follow along with the work sheet to help the students understand what scale is and how it can be used to represent real things either very large or very small on paper or in a model at a size that people can understand.

3. Students will measure the classroom using a unit of measurement of their choice(centimeter, meters, inches, feet, yard) and the measuring tool of their choice(ruler, tape measure, meter stick). Students will create a scale factor (i.e. 25cm=1cm) that they will then use to create their scaled diagram of the room. Students should include labels of the important science classroom items, including safety tools and equipment. See example on next page.

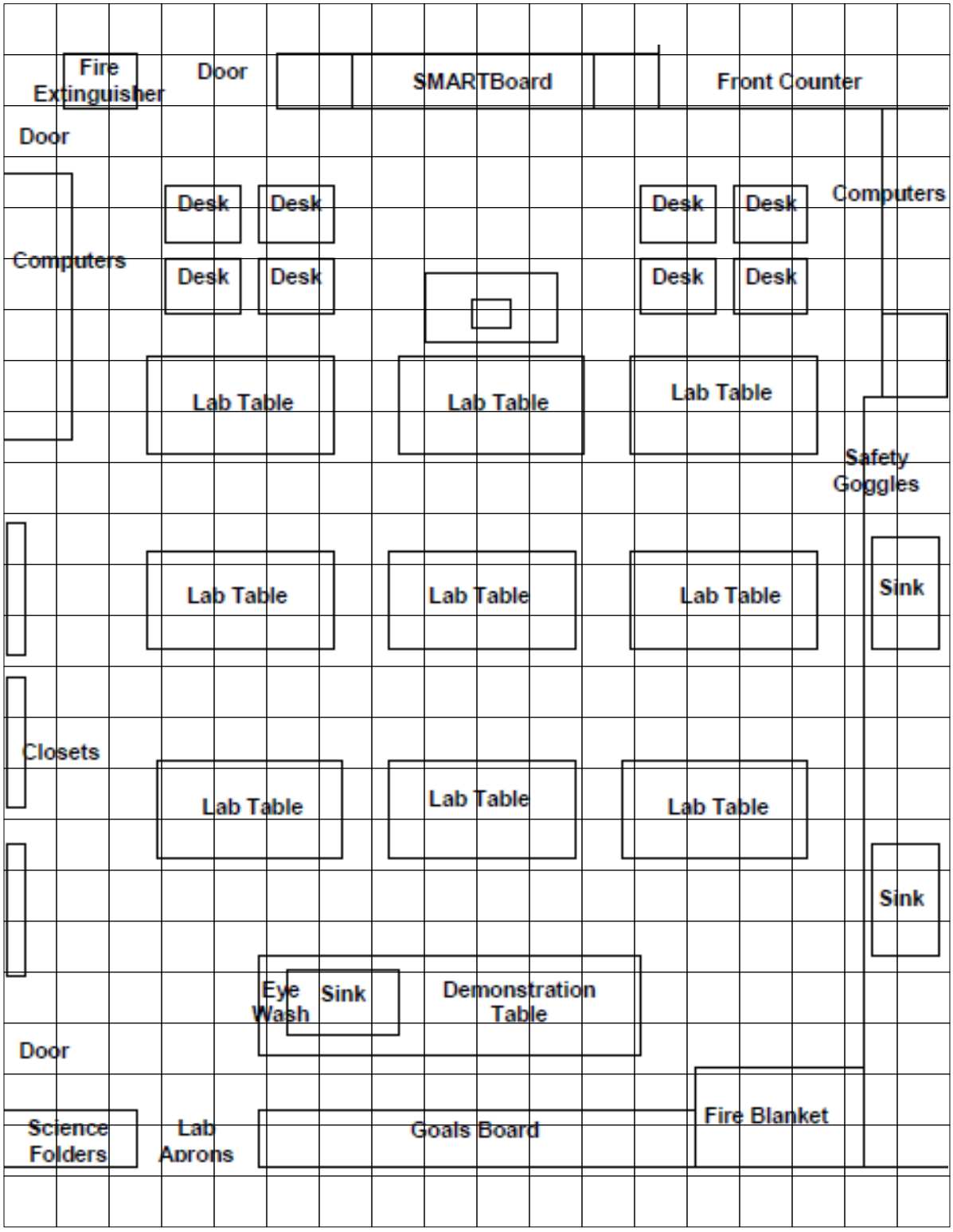
4. In the "Follow-up: Scale models of the Lab Room", students are asked to explain why using the metric system might be better for measuring the classroom. Possible answers might include:
   The Metric System is based on the powers of 10, making it easy to do conversions. Accept most reasonable answers.

5. Facilitate a close reading of the story, *Metric Mishap Caused Loss of NASA Orbiter,* from CNN to help students realize why scientists use the metric system. This article explains the confusion regarding units of measure that caused a big problem for NASA scientists.
   http://www.cnn.com/TECH/space/9909/30/mars.metric.02/

6. Students will engage in a "treasure hunt". They must start from a spot you tell them to (i.e. the door) measure on their model how far an object in the class (i.e. the sink) is from the door, convert to the appropriate units and direct another student starting in the actual starting point to the object in the class (i.e. start at the left corner of the door, move six meters toward the wall. Turn left. Go half a meter…). Students will practice giving detailed and accurate directions.

The following picture is an example of a drawing of a classroom.

Diagram Example



Name _____ Date _____

My Science Classroom: Scale Diagrams

1) If you want to draw a map of the city for your friend, should you make your map as big as the city? Why or why not?

_____

_____

_____

_____

How could you let your friend know how much bigger or smaller your map is than the city actually is?
The way to tell your friend how much bigger or smaller your map is than the city, is called "scale."

Your mission is to draw a scale map of your classroom and label the important objects and places in the room related to science laboratory investigations. First, select the scale you will use to draw your map. You have one piece of centimeter or inch grid paper.

2) What unit of measurement will you use? _____

3) Measure the room based on your chosen unit of measurement and measuring tool(s).

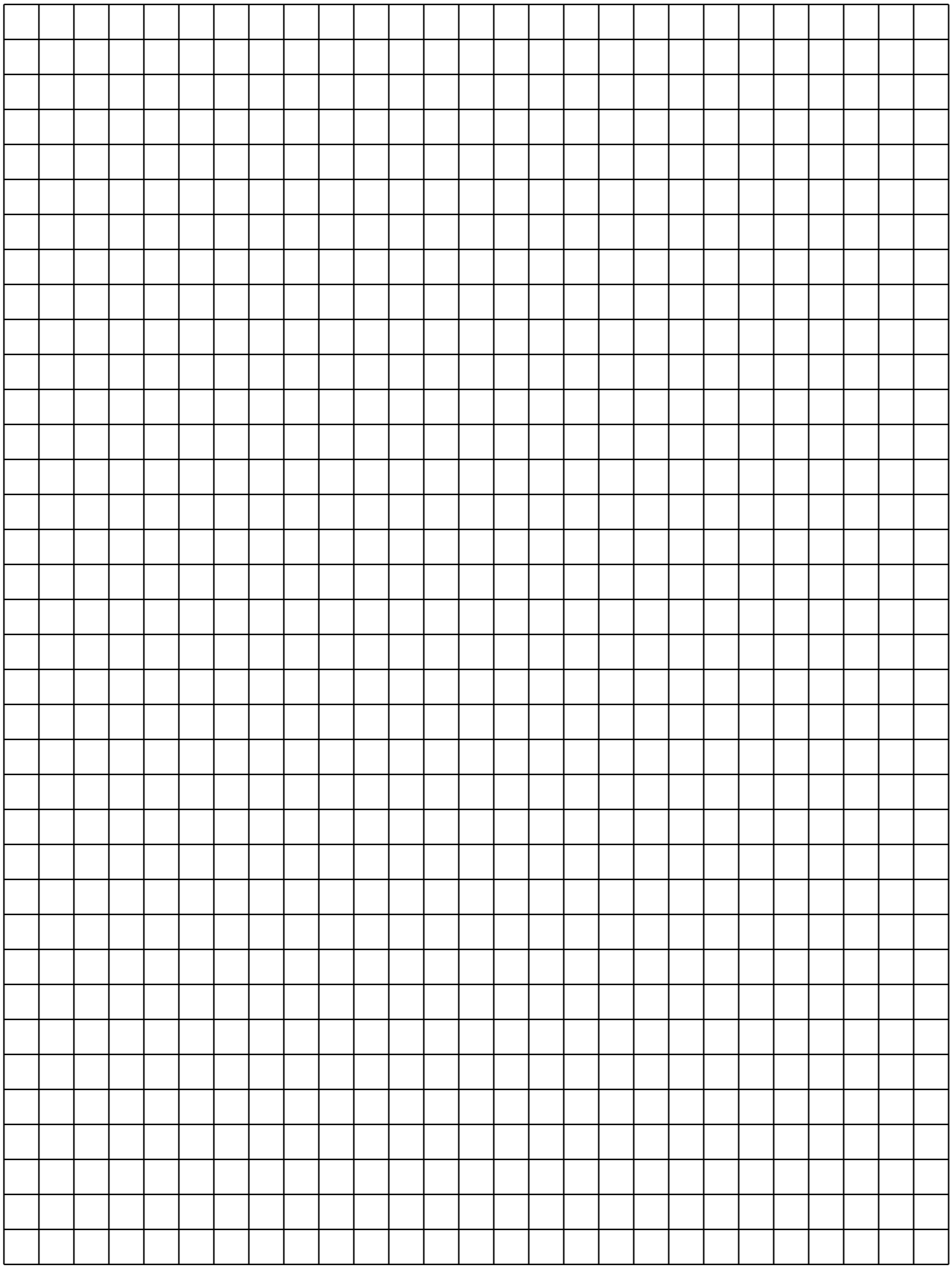
How long is the room? _____ How wide is the room? _____

Be careful to keep your measurement in the units you want to make your drawing in. If your unit is centimeters, then don't measure the wall in meters, or feet.

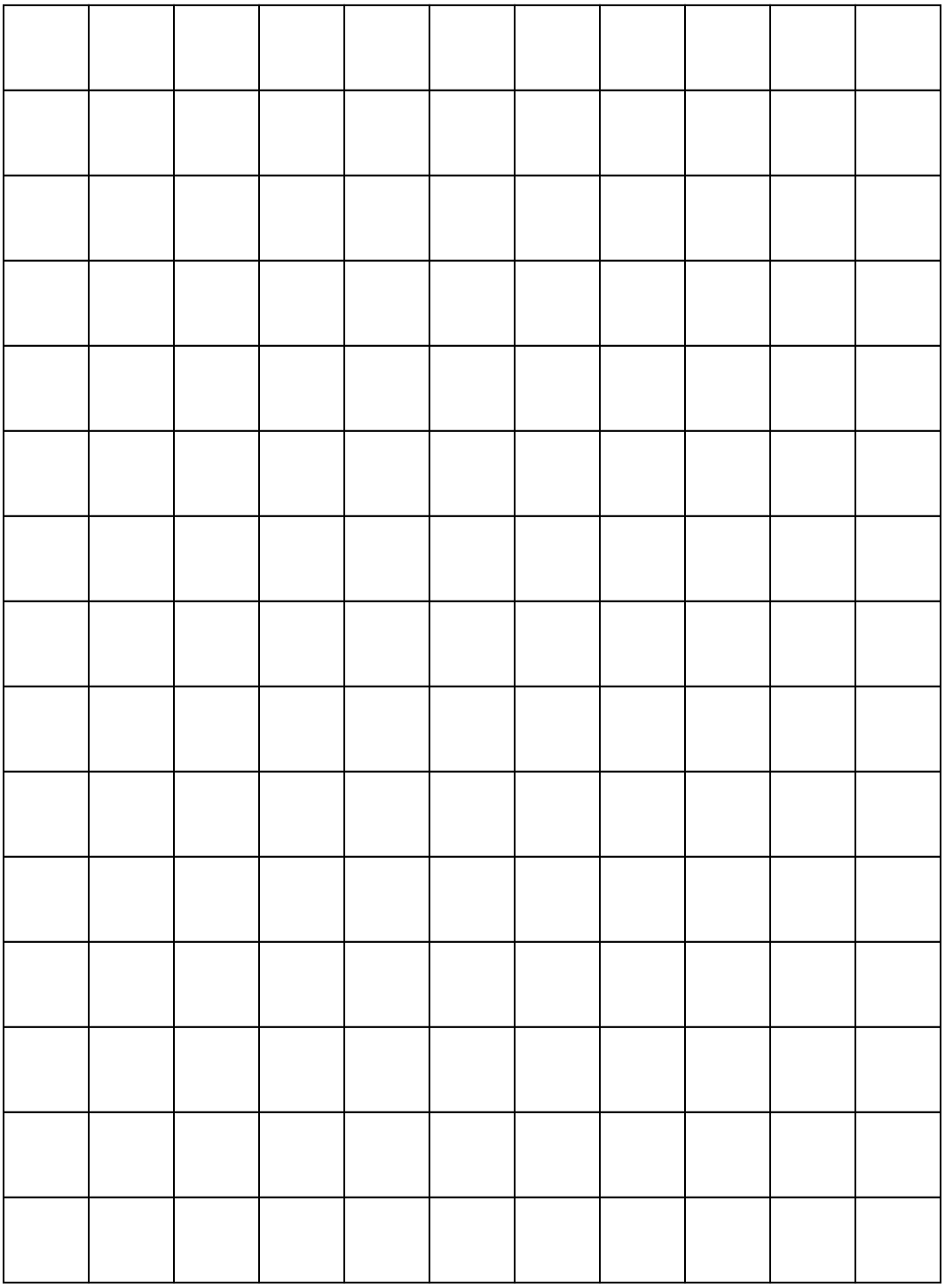
Now decide based on your paper size how many units on paper is equal to how many units on the wall.

Once you have your scale you can start to measure and draw the classroom. One last consideration…Should you measure the overall length and width of the room first or the location of items along the wall? You decide.

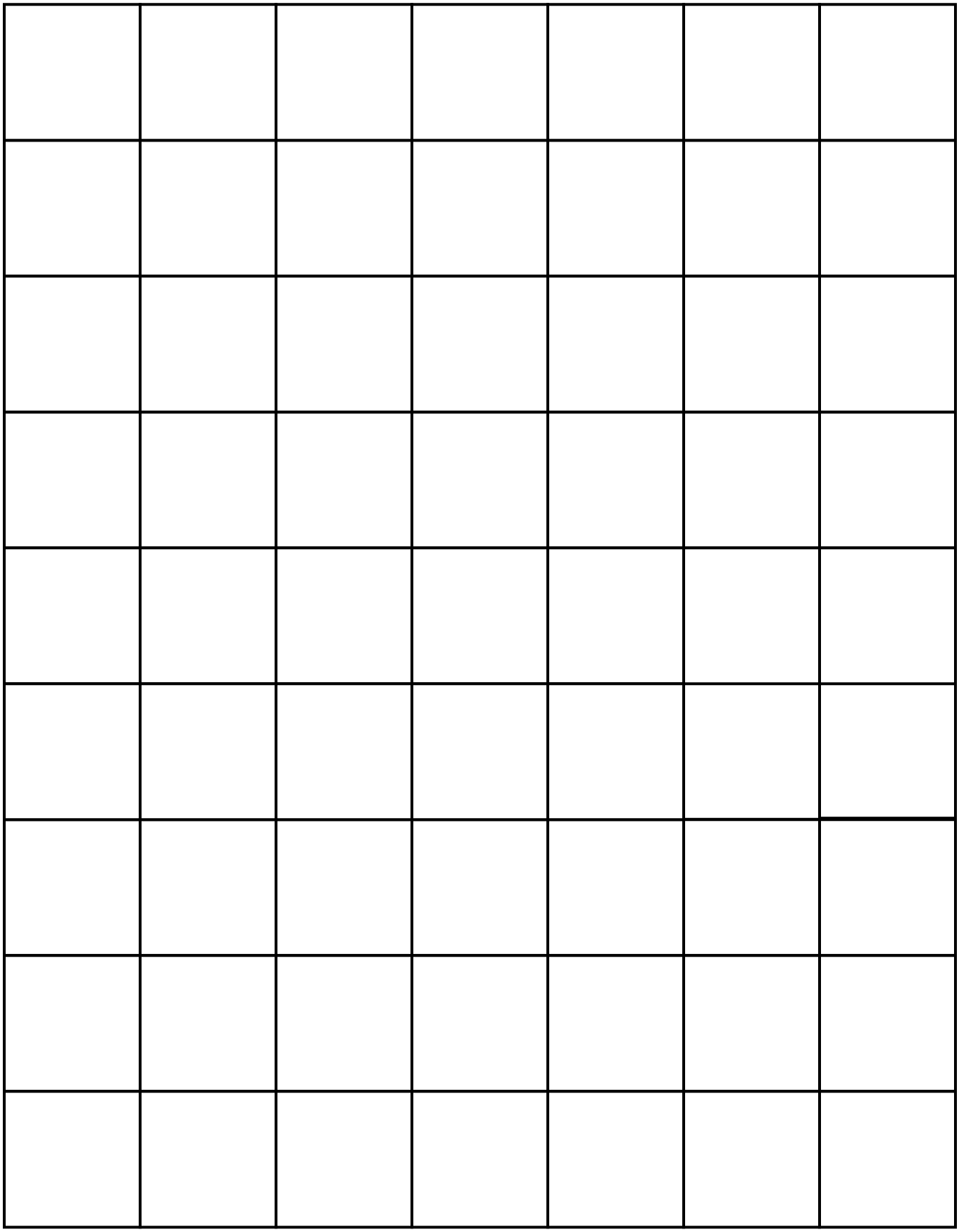
¼ inch Grid Paper



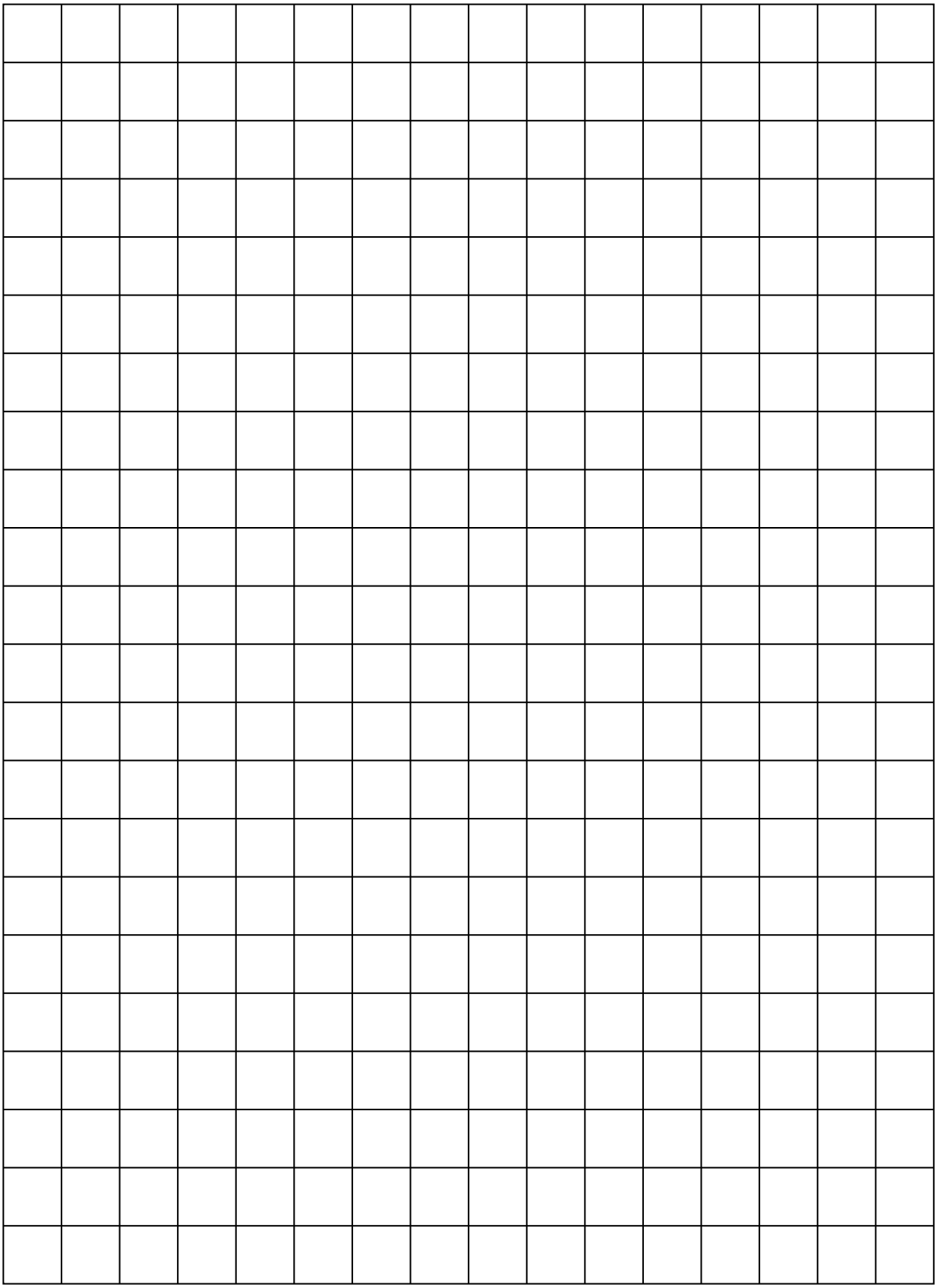
½ inch Grid Paper



1 inch grid



1 centimeter grid



Name_____Date_____Period_____

Follow-up: Scale Models of the Lab Room

1) What is scale and how is it used in everyday life? Provide an example.

2) Think about the unit of measurement you used. Should you have chosen another unit? (for example, was there a benefit to using centimeters or inches?) Explain why using the metric system might be better.

3) Did you know that scientists around the world use the metric system? Read the story from CNN that your teacher has given you and write a paragraph explaining why scientists always should use the metric system.

4) Did the grid paper you have influence which unit of measure you used to measure the classroom? Explain.

5) Were you able to include everything in the classroom in your drawing? Why or why not?

_____

_____

_____

_____

6) Using your scale model can you tell someone else, exactly where an object in the class is? Try it. Measure on your scale model, convert the units to the real world scale measurement and see if you can direct another student to find an object in the classroom. Write your directions below:

Did you succeed? Explain why or why not?

_____

_____

_____

_____

Metric mishap caused loss of NASA orbiter

By Robin Lloyd
CNN Interactive Senior Writer

(CNN) -- NASA lost a $125 million Mars orbiter because a Lockheed Martin engineering team used English units of measurement while the agency's team used the more conventional metric system for a key spacecraft operation, according to a review finding released Thursday.

The units mismatch prevented navigation information from transferring between the Mars Climate Orbiter spacecraft team in at Lockheed Martin in Denver and the flight team at NASA's Jet Propulsion Laboratory in Pasadena, California. Lockheed Martin helped build, develop and operate the spacecraft for NASA. Its engineers provided navigation commands for Climate Orbiter's thrusters in English units although NASA has been using the metric system predominantly since at least 1990. No one is pointing fingers at Lockheed Martin, said Tom Gavin, the JPL administrator to whom all project managers report.

"This is an end-to-end process problem," he said. "A single error like this should not have caused the loss of Climate Orbiter. Something went wrong in our system processes in checks and balances that we have that should have caught this and fixed it."

The finding came from an internal review panel at JPL that reported the cause to Gavin on Wednesday. The group included about 10 navigation specialists, many of whom recently retired from JPL. "They have been looking at this since Friday morning following the loss," Gavin said.

The navigation mishap killed the mission on a day when engineers had expected to celebrate the craft's entry into Mars' orbit. After a 286-day journey, the probe fired its engine on September 23 to push itself into orbit. The engine fired but the spacecraft came within 60 km (36 miles) of the planet -- about 100 km closer than planned and about 25 km (15 miles) beneath the level at which the it could function properly, mission members said.

The latest findings show that the spacecraft's propulsion system overheated and was disabled as Climate Orbiter dipped deeply into the atmosphere, JPL spokesman Frank O'Donnell said. That probably stopped the engine from completing its burn, so Climate Orbiter likely plowed through the atmosphere, continued out beyond Mars and now could be orbiting the sun, he said.

Climate Orbiter was to relay data from an upcoming partner mission called Mars Polar Lander, scheduled to set down on Mars in December. Now mission planners are working out how to relay its data via its own radio and another orbiter now circling the red planet. Climate Orbiter and Polar Lander were designed to help scientists understand Mars' water history and the potential for life in the planet's past. There is strong evidence that Mars was once awash with water, but scientists have no clear answers to where the water went and what drove it away.

NASA has convened two panels to look into what led to the loss of the orbiter, including the internal peer review panel that released the Thursday finding. NASA also plans to form a third board -- an independent review panel -- to look into the accident.

Metric system used by NASA for many years

A NASA document came out several years ago, when the Cassini mission to Saturn was under development, establishing the metric system for all units of measurement, Gavin said.

The metric system is used for the Polar Lander mission, as well as upcoming missions to Mars, he said. That review panel's findings now are being studied by a second group -- a special review board headed up by John Casani, which will search for the processes that failed to find the metric to English mismatch. Casani retired from JPL two months ago from the position of chief engineer for the Lab.

"We're going to look at how was the data transferred," Gavin said. "How did it originally get into system in English units? How was it transferred? When we were doing navigation and Doppler (distance and speed) checks, how come we didn't find it?"

"People make errors," Gavin said. "The problem here was not the error. It was the failure of us to look at it end-to-end and find it. It's unfair to rely on any one person."

Lockheed Martin, which failed to immediately return a telephone call for comment, is building orbiters and landers for future Mars missions, including one set to launch in 2001 and a mission that will return some Mars rocks to Earth a few years down the line.

It also has helped with the Polar Lander mission, set to land on Mars on December 3 and conduct a 90-day mission studying martian weather. It also is designed to extend a robotic arm that will dig into the nearby martian soil and search for signs of water.

NASA managers have said the Polar Lander mission will go on as planned and return answers to the same scientific questions originally planned -- even though the lander will have to relay its data to Earth without help from Climate Orbiter.

Error points to nation's conversion lag

Lorelle Young, president of the U.S. Metric Association, said the loss of Climate Orbiter brings up the "untenable" position of the United States in relation to most other countries, which rely on the metric system for measurement. She was not surprised at the error that arose.

"In this day and age when the metric system is the measurement language of all sophisticated science, two measurements systems should not be used," Young said.

"Only the metric system should be used because that is the system science uses," she said.

She put blame at the feet of Congress that she said has squeezed NASA's budget to the point that it has no funds to completely convert its operations to metric.

"This should be a loud wake-up call to Congress that being first in technology requires funding," she said, "and it's a very important area for the country."

Article taken from: http://www.cnn.com/TECH/space/9909/30/mars.metric.02/