CLASSROOM ACTIVITY
Locating a Point

Learn how to plot a position using the same kind of information provided by real Global Positioning Systems! Find out how scientists use GPS in their research, and consider the usefulness of this technology for Antarctic research. Focus your investigation on the questions below. After you and your team have completed the activity, respond to these questions directly in your journal.

- How are satellites used to locate positions on the surface of the Earth?
- How many satellite positions do you need to use to figure out precisely where a meteorite is?
- Why would GPS technology be particularly useful for Antarctic research?

Gather with your team and choose a captain and a note taker for today, as well as an artist to illustrate the group's findings.

The captain appoints group members to collect the required materials while the rest of the group reviews today's procedure. Before beginning, the captain makes sure that the group has all required materials, and that everyone knows the day's procedure.

The note taker takes notes on the group's findings for your team. Remember to record your observations and explanations in your journal for your own research notes. Include drawings to illustrate your findings.

MATERIALS

- copy of Points on a Grid
- red, green, and blue pencils or pens
- 1 compass for drawing circles
- ruler

PROCEDURE

Use your worksheets to complete the activity.

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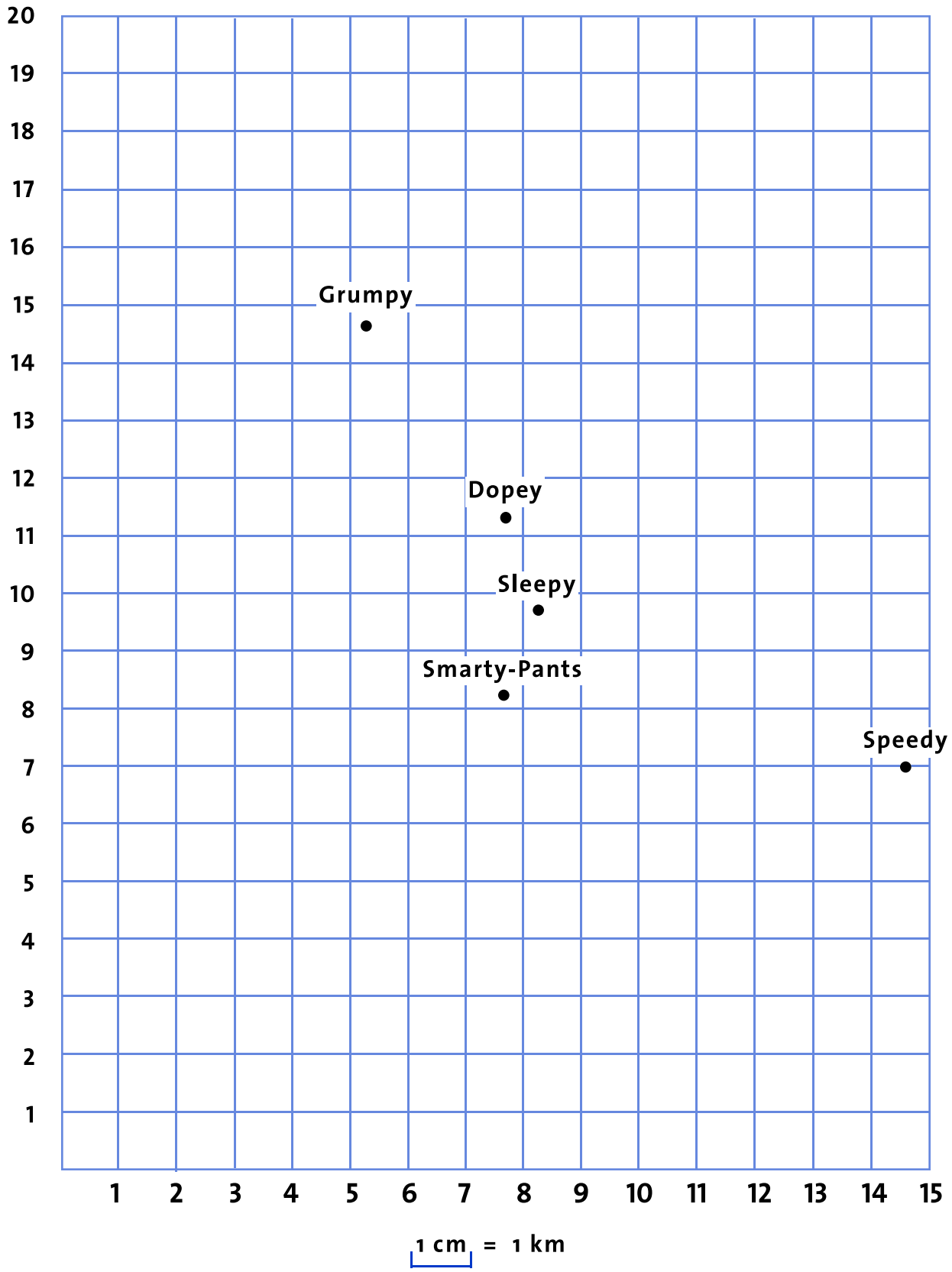

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GROUP WORKSHEET 1
ANTARCTIC TEAM __

GROUP MEMBERS _____

CAPTAIN _____ **NOTE TAKER** _____

1. Suppose that researchers are studying a fallen meteorite in Antarctica. They have not completed their work; but in a few more days, the Antarctic winter will be in full swing, and the Antarctic night will make further field research impossible for six months. The scientists want to return in six months to continue their work. How can they find the exact location of the meteorite again? Brainstorm with your team; write some of your ideas below.

2. How would these scientists pinpoint the location of the meteorite? And how would they find that exact location when they return next year, with all physical landmarks changed during the harsh Antarctic winter? Satellites! These "Global Positioning Satellites" orbit the Earth about 20,200 kilometers (12,552 miles) from the Earth's surface; and today you'll recreate on paper what those satellites do in space. You can't mimic exactly what they do—if you wanted to use the actual units, you'd need a GIGANTIC compass. For today, use centimeters to represent kilometers (1 cm = 1 km); that way, your calculations can fit on your paper!

Your mission? You must find the meteorite using the location of the satellites on the map. Way up in space, high above the icy Antarctic surface where the meteorite sits, five Global Positioning Satellites orbit the Earth. You don't know where the meteorite is, but the map will tell you the position of the satellites, and the chart below (based on the satellites' signals) tells you their distance from the meteorite. Remember that distance corresponds to the radius of a circle defined by the intersection of the sphere of the satellite's signal and the sphere of the Earth.

SATELLITE NUMBER & NAME	DISTANCE FROM UNKNOWN POINT
#1 – Grumpy	10 centimeters
#2 – Sleepy	7.5 centimeters
#3 – Smarty-Pants	11 centimeters
#4 – Speedy	15 centimeters
#5 – Dopey	6 centimeters

How can you use this information to figure out the location of the meteorite?

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GROUP WORKSHEET 2
ANTARCTIC TEAM _

3. Begin zeroing in on your position using the information you have about Satellite Grumpy's (#1) distance from the meteorite. Use your compass to recreate the intersection of the sphere of Grumpy's signal with the sphere of the Earth on your map (the point labelled "Gumpy" represents the projection of the position of Grumpy in space onto the Earth's surface and is the center of the circle created by the intersection of Grumpy's satellite signal and the sphere of the Earth). Use your green pen or pencil. Explain what you know so far about the meteorite's location, and what further information you'll need to pinpoint it.

4. Get a little closer! Pick another satellite and use your compass to recreate the intersection of the sphere of its signal with the sphere of the Earth, using the distance listed in the chart. This time use a blue pen or pencil to mark your map. Explain what you know so far about the meteorite's location, and what further information you'll need to pinpoint it. Make sure you to include the name of the satellite you used for your calculations.

5. What does the map look like now? How much information do you have about the meteorite's location? How much more information do you need to find the satellite?

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GROUP WORKSHEET 3
ANTARCTIC TEAM _

6. Use the rest of the satellites' signals, using your compass to draw the signal's intersection of the sphere, with the Earth's surface. Describe your process. When were you reasonably sure where the satellite was? When were you positive?

7. What is the minimum number of satellites you'd need to pinpoint the location of the meteorite? Why might you want to use more than that minimum when looking for a meteorite in Antarctica?

8. Draw some conclusions based on your experience. Why might GPS technology be useful to research scientists? Why do you think this technology is especially important to scientists working in Antarctica? What situations, other than this meteorite mission, might require the use of GPS? What other uses might there be for GPS?