

N8 • Using directed numbers in context

Mathematical goals

To help learners to:

- understand and use directed numbers in the context of temperatures.

Starting points

This session requires no prior knowledge.

Learners are provided with the temperatures in four cities. Temperature differences between these and four other cities are also given. Learners are asked to find missing temperatures and temperature differences. This leads them to consider one interpretation of addition and subtraction with negative numbers.

Materials required

For each small group of learners you will need:

- Card set A – *City temperatures*;
- Card set B – *Temperature changes*;

and possibly:

- a temperature scale cut from Sheet 1 – *Temperature scales*.

Time needed

Approximately 1 hour.

Suggested approach **Beginning the session**

Ask four learners to come to the front of the room and give them each a card on which you have written the name of a city and a temperature.

For example, you could use the following:

| | |
|----------|--------|
| London | 13 °C |
| Moscow | –8 °C |
| Montreal | –11 °C |
| Madrid | 20 °C |

Ask the learners to stand in order of temperature – coldest to hottest.

Ask the rest of the group questions such as the following:

If I travel instantly from London to Madrid:

- Does the temperature rise or fall? By how much?
- Madrid to Moscow?
- Moscow to Montreal?

Cairo is 30° warmer than Montreal.

- What is the temperature in Cairo?

After each question ask learners to explain how they worked it out.

You may find it helpful to use an OHT of one of the temperature scales to help with the explanation.

Working in groups

Ask learners to sit in pairs or threes. Give out Card set A – *City temperatures* and Card set B – *Temperature changes*. Card set B shows temperature changes as you travel from one city to another.

Ask learners to link the *City temperatures* cards to the *Temperature changes* cards. As they position each card, they should be able to work out either an unknown city temperature or an unknown temperature change and write it in the space on the card.

Ask learners to take it in turns to place the *Temperature changes* cards in their correct positions. As they place a card, they should explain to their partner(s) why they have placed the card in that position. When they have given their explanation, their partner(s) should either challenge what they have said or say why they agree.

While they work on the task, encourage learners to check their work using different routes with the cards.

If learners have difficulty, give them a temperature scale from Sheet 1 to help them illustrate the changes.

Reviewing and extending learning

Explain to the whole group that there are several ways of calculating missing numbers. Ask learners to describe the ways they have used for some specific examples. Elicit more than one method for each case and use these to develop the structure of the situations as directed number calculations. For example:

Final temperature missing

| | | |
|-------------|---------------------------|------------|
| Verkhoyansk | Verkhoyansk to Wellington | Wellington |
| -40 °C | +55 °C | ? |

$$\begin{aligned} \text{Starting temperature} + \text{change} &= \text{final temperature:} \\ -40 + (+55) &= +15 \end{aligned}$$

Starting temperature missing

| | | |
|----------|--------------------|--------|
| Khartoum | Khartoum to Sydney | Sydney |
| ? | -10 °C | +25 °C |

$$\begin{aligned} \text{Final temperature} - \text{change} &= \text{starting temperature:} \\ +25 - (-10) &= +35 \end{aligned}$$

Change missing

| | | |
|--------|-----------------------|-------------|
| Sydney | Sydney to Verkhoyansk | Verkhoyansk |
| 25 °C | ? | -40 °C |

$$\begin{aligned} \text{Final temperature} - \text{initial temperature} &= \text{change in temperature:} \\ -40 - (+25) &= -65 \end{aligned}$$

Combining changes

| | | |
|--------------------|------------------|--------------------|
| Khartoum to Sydney | Sydney to Moscow | Khartoum to Moscow |
| -10 °C | -35 °C | ? |

$$\begin{aligned} \text{First change} + \text{second change} &= \text{combined change:} \\ -10 + (-35) &= -45 \end{aligned}$$

What learners might do next

Ask learners to generalise rules for adding or subtracting directed quantities from these or similar examples. For instance, the four examples shown above illustrate the effect of adding a positive, subtracting a negative, subtracting a positive, and adding a negative.

Remind learners of other situations and contexts where negative numbers appear e.g. time differences, bank credits and debits etc. For given calculations, can they think of suitable problems?

For example: $-25 + (-30) = -55$

I have two bank accounts. One has an overdraft of £25. The other has an overdraft of £30. Altogether I have an overdraft of £55.

Session **N9 Evaluating directed number statements** would be a useful follow-up to this session.

There are several websites that give information on time differences between Greenwich Mean Time and other world cities. Learners could investigate these and create problems involving time differences.

Further ideas

This session uses representations of states (temperatures) and transformations (temperature changes). Similar activities in other mathematical contexts are included in this pack. For example:

SS7 Transforming shapes

(states are shapes; transformations are translations, reflections rotations and enlargements);

N7 Using percentages to increase quantities

(states are money values; transformations are percentage increases/decreases).

N8 Card set A – City temperatures

| | |
|---------------------------|------------------------------|
| Anchorage | London -5 °C |
| Moscow | Verkhoyansk -40 °C |
| Rio 30 °C | Khartoum |
| Sydney +25 °C | Wellington |

N8 Card set B – Temperature changes

| | |
|---|---|
| <p>Anchorage to London +15 °C</p> | <p>Wellington to Sydney +10 °C</p> |
| <p>London to Moscow °C</p> | <p>Anchorage to Rio +50 °C</p> |
| <p>Moscow to Verkhoyansk -30 °C</p> | <p>London to Khartoum +40 °C</p> |
| <p>Rio to Khartoum °C</p> | <p>Moscow to Sydney +35 °C</p> |
| <p>Khartoum to Sydney -10 °C</p> | <p>Verkhoyansk to Wellington +55 °C</p> |

N8 Card set B – Temperature changes (continued)

| | |
|--|--|
| <p>Anchorage to Khartoum °C</p> | <p>Rio to London °C</p> |
| <p>London to Sydney °C</p> | <p>Khartoum to Moscow °C</p> |
| <p>Moscow to Wellington °C</p> | <p>Sydney to Verkhoyansk °C</p> |
| | |
| | |

N8 Sheet 1 – Temperature scales (four copies)

