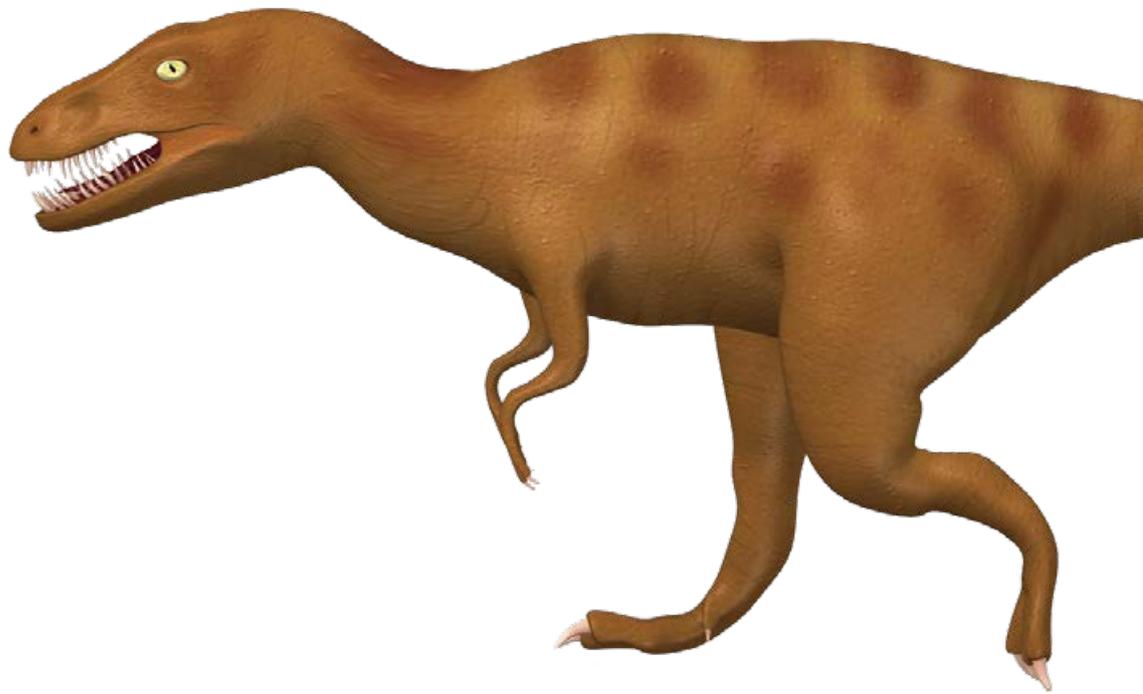


Reasoning in the classroom

Dinosaur footprints



Support materials for teachers

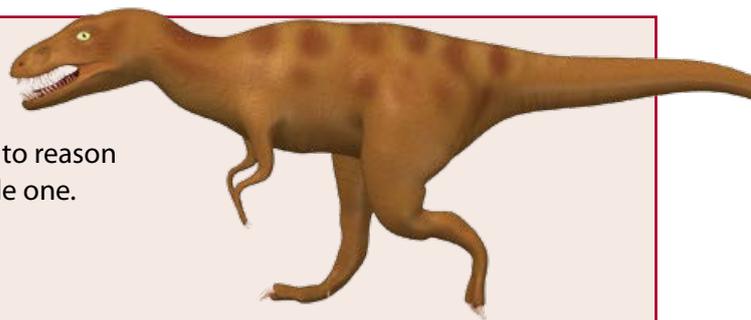
Year 5



Llywodraeth Cymru
Welsh Government

Year 5 Reasoning in the classroom – Dinosaur footprints

These activities are based on the theme of dinosaurs.



Activity 1

Dinosaur footprints

Learners use formulae, given in words, to reason whether a big dinosaur can catch a little one.

Includes:

- Teachers' script
- PowerPoint presentation
- Dinosaur footprints question
- Markscheme

Activity 2

Legs and feet

They explore the relationship between the length of their own legs and their feet.

Includes:

- Explain and question – instructions for teachers
- Whiteboard – Remember the rule?

Activity 3

Run for your life!

They then find routes for the small dinosaur to escape from the clutches of big dinosaurs.

Includes:

- Explain and question – instructions for teachers
- Whiteboard – Game board 1
- Resource sheet – Game board 1
- Resource sheet – Game board 2

Reasoning skills required

Identify

Learners choose their own strategies. They use a calculator when appropriate.

Communicate

They decide how to record outcomes.

Review

They share their conclusions and try to find reasons for their findings.

Procedural skills

- Multiplication and division
- Addition and subtraction
- Measuring (length)
- Compass points

Numerical language

- Height
- Length
- Horizontal
- Vertical
- Diagonal

Activity 1

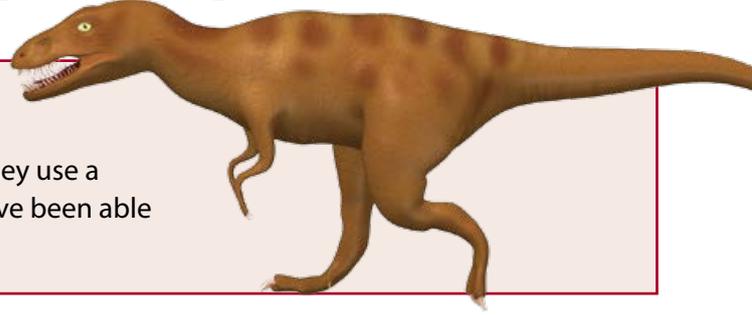
Dinosaur footprints

Activity 1 – Dinosaur footprints



Outline

Learners are given simple formulae used by scientists. They use a calculator to work out whether a little dinosaur could have been able to escape from a big one (it could!).



You will need



Teachers' script



PowerPoint presentation



Dinosaur footprints question

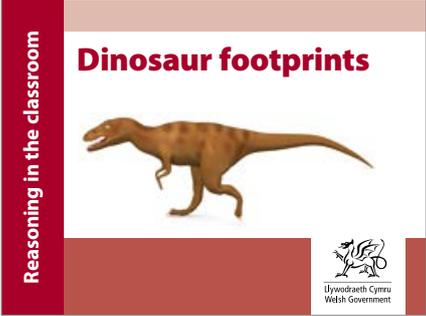
Two pages for each learner, must not be printed double-sided

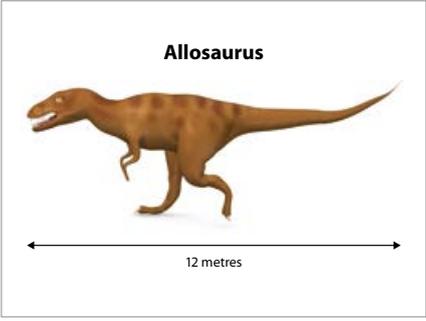
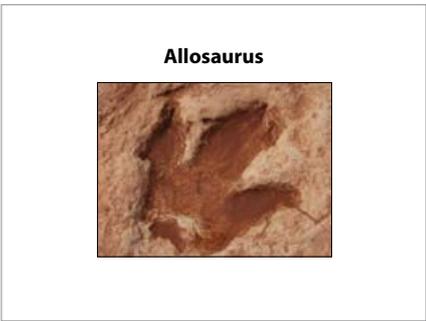
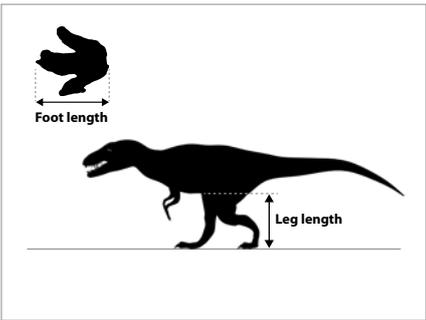
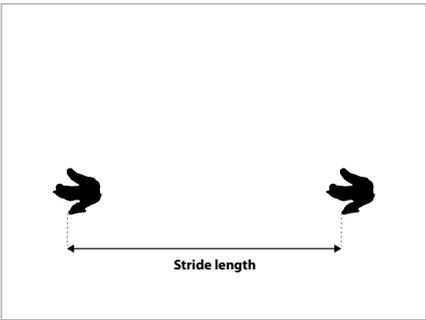


Markscheme

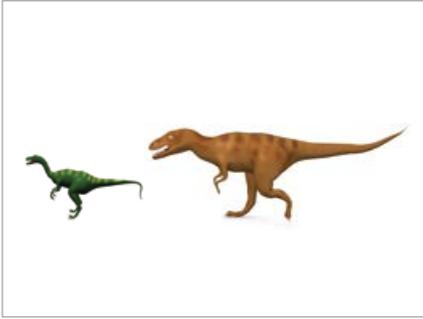
Presentation to be shown to learners before they work on Dinosaur footprints

The text in the right-hand boxes (but not italics) should be read to learners. You can use your own words, or provide additional explanation of contexts, if necessary. However, if you are using this as an assessment item, no help must be given with the numeracy that is to be assessed.

<p>Slide 1</p>		<p><i>(Keep this slide on the screen until you are ready to start the presentation.)</i></p>
<p>Slide 2</p>		<p>Although dinosaurs lived millions of years ago, scientists can work out facts about them by the clues they have left behind.</p> <p>One set of clues is ... footprints.</p>
<p>Slide 3</p>		<p>Dinosaur footprints like these were found in the rocks near Sully in South Wales. The dinosaurs walked there when it was wet with mud and silt. When it dried out the footprints were fossilised so we can still see them today.</p>

<p>Slide 4</p>	 <p style="text-align: center;">Allosaurus</p>	<p>There were many different types of dinosaur. This one is called an Allosaurus.</p> <p>It had sharp teeth. Unlike many dinosaurs which were plant-eating, an Allosaurus ate meat including other dinosaurs.</p>
<p>Slide 5</p>	 <p style="text-align: center;">Allosaurus</p>	<p>This is a footprint from an Allosaurus. It was found in America.</p> <p><i>(Trace the edge of the footprint with your finger.)</i></p> <p>Scientists can use the footprint to work out information about the Allosaurus.</p>
<p>Slide 6</p>		<p>The scientists measure foot length.</p> <p>Then they use mathematics to work out the leg length.</p> <p><i>(Do not give the rule.)</i></p>
<p>Slide 7</p>		<p>The scientists also measure the distance between footprints – this distance is called the stride length.</p> <p>Then they use more mathematics to work out how fast the dinosaur could run.</p> <p><i>(Do not give the rule.)</i></p>

Slide 8

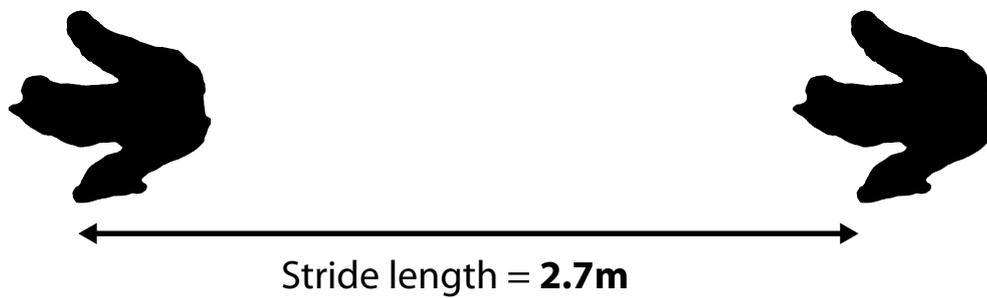
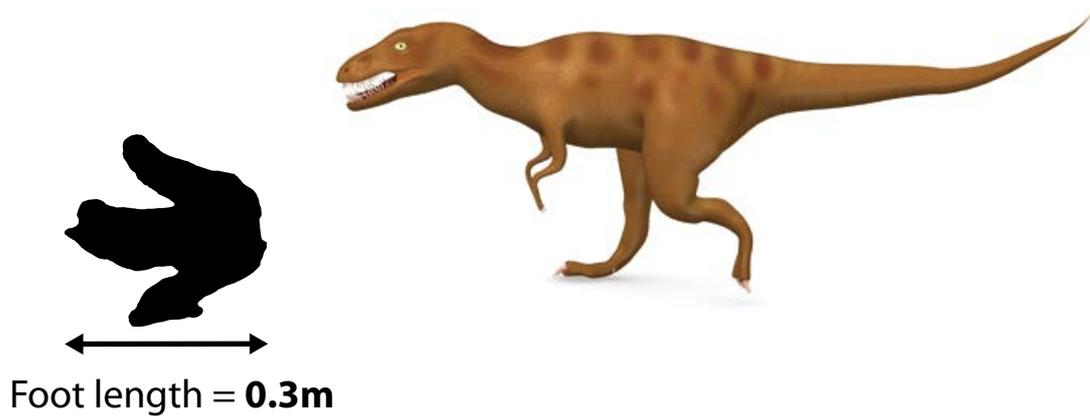


The Allosaurus is chasing a smaller dinosaur. Run, little dinosaur, run!

Now you are going to work out whether the Allosaurus is likely to catch the smaller dinosaur.

Remember to show your working so that someone else can understand what you are doing and why.

(If you are using this item for assessment purposes, you may wish to limit the time available, e.g. 10 minutes.)

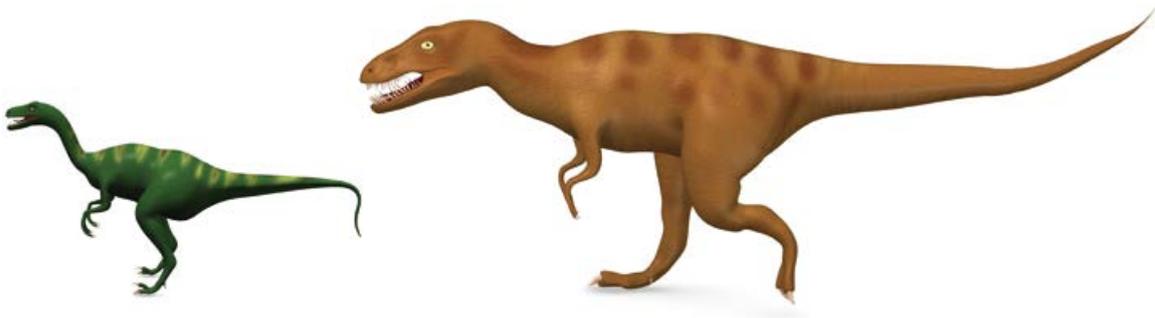


We think leg length is four times foot length.

To find how many metres a dinosaur can run in one minute:

Multiply stride length by 84, divide the result by leg length and then subtract 16

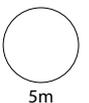




The smaller dinosaur can run about **180 metres** in one minute.

Is the Allosaurus likely to catch it?

Show how you decide.



Activity 1 – Dinosaur footprints – Markscheme

Marks	Answer
5m	Shows or implies that the Allosaurus runs 173 metres in one minute (accept units omitted) and gives a correct conclusion , e.g. <ul style="list-style-type: none"> • $173 < 180$ so the little one will escape • The big one runs 7m less than the small dinosaur so it can't eat it
Or 4m	Shows or implies 173
Or 3m	Shows 189 or 189 followed by any decimal, e.g. <ul style="list-style-type: none"> • 189.72 <p>Or</p> Shows a method that would lead to 173 if calculated correctly
Or 2m	Shows 226.8 (accept 227 or 226) <p>Or</p> Shows the intent to multiply 2.7 by 84 and also to divide by 1.2
Or 1m	Shows 1.2 <p>Or</p> Shows the intent to multiply 2.7 by 84

◀ **Stride length × 84, divided by leg length**

◀ **Stride length × 84**

◀ **Leg length**

Activity 1 – Dinosaur footprints – Exemplars



First I did $2.7 \times 84 = 226.8$ then I did $226.8 \div 1.2$ because $0.3 \times 4 = 1.2$ and $226.8 \div 1.2 = 189$ but then I had to take away 16 and $189 - 16 = 173$ so I know that it runs 173 metres in one minute but the small dinosaur goes faster so it can probably run away in time unless it falls over.

Correct; **5 marks**

- This learner shows good communication skills.



The little dinosaur is faster because he can run 180 metres in one minute and the big one can only go 173 metres in one minute so he is faster than the big one and wont be caught up by the big one.

Correct; **5 marks**

- In contrast to the exemplar above, this learner shows no calculations. They would benefit from discussion about the importance of showing working.



$0.3 + 0.3 + 0.3 + 0.3 = 0.12$
 $2.7 \text{ times } 84 = 226.8$
 $226.8 \div 0.12 = 1890$
 $1890 - 16 = 1874$ so it is dead.

Correct method; **3 marks**



The only error in this working is that the learner has added the 0.3's incorrectly. This error shows a common conceptual difficulty in adding decimals.



2.7×84
 5.4×42
 10.8×21
 $10.8 + 10.8 = 21.6$
 $21.6 \times 2 = 43.2$
 $43.2 \times 2 = 86.4$
 $86.4 + 86.4 = 172.8$
 $172.8 + 43.2 + 10.8 = 226.8$

Shows 226.8; **2 marks**

- This learner has successfully worked out 2.7×84 but has incurred a time penalty by not using a calculator. Knowing when and why to use a calculator is an essential numerical skill.



Well what I no that the stride is 2.7 metres so I did times 84 on my calculator and it showed 226.8 so then I worked out 226 shared by 0.3 on my calculator and the answer was 753 so then I worked out that it can run faster so it will definately catch it up

Shows 226.8; **2 marks**

- This learner has forgotten that foot length is four times leg length.



$$\begin{array}{r} 27 \\ \times 84 \\ \hline 108 \\ 216 \\ \hline 324 \\ \hline 84 \overline{) 324} \end{array}$$

3 and a bit

$84 \overline{) 32.4}$

3 and a bit
I don't know

$$\begin{array}{r} 84 \\ 84 \\ 84 \\ 84 \\ 84 \\ \hline 336 \end{array}$$

$$\begin{array}{r} 84 \\ 84 \\ 84 \\ 84 \\ \hline 252 \end{array}$$

Shows the intent to multiply 2.7 by 84; **1 mark**



By not using a calculator, this learner has become muddled and additionally has incurred a time penalty. They also show a common conceptual difficulty when doing long multiplication.

Activity 2

Legs and feet

Activity 2 – Legs and feet



Outline

In **Activity 1 – Dinosaur footprints**, learners use the rule ‘leg length is four times foot length’. This activity explores whether the same rule applies to children.

It is a practical activity designed to take place outside, as it entails measuring against a wall. However, it can readily be adapted to take place inside the classroom using long pieces of paper (e.g. wallpaper lining) instead of the wall.

If there are learners with mobility difficulties within the class, an alternative way of measuring leg length may need to be implemented.

You will need



Whiteboard – Remember the rule?



Chalk (or long pieces of paper)



Tape measures

Activity 2 – Legs and feet



Explain

On the whiteboard, show **Remember the rule?**, showing that leg length is four times foot length.

Ask them if they think that the scientists' rule is true for every animal that has legs and feet. What about a cat? Or a giraffe? What about their own legs and their feet? Does it apply to them? Tell them they are going to find out for themselves. *(This can be approached using the following structure: What do I want to find out? What do I need? What do I need to keep the same? My prediction, my results, what I learned.)*

Learners work in groups. Each learner stands alongside a wall and marks (with chalk) the top of the outside of their leg. They then measure the leg lengths, choosing how to record them.

Next they measure one or both of their feet, again choosing how to record their data.

Then they look at the findings for their group and decide whether or not the relationship in the scientists' rule applies to them or not.

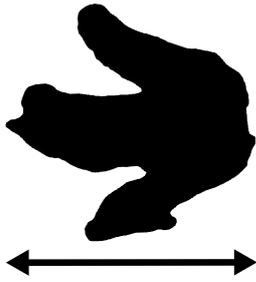
To complete the activity, groups share their findings with the rest of the class, showing their recording and their conclusions.



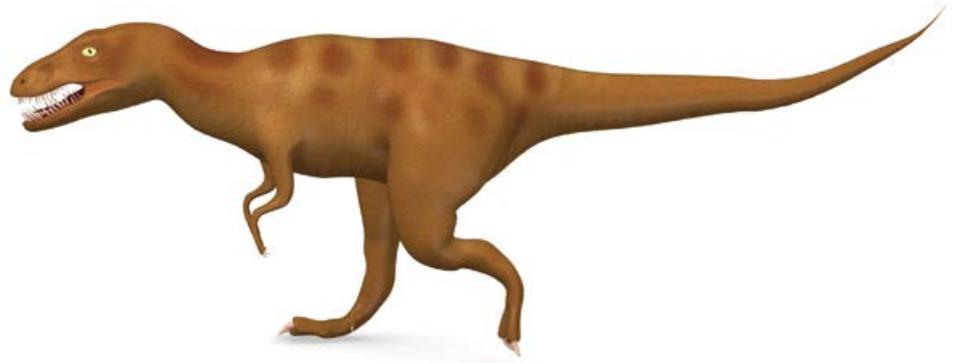
Question

- Look at the image of the dinosaur. Where do you think its leg starts? Why is that important? How did you decide where your leg starts and finishes?
- When you measure your feet does it make a difference whether you take off your shoes? Why? And what about socks?
- What units are you using to measure? Why? What other measurements could you have chosen?
- How are you recording your findings? Why?
- How are you working out how many times longer your leg is than your foot? Would you expect it to be exactly the same for each one of you? Is it a bit different or a lot? *(Support them in understanding that some variation would be expected.)*
- Is there a better rule? If so, what? Do you think your new rule might apply to everyone, or just for children of your age? Why?
- Now that you have heard the conclusions from other groups, what would you change about your work? Why?

Remember the rule?



Foot length = **0.3m**



We think leg length
is four times
foot length.



Activity 3

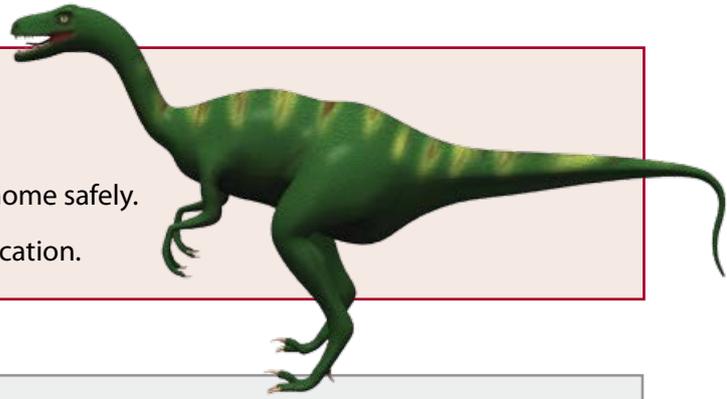
Run for your life!

Activity 3 – Run for your life!



Outline

This activity builds on **Activity 1 – Dinosaur footprints**.
Learners find routes that allow the small dinosaur to get home safely.
The activity encourages logical thinking and simple justification.



You will need



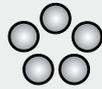
Whiteboard – Game board 1



Resource sheet – Game board 1
One sheet per learner



Resource sheet – Game board 2
One sheet per group/pair



Each group/pair needs 5 counters

Activity 3 – Run for your life!



Explain

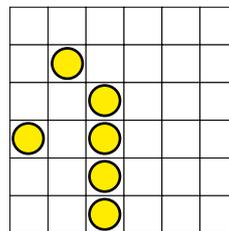
Explain that in Dinosaur Town there are lots of big dinosaurs all after the small one (*make sure learners realise this is fantasy!*). They are going to work out how to get the small dinosaur home safely without being caught.

Show **Game board 1** on the whiteboard. Explain that this is like a map: it shows where the small dinosaur starts and where her home is. The big dinosaurs must stay where they are unless she doesn't follow the rules! The small dinosaur is allowed to move vertically and horizontally, but not diagonally. If she only moves vertically or horizontally, the big dinosaurs must stay where they are. But if she moves diagonally, the big dinosaurs will catch her! (*If necessary, show part of a route to help explain.*)

Now give each learner a copy of the resource sheet **Game board 1**. Ask them to show four different routes so that the small dinosaur gets home safely. For each route, tell learners to count the number of squares that their dinosaur has crossed. Share the results. (*11 is likely to be the most common answer but odd numbers greater than 11 are also possible. If even numbers, or odd numbers less than 11, are offered, ask learners to check that they counted correctly.*)

Now give learners a copy of the resource sheet **Game board 2** and ask them where to place the six big dinosaurs so the small dinosaur **must** cross more than 11 squares to get home. Explain the dinosaur has to get home, so they cannot simply block her, or her house, in. (*Using counters to do this will avoid the risk of endless drawn attempts.*)

(*Solution – any path that forces the small dinosaur to turn west or south, e.g. the counters positioned as shown.*)

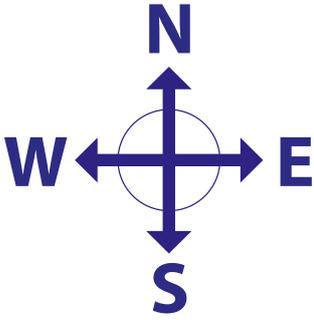


Question

- Why must 11 be the smallest possible number of squares crossed? Can you convince me that there is no shorter route? (*It must have a total of 6 east and 5 north.*)
- Why is it not possible to find the greatest possible number of squares crossed? (*The dinosaur could keep going round one part of the route for ever.*)
- Think about the compass directions. What do routes crossing 11 squares have in common? (*The dinosaur moves only north and east.*) What do routes crossing more than 11 squares have in common? (*The dinosaur also moves south and/or west.*)

Extension

- For a board which is 6 squares across and 6 squares up, 11 is the minimum number of squares crossed. How does this change for boards of different sizes? (*The minimum number is one less than the sum of the number of squares across and the number of squares up.*)



 can move \updownarrow or \rightleftarrows but not $\nearrow\searrow$

