UNIT 5

Linked Up

What is the longest paper chain that can be made from A4 paper?

WHAT HAPPENS?

In this unit students use an A4 sheet of coloured paper to produce a paper chain.

Students will:

- Explore ways to construct paper chains. (Discover)
- Investigate ways to construct long paper chains. (Devise)
- Construct a paper chain and compare its length with other students' paper chains. (Develop)
- Determine which paper chain is the longest. (Defend)
- Consider other features to evaluate which paper chain would be best for decorating the room. (Defend)

TEACHER NOTES:

Teachers are always on the look-out for engaging Christmas activities that are not just busy work for their students. This inquiry provides a mathematical challenge for students to discover how to construct the best paper chain and an opportunity to transfer what they have discovered about paper chains by decorating the classroom with suitable paper chains constructed at the conclusion of the inquiry.

This is one of students' favourite Christmas activities: they love using maths to decorate the classroom!

Materials

- Plastic links
- Scrap paper
- Coloured A4 paper: one sheet per student
- Scissors and glue or sticky tape
- Rulers
- Metre rulers or informal measurement items
- One fifty metre measuring tape

Mathematical Focus

- Number and Algebra – Patterning
- Measurement and Geometry – Area (conservation); Length (combining measurements, ordering and comparing measurements)

Resource Sheets

- Resource sheet 1: Reflection Links

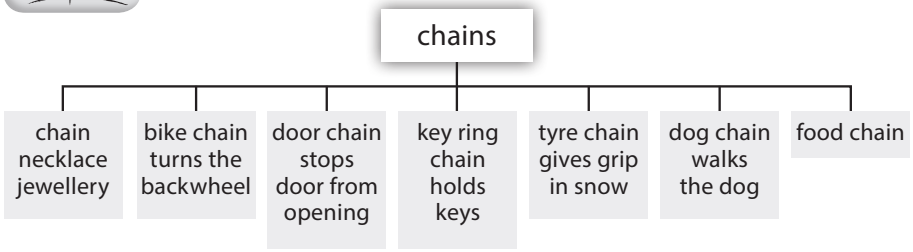
Support Website

www.curriculumpress.edu.au/maths

All of the resource sheets are available on the support website to download as PDF files. Those that you might customise are also available as editable Word documents.

EXPLORE WAYS TO CONSTRUCT PAPER CHAINS

Using a graphic organiser, such as the one illustrated below, have students brainstorm different types of chains and their uses.



Assessment Idea

Focused observation:

- Were students able to construct chains to the given criteria?

Discuss with students what all chains have in common (links). Allow students to construct plastic link chains to a given criteria, such as a pattern involving two different colours of links or twice as many blue links as yellow links, a chain as long as a desk, etc.

CONSTRUCT A PAPER CHAIN

Mathematical Focus

Algebra – patterning

Ask students to define a paper chain. Have two or three volunteers show and describe how they would construct a paper chain from a sheet of paper.

TIP

Students unfamiliar with paper chains don't always visualise that the chain links are made from rectangular strips of paper. Before proceeding to the Devise stage ensure students are aware of how the paper chains are constructed.

INVESTIGATE WAYS TO CONSTRUCT LONG PAPER CHAINS

Provide students with the inquiry question: What is the longest paper chain that can be made from A4 paper?

Students use their Maths Investigator Hat (an imaginary hat that assists them to think like maths investigators, see p 18) to identify the maths in the inquiry question. Possible answers might include:

- length of the strips
- width of the strips
- horizontal or vertical strips
- length and width of the A4 paper
- length of the finished chain
- length of overlap in each ring.

Mathematical Focus

Measurement – length

Predictions can be made using formal or informal units of measure.

Have students predict the length of a finished chain and justify their prediction.

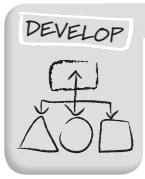
Assessment Ideas

Focused observation:

- Note students' predictions of the chain lengths and consider the reasonableness of the measurement.
- Were students able to share their ideas about ways to answer the question?

MAKE A PLAN

In pairs, students discuss what they would need to do to answer the inquiry question. Share some of the ideas with the whole class. For example: We could make paper chains from a single sheet of A4 paper and see whose is the longest.



CONSTRUCT PAPER CHAINS

Discuss with students what they know about a metre (it is 100 centimetres, about two large steps or the length of the blackboard ruler).

Provide each student with a coloured sheet of A4 paper and challenge them to construct the longest possible paper chain, making sure their chain is at least a metre long. Allow them to use scissors, a ruler, glue or sticky tape.

Place a metre ruler where students can readily access it throughout the construction of their chain. This enables them to check the length of their chain repeatedly and encourages students to discuss their progress.

TIP

Students may find that paper chains can be stretched to make them longer – and will break if over-stretched. Broken chains are easily repaired and students quickly learn to treat them with care. There's no need to intervene. These experiences will assist with the reflection at the end of the unit.

FOCUS QUESTIONS

During the construction of their paper chains, some students will require individual guidance through focus questions to avoid frustration. For example:

- How much of your paper have you used?
- If you continue making your chain in the same manner will it reach one metre?
- Can you think of a way to make it longer?
- What else could you try?
- Can you do something to change or alter the links you have already made?

DETERMINE LONGEST AND BEST PAPER CHAIN

Open the class discussion by asking students what all of the chains have in common (they all started with the same area of A4 paper). Ask them to consider whether all of the chains will be similar and provide a reason for their answer.

Engage students in a variety of activities which will allow them to share their chains with others. Activities could include:

Find someone with:

- a chain similar to yours
- a chain shorter/longer than yours
- a chain twice as big as yours
- a chain as long as yours
- a chain with thicker/thinner links than yours
- a chain with different/the same sized links
- a chain with greater/fewer links than yours.

Mathematical Focus

Measurement – length, relationship between centimetres and metres

Assessment Ideas

Focused observation:

- Did students use the metre ruler sparingly as a reference to check their progress, or did they need to refer to it continually, after every few links?

Assessment Ideas

Task analysis:
Paper chain. Was the chain:

- Longer than one metre?
- Constructed with links that were appropriately sized (including making modifications, as needed)?
- Constructed with reasonable overlaps?
- Constructed with ruled paper strips?
- Constructed using the whole A4 sheet?

Mathematical Focus

Measurement – length, relationship between centimetres and metres, estimating, combining measurements, ordering and comparing measurements

Providing only a single metre ruler presents students with the dilemma of how to measure lengths greater than one metre. Allow students to experiment with ways to measure the lengths accurately. This is a good opportunity for them to discuss and check the accuracy and reasonableness of their measurement with others.

SORT THE CHAINS

To sort the chains, students estimate the length of their own chain and set up a class chart. They nominate which column of the class chart they think their chain belongs in.

A class table might look like this:

Less than one metre	Between one and two metres	Between two and three metres	More than three metres
Shayla	Caleb	Henry	Blake
Rhys	Angie	Matt	
	Anna	Jasmin	
	Ewan		

Gather the students together, with their paper chains, to sit in a circle around the metre ruler. Ask students with nominated chain lengths of less than a metre to place their chain beside the metre ruler and identify the length. Record this measurement beside their name on the class chart.

Repeat with the other three columns. (If a student's estimate is incorrect, allow the student to change columns when the measurement of their chain is confirmed.)

Focus students on the class table, and have them:

- Identify the length of the longest chain.
- Identify the most common length for a paper chain made from an A4 sheet of paper.
- Suggest reasons for the large variance in the length of the chains.
- Arrange the paper chains from shortest to longest.

Assessment Ideas

Focused observation:

- Could students provide reasonable estimates?
- Were students able to measure accurately? Combine measurements if required?
- Could students explain a method to measure lengths greater than one metre using only a metre ruler?

IDENTIFY THE LONGEST CHAIN

Revisit the inquiry question: What is the longest paper chain that can be made from an A4 sheet of paper? Answer the question using the evidence provided on the chart.

Discuss the qualities and limitations of the longest chain. Some questions might include:

- What did you notice about the loops in the longer chains compared to those in the shorter ones?
- What are some of the characteristics of the longest chains?

Assessment Ideas

Focused observation:

- Were students able to suggest reasons for the variance in the chain lengths?
- Were students able to order and compare the measurements?

REFLECT – IS THE LONGEST PAPER CHAIN THE BEST?

Have students predict how long they think a class chain would be if all of the chains were joined together. To encourage reasonable estimates from students rather than just a guess, have them provide both the estimate and a reason for their estimate. Take students outside to measure the actual length of the class chain using a fifty metre measuring tape.

Assessment Ideas

Focused observation:
These reflections could be used to evaluate each student's:

1. measurement sense
2. ability to connect characteristics with purpose
3. capacity to articulate their mathematical thinking.

Instead of the longest chain, ask students what other kinds of chains could be made. What kind of chain would we need to create to make the:

- Strongest paper chain? (Thick loops.)
- Chain with the most loops? (Small, thin loops.)
- Most beautiful chain? (Colourful paper, decorated strips, etc.)

Ask students what kind of chain would be best if we wanted to decorate the classroom. Focus on three or four of the responses students give, and have the class construct the best chain.

Provide students with a reflection link from Resource sheet 1 and allow them enough thinking time to construct an answer. Have students link elbows to form a chain before sharing their reflections with the class. (See Linked Up In Action on the next page.)

Encourage students to consider multiple features when selecting the best chain (eg length, colour, patterns, strength, consistency of loops, loop appearance).

Assessment Idea

Task analysis:
Reflection links

- Were students able to reflect meaningfully on their learning?

TO EXTEND:

- The principal has asked our class to decorate the hall with paper chains. Using what we've already discovered, how many sheets of coloured A4 paper will we need? Consider what size of paper strips will make the best paper chains for this purpose.

TO SIMPLIFY:

- Can you make a paper chain more than one metre long, using an A4 sheet of paper?

ALTERNATIVE INQUIRIES

- What is the greatest number of candy cane shapes that you can cut out of a piece of A4 red coloured paper (using a template provided by the teacher)? Have students modify the template and use another piece of A4 red coloured paper to generate at least 4 more candy cane shapes than on the previous sheet.

INACTION! LINKED UP

REFLECTING ON THE LEARNING

Students find it challenging to articulate what they have learnt and to transfer that learning to another context. While several substantive conversations can occur throughout an inquiry unit amongst peers or between the teacher and individual students, the whole class doesn't always experience the learning that arises from these conversations. Whole class reflection time is an opportunity to share some of this learning.

The reflection links for this inquiry are an attempt to have students share some of the conversations and learning they experienced individually throughout this inquiry. These are some sample student responses to the reflection links.

Next time I would…

- make my strips thicker so they won't break.
- cut my strips lengthwise (horizontally).
- use a ruler and make straight strips.
- make my links all the same size.
- work faster and use all of my A4 sheet.
- listen to others.

I found it hard to…

- finish my chain on time.
- think of a way to make it longer.
- make thin links.
- measure my chain because it was springy.
- find someone with a chain twice as long as mine.

To make my chain longer, I…

- cut each of my thick links in half.
- changed my links from little ones to bigger ones.
- cut thinner strips.
- used a ruler on the rest of my sheet to make skinnier links.

I learnt…

- that most of our chains were between one and two metres.
- that I needed narrow links to make a long chain.
- how long a metre is.
- to estimate things before I measure them.
- that one metre and fifty-six centimetres is longer than one metre and fifty centimetres.
- that even though we had the same size piece of paper our chains were all different sizes because we used different ways to make our chains.

Reflection Links