Tea bag design and production

Learning objectives

- **Representing Level 2:** undertake problem solving in an unfamiliar context and recognise that real life decision-making sometimes involves using mathematics
- **Analysing Level 2:** analyse shape and costs using appropriate mathematical approaches and understand their impact on design and manufacturing
- **Interpreting Level 2:** interpret results to evaluate solutions to real-life problems, and make recommendations

APP

Evidence for Shape, space and measure Level 5, Handling data Level 6, Using and applying mathematics Level 6, Calculating Level 7

PLTS

Develops Independent enquirers, Creative thinkers

Every child matters outcome

Be healthy

Cross-curricular links

Design and Technology, English

Underpinning maths

- Nets
- Perimeter
- Circumference of a circle
- Conversion between metric units
- Using sketches for mathematical visualisation
- Calculating to solve real-life problems
- Conducting surveys

Resources

- Student Book page XX
- Tea bags (optional)
- Calculator

Context

- All students should be familiar with tea bags and their different shapes.
- This activity is about investigating shape and design for the efficient use of materials and costs in tea bag production.

Lesson plan

This activity takes two lessons. You may do it in one lesson by using Tasks 1 and 2 questions only and focusing on shape. Task 5 would make a good homework activity.

Starter

- Conduct a quick survey, asking each student how many cups of tea, on average, they drink each day. Keep a tally altogether and work out how many cups of tea are drunk daily among the class.
- Ask students to read this large number aloud: 165,000,000 (165 million). Tell them that this is the number of cups of tea drunk daily in Great Britain, and that this makes tea bag production big business! Ask students to use their calculators to work out how many cups of tea are drunk per person per day if the population of Great Britain is rounded to 60 million. (Answer: 2.75 cups). Compare this answer to your class survey.
- Ask students what shape tea bags they have in their homes. Make a list of the shapes.

Main activity

- Based on the discussion of tea bag shapes, discuss with students how they think tea bags are made. (3D shaped tea bags – from nets of filter paper, filled with dried tea leaves, and sealed along the edges; flat tea bags – from tea sandwiched between two large rolls of filter paper, heat sealed and cut in the tea bag shape). You may use real tea bags to pass around the class to help students answer this question.
- Read Task 1 with the students. Remind students that a net is a flat shape that can be folded into a 3D shape. Discuss with students what is meant by 'sketch', i.e. that an accurate scale drawing is not required.
- **Let students do Task 1.** Encourage them to think about where each tea bag shape is sealed (note: those made from nets will not require sealing along every edge). Also, you may wish to remind students of the radius, diameter and circumference of a circle (circumference = Π x diameter or Π x 2 x radius).
- Ask students to look at the dimensions of the tea bags and then read the first sentence of Task 2. Ask them what they notice about the measurements. (Answer: the tea bags are measured in cm, while the roll of filter paper has width in mm, and length in m). Discuss with students the need to use the same measure for their calculations and what the most sensible measure might be (note conversions: 10 mm = 1 cm; 1 m = 100 cm).
- **Let students do Task 2.** Remind them how tea bags are made, and in particular how the two rolls of filter paper will be used for each tea bag shape, i.e. the two sides of the square, rectangular and circular tea bags will be cut from different rolls, but nets for the whole tetrahedron and pyramidal tea bags can be made from a single roll. Encourage students to use sketches to help them visualise how each tea bag shape will be cut from the filter paper.
- Read task 3, question 1 with the students. Ask them what calculation they need to do (Answer: number of tea bags, as found in Task 2 x number of grams). The question asks for answers in kg – ask students what this tells them about the number of grams of tea that may be required (Answer: over 1000 g, i.e. 1 kg).
- **Let students do Task 3.** Encourage them to think about the calculations they need to do and the conversion between units (i.e. 1000 g = 1 kg and 100p = £1)
- Discuss with students the information and calculations required for Task 4 (Answer for question 1: each cost calculated in Task 3, question 2 + cost calculated in Task 3, question 3; for question 2: total cost divided by number of tea bags). **Let students do Task 4.**
- Ask students to work in pairs to reflect on their answers to Tasks 1–4 and determine which tea bag shape is the cheapest to make (Answer: tetrahedron) and which is the most expensive to make (Answer: circular). Discuss as a class.

- For the extension **(Task 5),** discuss with students how they might conduct their survey of the sale price of different shaped tea bags, and what they might do with the information. For example, you may wish to them to think about the number of tea bags that come in a box, and how they will compare the price of a box of 80 tea bags with their answer to Task 4, question 2.

Plenary

- Ask students if they are surprised by the difference in the cost of making different shaped tea bags.
- Ask students what other products they can think of that come in different shapes and sizes. What mathematical analysis might they do in order to make comparisons in the manufacture and design of these products?

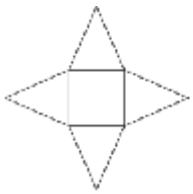
Outcomes

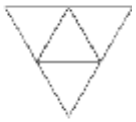
- Students will have used mathematics to gain insight into a real-life problem.
- Students will have used shape and chosen the correct calculations to do in order to make comparisons and draw conclusions.

Answers

Task 1

1 **a** **b**





2 Length of seals for:

Square = 24.4 cm

Rectangle = 24.2 cm

Pyramid = 20.8 cm

Tetrahedron = 12.3 cm

Circle = 23 cm

The square requires the most seal; the tetrahedron requires the least seal.

Task 2

1 **a** 2

b 327

c 654

2 **a** 2 (one arranged landscape, one arranged portrait)

b 363 + 303 = 666

3 320

4 1124

5 420

Task 3

1 **a** 654 x 3 = 1962 g = 1.96 kg (2 d.p.)

b 666 x 3.3 = 2197.8 g = 2.20 kg (2 d.p.)

c 320 x 3.2 = 1024 g = 1.02 kg (2 d.p.)

d 1124 x 2.6 = 2922.4 g = 2.92 kg (2 d.p.)

e 420 x 2.8 = 1176 g = 1.18 kg (2 d.p.)

2 **a** 1960 g x 0.2p = £3.92

b 2200 g x 0.2p = £4.40

c 1020 g x 0.2p = £2.04

d 2920 g x 0.2p = £5.84

e 1180 g x 0.2p = £2.36

3 £1.30

Task 4

1 **a** 654, £5.22

b 666, £5.70

c 334, £3.20

d 1124, £7.14

e 420, £3.36

2 **a** 1 square tea bag costs 522 ÷ 654 = 0.80p

b 1 rectangular tea bag costs 570 ÷ 666 = 0.86p

c 1 circular tea bag costs 334 ÷ 320 = 1.04p

d 1 tetrahedral tea bag costs 714 ÷ 1124 = 0.64p

e 1 pyramidal tea bag costs 336 ÷ 420 = 0.80p

Task 5

Students' board reports should provide evidence of a sound approach to conducting a survey and sensible calculations to enable comparisons. (For example, they should examine the price of more than one brand of tea bag for each shape, and calculate the sale price per single tea bag, i.e. cost of a box divided by the number of tea bags in the box.) They should compare this data with their answer to Task 4, question 2.

The most likely outcome is that students' surveys reveal that pyramidal and tetrahedral tea bags tend to have a higher sale price, and their calculations show that these tea bags (along with those that are square) are the cheapest to produce. Students' board reports may draw on these facts to recommend that the tea bag manufacturer makes tetrahedron and pyramid shaped tea bags.