

Lesson Plan

Student Activity

There are 2 pirates and 4 treasure chests on an island.

The pirates have 1 small boat to take the treasure to their ship.

The boat can take 2 pirates or 1 pirate and 1 chest of treasure.

How many trips do the pirates have to take to get all the treasure and both pirates onto the ship?

Specific Learning Outcomes

- Use equipment to work out a problem
- Make and describe a repeating pattern to solve a problem
- Devise and use problem solving strategies to explore situations mathematically

Description of Mathematics

- This problem develops a strategy that works a number of times, as students use equipment or a diagram, and logic to solve the problem.
- This problem is an introduction to algebra where the notation gives a way of expressing the repetition of a strategy.

Required Resource Materials

- Paper and pencil
- 2 orange rods (pirates) and 4 yellow rods (treasure chests)

Problem

There are 2 pirates and 4 treasure chests on an island. The pirates have 1 small boat to take the treasure to their ship. The boat can take 2 pirates or 1 pirate and 1 chest of treasure.

How many trips do the pirates have to take to get all the treasure and both pirates onto the ship?

Teaching Sequence

1. Introduce the problem by reading a poem about pirates.
2. Pose the problem to the class.
3. Ask the students to describe the problem in their own words to make sure that they understand what is required.

4. Using 2 students act out a trip to the ship with the treasure. Discuss the ways that you could keep track of the trips taken (draw, list).
5. Let the students continue the problem in pairs.
6. As the students work ask questions that focus their thinking on the steps they are taking.
How many trips have you taken?
How did you work out who to put in the boat?
Can you see any patterns in what you are doing? Describe them.
How are you keeping a record of the trips?
Do you think that you can use a smaller number of trips?
7. Share the written solutions to the problem.

Extension to the problem

What if there are 8 treasure chests?

Other Contexts for the Problem

Fairytales: 3 Bears and 5 bowls of porridge (Baby Bear taking bowls of porridge to the dining room table);

3 Pigs and 10 bricks (Porky Pig moving bricks).

These problems also extend the pirate problem in that they require the same strategy but use larger numbers. The problem can be further developed using any number of people (or animals) and any number of objects to be transported.

Solution

There are 9 trips from island to ship.

1. 2 pirates go to ship
2. 1 pirate returns for treasure
3. Pirate takes 1 treasure chest to ship
4. Returns to island
5. Takes 2nd treasure chest to ship
6. Returns to island
7. Takes 3rd treasure chest to ship
8. Returns to island
9. Takes last treasure chest to ship

Note that steps 1 and 2 can occur at any time that the small boat is on the land or steps 3 to 9 can be followed by 'returns to land, 2 pirates go to ship'.

Solution to the extension

Each treasure chest requires two trips, one to the ship and one back to the land. So with 8 chests the pirates will need 8×2 trips with the chests and 1 trip to take the extra pirate. This means 17 trips.

(With c chests and two pirates there will need to be $2c + 1$ trips.)

Mary has a £5 note.

She exchanges it with her brother Sam for some coins worth £5.

Can she exchange it for 6 coins?

What is the largest number of coins that Sam can have given Mary?

Specific Learning Outcomes

Represent a sum of money by a combinations of coins

Use a list to work systematically

Devise and use problem solving strategies to explore situations mathematically (systematic list, use equipment)

Description of Mathematics

In this problem students apply additive strategies to solve money problems. The focus is on developing the skill of making a systematic list that enables the student to check that they have found all possible solutions.

The Problem

Mary has a £5 note.

- She exchanges it with her brother Sam for some coins worth £5.
Can she exchange it for 6 coins?
What is the largest number of coins that Sam can have given Mary?

Teaching sequence

1. Play guess the coin and guess the note. For example:
I have a gold coin with a flying kotuku on it. What coin is it?
I have a red note with Sir Edmund Hillary and a yellow eyed penguin on it. What note is it?
2. Read the problem to the class.
3. Brainstorm ways to solve the problem and have students suggest how they might record their solution ideas in an organized way.
4. As the students work on the problem ask questions that encourage them to work systematically:
Tell me how you are solving the problem? Why did you select that

strategy?

Are there other coins that you could have used?

How do you know that you have checked all the possibilities?

5. Share solutions.

Extension to the problem

Can Mary exchange the £5 for 10 coins? If so, how?

Solution

The coins might have been £2, £2, 50c, 20c, 20c and 10c, or £1, £1, £1, £1, 50c and 50c. But are they all the possible answers? Don't expect the students to give such a complete justification as the one that follows. The answer with a description of how they got it is fine at this level.

To do this systematically takes a little time. Clearly there can be at most two £2 coins. So suppose that there are precisely two £2 coins. Then we have to make up £1 with four coins. We can't have two 50c coins but we can have one. Then we have to have at least one 10c coin. Two 20c coins give the only way to finish this case off to give **£2, £2, 50c, 20c, 20c, 10c**.

What if we only have one £2 coin? Then we can have two, one or no £1 coins. We can't have two £1 coins because we would have to be able to make up £1 with three coins and this isn't possible. One £1 coin would mean that we would have to find four coins to make up £2. This can only be done with four 50c coins. So another answer is **£2, £1, 50c, 50c, 50c, 50c**. So suppose that we have no £1 coins. We have to make up £3 with five coins. But the biggest coin we can have now is 50c and five 50c just isn't big enough. This means that there is only one answer with one £2 coin.

The most £1 coins we can use is four. This leads to **£1, £1, £1, £1, 50c, 50c**. If we only use three £1 coins then we have to make up £3 with three coins but 3 x 50 isn't big enough. The same goes for fewer than three £1 coins.

So there is only one way to use £1 coins (and no £2 coins). There appear to be three answers to the problem.

Part B.

The most coins Sam could have would be when he only had 10c coins. There are fifty tens in 500. So the largest number of coins that Sam could give to Mary is fifty 10c coins.

Extension:

This is harder than the 6 coin problem. One approach is to keep a list of the answers that the students give and see how many they can come up with.

Since $10 \times 50 = 500$, Sam had to have had at least one coin worth 50c or more. So we have to look systematically at the cases where Sam has £2 coins, £1 coins and 50c coins. The only answers are

£2, £2, 20c, 20c, 10c, 10c, 10c, 10c, 10c, 10c;

£2, £1, £1, 20c, 20c, 20c, 10c, 10c, 10c, 10c;

£2, £1, 50c, 50c, 50c, 10c, 10c, 10c, 10c, 10c;

£2, £1, 50c, 50c, 20c, 20c, 20c, 20c, 10c, 10c;

£2, 50c, 50c, 50c, 50c, 20c, 20c, 20c, 20c, 20c;

£1, £1, £1, £1, 50c, 10c, 10c, 10c, 10c, 10c;

£1, £1, £1, £1, 20c, 20c, 20c, 20c, 10c, 10c;

£1, £1, £1, 50c, 50c, 50c, 20c, 10c, 10c, 10c;

£1, £1, £1, 50c, 50c, 20c, 20c, 20c, 20c, 20c;

£1, £1, 50c, 50c, 50c, 50c, 50c, 20c, 20c, 10c;

50c, 50c, 50c, 50c, 50c, 50c, 50c, 50c, 50c, 50c.