## Section I. Co-operative logic problems

#### Introduction

Co-operative logic problems are an excellent way to encourage students to think mathematically, to problem solve and to share their mathematical knowledge and language. And they have fun doing it. They can be written to cover a range of content areas and skill levels. Some of the co-operative logic problems here cover number, shape, location and basic algebra skills.

As mentioned in the Introduction, games and activities promote and support the communication of mathematical skills and concepts. Co-operative logic problems are explicitly structured so that students must talk to each other during the game and in doing so explain actions, strategies, concepts and facts that are based around mathematical concepts and skills.

#### Instructions

You need to photocopy each of the pieces for each problem, preferably onto coloured paper or card, and then cut them out and store each set in an envelope or plastic clip lock bag. The pieces could be laminated to extend their lives. You need to have enough sets for each group of 4 to 6 students.

Usually there are different sets of pieces for solving each problem:

- the problem or question to be solved/answered
- moveable pieces of supporting information and materials (e.g. a map, a set of digits, names of people/cities, etc.)



• the clue cards.

You need to organise students to work in small groups of 4 to 6 to jointly solve the problem they are given. You need to explain that the aim is to solve the problem by working together cooperatively. Each student is to have **at least** one clue card and they read out their clue in turn to the group, then discuss together what that means and use the supporting information and handson materials to work towards a solution that eventually satisfies everyone's clues.

It is important to tell students that they need to listen carefully as each clue is read out. If you are aware that some students have reading difficulties, pair them with someone who reads well and they can work together jointly with their clues.

Some students may be tempted to take all the clues and solve the problem themselves — leaving the other students bewildered, unengaged and not understanding how the problem was solved. This defeats the whole purpose of the problem solving activity. So it is important to explain carefully how the group is to work co-operatively to solve the problem, and to observe how they are working together and to interfere and encourage all participants to contribute effectively.

Once students are familiar with the process they are usually very keen for more problems to solve.

#### Instructions for each group of students

- Empty the contents of the envelope or bag on to the table.
- Place the question card on the table along with the other information and materials.
- Share out the clue cards so that everyone has at least one clue card.
- Take it in turn to read out your clue to the rest of the group and work together to find an answer that you all agree with.
- Use the cards and materials to help solve the problem move them around each time to satisfy each clue.
- You will need to continue talking and arguing with each other until you are all happy with the solution.
- Don't give your clue card(s) to another student.
- When you think you have an answer, go back through each clue to double check that all the clues are satisfied.

#### Teacher's role

The teacher's main role is to observe how each group is going and to support and encourage students if they are stuck.

If you notice that they have misinterpreted a crucial word or term, help them to work out or discuss what it means. Encourage students to explain to each other any words or terms that are causing confusion or are not understood. You may find that there are some key maths skills or knowledge that they don't know or understand – so the activity can indicate to you what areas they may need some teaching in. You may need to give this advice on the spot or ask the group if someone know the meaning.

Often a group will want you to tell them if they have the "correct" answer/solution. It is best if you simply ask them if they are all happy with the solution — have they double checked their answer? Whilst you should know the answer in advance, it is best to prompt and stimulate their thinking rather than saying they are wrong — if you are aware that their answer is incorrect ask questions such as: "Do you want to read out your clue to the group again?" or "Are you happy with the group's answer?".

#### Problem solving strategies

The co-operative logic problems are structured with their clue cards and moveable pieces to demonstrate at least three key problem solving strategies:

- using visual aids and hands-on materials to give a picture of what is to be solved
- guessing and checking/trial and error an important problem solving strategy
- working with others co-operating and working together and talking a problem through.

After students have solved a few co-operative logic problems it may be useful to have a class discussion about problem solving strategies. You could ask them to come up with a list of the different skills and strategies they used to solve the problems. This could include:

- guessing and checking taking risks
- explaining and talking to each other
- making sure the problem is clear and everyone understands what has to be done

- listening carefully
- thinking logically
- using hands-on materials
- discarding irrelevant information
- co-operating and working collaboratively not in isolation.

#### Making your own co-operative logic problems

You or your students could make more co-operative logic problems. A process for doing this with students could be:

- provide a model of the type of co-operative logic problem for them to solve
- give each group any supporting information they would need to create a similar problem (e.g. sports results, maps, populations, etc.)
- give them coloured paper, pens, scissors
- get each group to make up their own set of clues and matching moveable pieces
- solve the problem to check it works
- when each group has made one up, each group swaps with another group and tests/trials the other group's problem
- each group gives feedback and suggests improvements to the other group
- groups finalise their co-operative logic problem and could design and format them.

**THE FLATS** (Place this in the centre of the table)



Problem: Who lives in which flat?

# THE FLATS



Jo Fisher walks downstairs to feed Maria Sartori's cat when she is away.	The Woods knock on the Tran's floor when their music is too loud.
The Johannsen family hear Mr Wood's feet overhead when he dances.	The Fishers do not live opposite the Johannsen family.
Maria Sartori passes the Bates' flat on the way up to visit the Tran family.	The Fishers grow tomatoes on their balcony in summer.

# CITY BLOCK



# **CLUES - CITY BLOCK**

Walking from the supermarket to the chemist, you pass the dress shop.	The post office is south of the chemist, and next to the shoe shop.
The department store and the post office are on corners.	The post office is opposite the dress shop.
The chemist shop is east of the supermarket.	The supermarket is north of the bookshop.



Breaking The Maths Barrier, B. Marr and S. Helme, 1991

Handout 2.5C

## The Stolen Golden Surfing Wagon

Problem: to be read aloud to the group before starting.

Donna's old golden coloured surfing wagon was known by everyone in the little town of Twin Creeks. One Sunday morning the town locals were amazed see it racing through the streets at great speed. Donna was usually a careful driver!

In fact the car had been taken by a gang from out of town who tried to steal it, but they had to abandon it when they ran out of petrol. On the way they lost a hub cap. With the help of the town locals, Donna worked out the exact route of the stolen car and was able to find the hubcap.

Can you draw the route on the map provided and show the exact spot at which the car was found?

The car nearly knocked over	The caretaker at the primary	
old Sam as it turned left at	school saw the car travelling	
the pub corner.	west past the school.	
Donna had left the car parked near a public toilet on The Esplanade.	Some kids in a phone box saw it speed straight through a red light beside them.	
The car had to wait at a level	As the car sped along Fisher	
crossing as the train pulled	St. it nearly collided with a	
into the station.	number 10 bus.	
The car was eventually	The car was seen passing all	
found beside a bridge in one	of the town's three	
of the town reserves.	churches.	
4	1	

Clues

# CL27. Map 7

# Where's Aunty Edna?

Wally and his family had a picnic at the Park on Watson Road near the Spring Creek bridge. They took their old Aunty Edna who is rather forgetful. While everyone else was playing football, Aunty Edna disappeared. Wally had to find Edna. Mark on the map the route Aunty Edna probably followed and where Wally found her.

Wally's friend Jill saw his Aunty walk north past her house in Thompson Rd just north of Acacia Ave soon after 4.00 pm	Aunty Edna was seen walking past the Station by the Railway attendant before the 2.35 pm train arrived.	She was seen going into the Hotel on the corner of Bridgewater Rd and Lydia St at around 3.00 pm
Aunty Edna was last seen at the Park by Wally at about 2 pm	The police said they didn't see (or hear) Aunty Edna go past the Police Station	Aunty Edna was seen leaving the Hotel on the corner of Acacia Ave and Thompson Rd at about 4 pm
She was heard singing as she walked along Jasmine Rd towards the Caravan Park at about 2.50 pm	Wally found Aunty Edna happily having a drink at the third of the town's Hotels soon after 5.00 pm	Wally's friend Jill saw his Aunty walk south past her house in Thompson Rd just north of Acacia Ave around 3.30 pm
Aunty Edna was seen turning right out of Thompson Road heading east down Sun St at about 4.15 pm	No one at the swimming pool saw her go past that afternoon	Aunty Edna is just over 80 years old

#### CL21. Map 1



Note: You need a copy of the map for each of the Map co-operative logic problems.

# CL9. Sport 1

In what order did the teams finish in the final of the Men's 4 x 100 m athletics relay at the Olympic Games?

Brazil	Nigeria	
Trinidad & Tobago	Japan	
USA	Great Britain	
Poland	Australia	

The last four teams were Australia, Brazil, Poland and Trinidad & Tobago, but not necessarily in that order	Brazil had a time of 38.67 seconds
Japan had a time of 38.49 seconds but did not win a medal	The USA was just one <sup>1</sup> / <sub>100</sub> <sup>th</sup> of a second behind Great Britain
Australia with a time of 38.56 seconds finished 4 places behind the USA	Great Britain had a time of 38.07 seconds
Trinidad & Tobago was 0.04 seconds behind Australia	Nigeria had a time of 38.23 seconds

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### Co-operative logic: What team's where? No. 1

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### What team's where?

Work out the ladder positions and the points for the 8 teams in the Northern Territory Football League Australian rules football competition after 10 rounds. Teams score 4 points for a win; 2 points for a draw and 0 points for a loss.

St Marys	Waratah	Tiwi Bombers	Southern Districts
Nightcliff	Palmerston Magpies	Darwin	Wanderers
4	8	12	16
20	32	32	36
The bottom 4 teams are Palmerston Magpies, Darwin, Wanderers and Nightcliff, but not necessarily in that order.		St Marys has only lost one game.	
Tiwi Bombers and Waratah have won the same number of games but Waratah is just ahead on percentage.		Nightcliff is just one place out of the top four with 16 points.	
The Wanderers are three places behind Nightcliff.		The Palmerston Magpies have won three games.	
No team has had any draws.		Jared llett is the of St N	current captain Marys.

## Co-operative logic: What team's where? No. 2

2

#### What team's where?

Work out the ladder positions and the points for the top 8 teams in the Australian Football League competition after 9 rounds.

Teams score 4 points for a win; 2 points for a draw and 0 points for a loss.

Adelaide	Brisbane	Bulldogs	Collingwood
Geelong	Hawthorn	North Melbourne	Sydney
20	20	22	22
24	30	32	36
Geelong is three places ahead of Sydney		There is a 6 point gap between the Bulldogs and Hawthorn	
The Bulldogs are above Adelaide on the ladder		The Bulldogs have had only one draw	
The 8 <sup>th</sup> position is held by a non-Victorian team		Collingwood's points is a multiple of 10	
Sydney and North Melbourne share the same number of points		The top four teams are the Bulldogs, Geelong, Adelaide and Hawthorn but not necessarily in that order	

### CL1-8. Mystery numbers



0	0	1	1
2	2	3	3
4	4	5	5
6	6	7	7
8	8	9	9
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**Note:** You need a set of the digits and symbols for each of the Mystery Number co-operative logic problems.

## CL1. Mystery number 1

# What number am I?

I have two digits	I am an even number
One of my factors is 7	I am less than 50
I am bigger than 20	I have more ones than tens

## CL2. Mystery number 2

#### 2

2

## What number am I?

I have two digits	I am an odd number
I am smaller than 60	I am greater than 30
I can be divided exactly by 5	My two digits add up to be an odd number

## What's the number? - 1

The number is less than 3

There are four digits

The number is just bigger than 2

There is a zero in the number

There are almost 50 thousandths

Two of the digits are 4 and 9

# What's the number? - 2

The number is greater than 10

The second digit is twice the first digit

The three digits add up to eleven

The tenths figure is an odd number

The decimal part is a half

The number is less than 100

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How long to work? Work out how long each of the four friends - Chris, Nick, Malia and Kate – take to get to work each morning. And also how they get to work.			
Chris	Nick	Malia	Kate
Walk	Drive	Ride a bike	Ride a motorbike
15 minutes	45 minutes	1 hour	75 minutes
Chris had a short walk to work		Nick's trip was longer than Chris's	
Nick's trip was 15 minutes shorter than Malia's		Kate had the longest trip to work	
Malia liked riding her motorbike to work		Kate took more than an hour to get to work in her car	

## Car Co-operative logic - Extra question

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What time did they leave for work?	
If they all arrive at work at 8.45 am.	
What time did they each leave home?	
Chris left home at:	Nick left home at:
Malia left home at:	Kate left home at: