

## Summary of learning goals

- To build students' ability to observe the similarity and differences of objects based on attributes.
- Students determine what an object might look like when one or two of its attributes are changed.

## Australian Curriculum: Mathematics (Foundation)

**ACMNA005:** Sort and classify familiar objects and explain the basis for these classifications. Copy, continue and create patterns with objects and drawings.

## Summary of lessons

### Who is this sequence for?

- Students will have used the attributes of objects to create patterns and have experience sorting and classifying objects into groups based on their attributes.

### Lesson 1: Attribute Train

Students use a set of attribute cards to create an attribute train, using the attributes of colour and shape. One shape is chosen as the start of the train and each subsequent card must change only one attribute at a time. Students use their cards to make the longest train that they can. Three additional challenges are then presented to the students.

### Lesson 2: Train Challenge

This resource builds on the first task by adding the attribute of size. In the game 'Attribute Train Challenge' students play against each other to create trains using three attributes. The lesson concludes by looking at a hypothetical game and considering the most strategic moves that can be made by each player.

## Reflection on this sequence

### Rationale

Identifying and exploring attributes of objects form an important part of mathematics. Attributes allow us to name, describe, classify and measure the object. As such, it is important that students develop an accurate mathematical vocabulary related to the specific features of objects. The development of language and the identification of attributes is the focus of much of the content in early mathematics. In early algebra, students use the attributes of objects to sort and classify, to create patterns, and to identify how things are the same and how they are different.

This sequence focuses students' attention on attributes and asks them to use appropriate language to describe how shapes are the same and how they are different.



### reSolve mathematics is purposeful

- Connections are made across algebra and geometry when students identify and apply generalisable attributes of shapes. Describing these attributes, specifically the name of some common shapes, their colour and size, develops students' mathematical vocabulary.
- This sequence focuses on embedding the proficiencies of the Australian Curriculum: Mathematics, particularly problem-solving and mathematical reasoning when students use logical thinking to complete the attribute trains.



### reSolve tasks are inclusive and challenging

- The openness of each question allows students to answer at a level appropriate to their understanding. The multiplicity of possible answers presents an opportunity to challenge students as they search for different solutions to the tasks.
- Challenge is offered in the game 'Attribute Train Challenge' presented in Lesson 2, whereby students are encouraged to think strategically and anticipate the moves of their opponent.



### reSolve classrooms have a knowledge-building culture

- Throughout the sequence students work collaboratively to create attribute trains. This provides the opportunity to enhance learning through active exploration of a variety of perspectives. As students describe the attributes of shapes, there is the opportunity to learn from others' use of language and to critique and refine one another's language use.
- Completing challenges in Lesson 2 requires students to take risks and allows them to learn from the mistakes they make in a secure and encouraging environment.

## Attribute Train

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## About this lesson

This task asks students to use a set of attribute cards to create an attribute train. The cards use the attributes of colour and shape. One shape is chosen as the start of the train and each subsequent card must change only one attribute at a time. Students use their cards to make the longest train that they can. Three additional challenges are then presented to the students.

## Australian Curriculum: Mathematics (Foundation)

**ACMNA005:** Sort and classify familiar objects and explain the basis for these classifications. Copy, continue and create patterns with objects and drawings.

## Mathematical purpose

- To observe the similarity and differences of objects based on the specific attributes of colour and shape.
- Students recognise how an object may change when one of its attributes changes.

## Learning intention

- To build an attribute train by changing one **attribute** at a time.



## Time

A lesson of approximately 1 hour.



## Vocabulary

- attribute
- circle
- difference
- similarity
- square
- triangle



## Resources

When printing the following resources, please ensure 'Actual size' is selected.

- About 30 very large attribute blocks for floor class activity (alternatively, three sets of large attribute blocks printed from the reSolve PDF *1a Class Set of Attribute Blocks*)
- reSolve PDF *1b Student Sets of Attribute Blocks* or a set of 12 attribute blocks that match those on PDF *1b* (one set per student or pair of students)
- reSolve PDF *1c Attribute Train Challenge 1* (one train per student or pair of students)
- reSolve PDF *1d Attribute Train Challenge 2* printed on A3 paper (one per student or pair of students)
- reSolve PDF *1e Attribute Train Challenge 3* (one per student or pair of students)
- reSolve PowerPoint *1f Attribute Train Reflection*

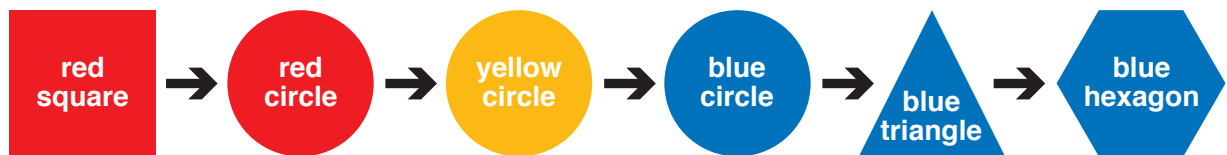
## Building a class train

Have the students sit in a circle. Place a collection of about thirty large, thin triangles, squares, circles and hexagons from a set of attribute blocks (or alternatively the large attribute blocks included in reSolve PDF *1a Class Set of Attribute Blocks*) into the centre of the circle.

Discuss how each block has two attributes: colour and shape. The attributes of the blocks are what makes them **similar** and **different**.

Select one block and explain that this block is the start of the class attribute train. The next person in the circle selects a block that has one attribute that is **different** and one attribute that is the **same**. Continue the train around the circle, changing one attribute each time. The train ends when the last person places a block. It is not intended that the attribute train will join up.

For example:



I chose a red square.

I chose a red circle. The colour is the same but the shape has changed.

I chose a yellow circle. The shape is the same but the colour has changed.

I chose a blue circle. The shape is the same but the colour has changed.

I chose a blue triangle. The colour is the same but the shape has changed.

I chose a blue hexagon. The colour is the same but the shape has changed.

**Pose the challenge:** After students have made a train that is six or seven blocks long, pose the challenge: *Do you think we could make a train using all the blocks?*

## Making your own train



**Resources:** Provide each student/pair of students with a copy of reSolve PDF *1b Student Sets of Attribute Blocks* or with a set of 12 pre-prepared cards or with a set of 12 attribute blocks that match those on reSolve PDF *1b*.

Students create their own attribute trains. Encourage the students to try to make a train that uses all their pictures or blocks, or as many as they can.

Conduct a class gallery walk to look at some of the trains created. Discuss the strategies used.

Allow students time to rebuild their train if they think they can make a longer train.

Students could record their longest train by gluing the pictures onto paper.

## Challenges



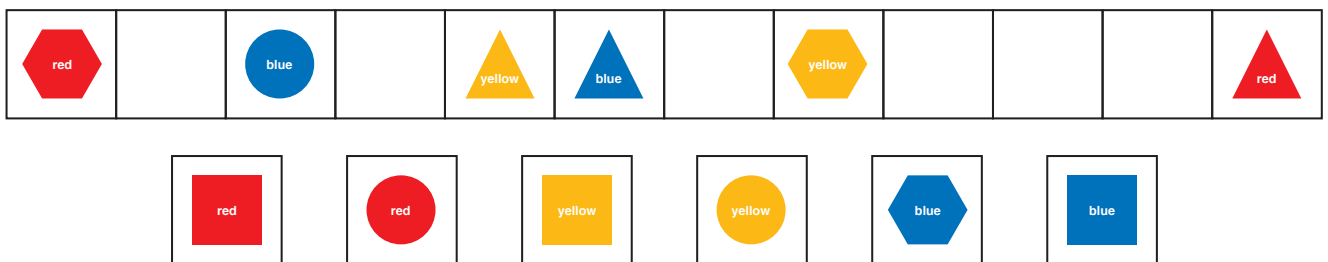
**Resources:** See reSolve PDFs *1c*, *1d* and *1e Attribute Train Challenges 1, 2 and 3* to complete the following challenges.

### Challenge 1

Can you create an attribute train that is seven blocks long, starting with a red square and ending with a yellow square?

### Challenge 2

This attribute train uses all the blocks from one complete set. Some are already placed. Can you place the remaining six blocks in the blank squares to complete the train, changing only one attribute each time?

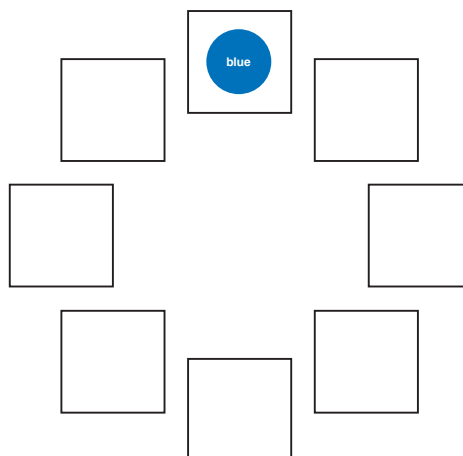


#### Teacher note:

- To move from the red hexagon to the blue circle, the blue hexagon *or* the red circle can be used. However, the blue hexagon is the *only* block that can be used between the blue triangle and the yellow hexagon. Students may reach the blue triangle, be unable to continue, and be encouraged to consider possible alternatives for previous moves.

### Challenge 3

Can you create a **circular** attribute train that starts and ends with a blue circle?



## Reflection

Students share their trains and the challenges they completed. Discuss different strategies that students used. Some questions for discussion:

- *What did you find challenging when creating your train?*
- *If you changed **two** attributes each time, what might your train look like?*

Show the reSolve PowerPoint *1f Attribute Train Reflection*. Ask students to identify the errors that have been made in each train.

## Where to next?

Lesson 2: Train Challenge introduces a game in which two players build a shared train and compete to be the first to use all their cards.

## Train Challenge

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## About this lesson

This resource builds on the first task in the sequence by adding the attribute of size. In the game 'Attribute Train Challenge' students play against each other to create trains using three attributes. The lesson concludes by looking at a hypothetical game and considering the most strategic moves that can be made by each player.

## Australian Curriculum: Mathematics (Foundation)

**ACMNA005:** Sort and classify familiar objects and explain the basis for these classifications. Copy, continue and create patterns with objects and drawings.

## Mathematical purpose

- To extend students' understanding of attributes by introducing a third attribute: size. Students identify how an object will change when one or two of its attributes are altered.

## Learning intention

- To build attribute trains using cards that have three different attributes instead of two.



## Time

A lesson of approximately 1 hour.



## Vocabulary

- attribute
- difference
- large
- similarity
- small



## Resources

- reSolve PDF *2a Class Set of Three-Attributes Blocks* (one set)
- reSolve PDF *2b Student Set of Three-Attributes Blocks* (one copy per pair of students)
- reSolve PowerPoint *2c Train Challenge Reflection*

## Class Attribute Train Challenge



**Resources:** Show the attribute blocks from reSolve PDF *2a Class Set of Three-Attributes Blocks* and introduce the new attribute of size to the students. Ensure that students understand that each block has three attributes: colour, size and shape. These attributes are what make the blocks **similar** and **different**.

Play a class game of the Attribute Train Challenge:

1. Place all the game cards on the floor/board.
2. One student selects any card and stands at the front of the train. They state the attributes of their shape. For example, "I have a large red square."
3. Select students to choose another attribute card that changes one attribute and join the train.



It is also possible to create a train where only one attribute is kept the same each time. This means **two** attributes will need to be changed each time the train grows.

## Pair Challenge



**Resources:** Show the attribute blocks from reSolve PDF *2b Student Set of Three-Attributes Blocks* and introduce the game 'Attribute Train Challenge', which is played in pairs.

1. Each pair of students is given one complete set of 24 three-attributes cards.
2. Each player takes five cards and places them face up in front of them. The remaining cards go face down in a pile. This is the redraw pile.
3. The first card in the redraw pile is flipped over. This is the start of the train.
4. Players take turns placing one of their cards on the end to continue the train, building from left to right. The card they place in the train must change one attribute and keep two attributes the same. If a player cannot place an appropriate card, they must pick up a new card from the redraw pile and add it to the cards in front of them.
5. The winner is the first player to use all their cards or, in the case of a stalemate, whoever played the last card.



### Teacher notes:

- There is the potential for strategic play in this game; for example, playing a card that your opponent is unable to join onto. Students at this stage may not recognise this and should not be pressed to play more strategically—this will be explored as a group in the reflection stage below.
- The game can be played so that students place a card on one end of the train, going left to right. A variation is to allow students to place a card on either end of the train.
- It may be beneficial to have a third player in each group to serve as an 'umpire'. They can monitor the cards being added to the train and if they think that one is incorrect, they can challenge the move. This third player may even be from a later grade (e.g. Year 4).





### Enabling prompt:

- Play the game with two sets of the attribute cards from Lesson 1: Attribute Train. This means that students will need to work with only two attributes rather than three.



### Extending prompt:

- After playing once, play a second game, changing two attributes with each move. This means only one attribute can be the same each time.

## Reflection

Students share their strategies for playing the game.



**Resources:** Show students the reSolve PowerPoint *2c Train Challenge Reflection*. There are two versions of the PowerPoint. *Train Challenge Reflection Animated* uses animations to step through the moves made in the game. Each mouse click shows a move or a question to ask students. *Train Challenge Reflection* shows the moves and questions on separate slides.

Alternatively, conduct Millie and Matt's game as a class activity using attribute blocks.

Explain that this is the start of a game between Millie and Matt.

### Slide 1

Look at the first moves. *How many attributes are Millie and Matt changing each time in their game?*

- They are changing one attribute each time.

It is Millie's turn. *Which cards can she play?*

- She can play the small yellow hexagon, the large yellow circle or the large blue hexagon.

*What is the best card for her to use? If Millie wants to make Matt draw a card on his turn, what should she play?*

- If Millie plays the large blue hexagon, Matt will not be able to play a card on his turn.
- Students may have other suggestions. Discuss how 'best' might be understood in this context.

### Slide 2/Animations 1 and 2

Millie plays the large blue hexagon and Matt must pick up a card from the redraw pile. This is a large blue circle. *What card must Millie play?*

### Slide 3/Animation 3

Millie plays the large blue square. *Which cards can Matt play? Which would be the best to play?*

- Matt can play the large blue circle or the small blue square. Playing the large blue circle means that Millie can play the large yellow circle, but playing the small blue square means that Millie will not be able to play a card on her turn.

### Slide 4/Animations 4 and 5

Matt plays the small blue square and Millie must pick up a card from the redraw pile. She picks up a small red circle. It is Matt's turn again. *Which cards can Matt play? Does it matter which one he chooses?*

- Matt can play the small yellow square or the small red square. Millie will be able to play a card regardless of which card Matt chooses.