Exemplar activity 2 (age 11-14):

Fraction Flags (Specific Teachers' Notes)

About this activity:

This is one of three exemplar activities that make up the Empowering Maths Learners collection.

This activity is aimed at learners aged 11-14.

These Specific Teachers' Notes are designed to supplement the Generic Teachers Notes that apply to all three activities and explain the rationale for the six learning phases.
You should refer to the Generic Teachers Notes alongside these Specific Teachers' Notes.
Note the diagrams/flags below are included in a separate PowerPoint file accompanying these notes.

Additional mathematics aims specific to this activity:

This activity aims to:

- Reinforce understanding of geometrical shapes, equivalent fractions; adding/subtracting fractions.
- Consolidate understanding of calculating areas of common shapes (e.g. squares, rectangles, triangles, trapeziums, circles) and compound shapes.
- Develop understanding of dividing up shapes into equal parts to identify proportions.

The six learning phases (refer also to Generic Teachers Notes):

Phase 1: Reviewing prior knowledge

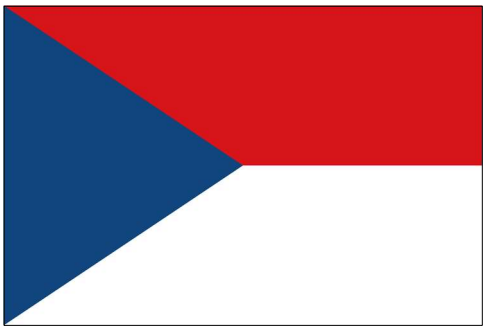
Resources:

Students have a go at these questions, on their own to begin with, before sharing responses with others:

Look at the two flags below.

Work out the fraction of each flag that is shaded in each colour. Explain how you did it.

Flag of Benin



Flag of Czechia

Additional guidance specific to this activity:

- Ensure you display/print off the fractions in the same proportions as above – the three rectangles in the flag of Benin should be congruent (even though an optical illusion suggests they are not).
- Allow students to use rulers to either measure or to compare lengths if they wish, or they may choose to draw a rectangular grid on top of a flag to help work out the fraction.
- Additional prompt questions:
    - *What is the same/different about the way the flags have been divided into colours?*

- *What measurements do you need to make to support your reasoning/check your answer(s)?*

- Students' summaries of the key mathematical ideas are likely to include:
  - Congruent shapes; equivalent fractions; adding fractions (e.g. fraction red = 1/4 + 1/8)
- You might want to work out these fractions for yourself first before doing this activity with students. If you wish to check the answers, these are included at the very end of these notes. Reinforce the idea that explaining the methods and reasoning used is more highly valued than giving correct answers.

Phase 2: Generating ideas

Resources:

Provide students with this prompt (which includes a range of flags from different parts of the world chosen for their interesting mathematical features relating to fractions):

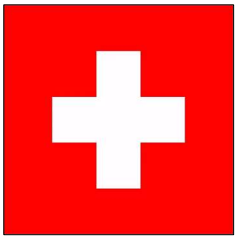
Choose one of the flags of the world below that you think would be interesting to explore.

Work out the fraction of the flag that is shaded in each colour.

Show your working out and explain your reasoning.

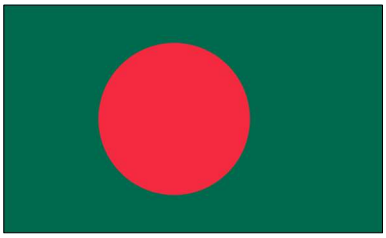
Flag of Kuwait

Flag of Congo



Flag of Switzerland

Flag of Bahrain



Flag of Bangladesh

Flag of Seychelles

Additional guidance specific to this activity:

- Remember to encourage different methods for arriving at the same answer and to attribute ideas to the students who came up with them.
- Additional questions to prompt discussions around prompt:
  - *How can you do it with as little measuring as possible?*
  - *What is the difference between explaining your reasoning and showing your working out?* You could generate a table like this (based on the Seychelles flag) to prompt further discussion. Collate ideas suggested by students into two columns without labelling them or revealing that you are sorting them into 'reasoning' and 'working out'. Then prompt a discussion about: *What is different about the two unlabelled columns?*

Turn the flag upside down to make it easier to find areas.	*Area of triangle = ½ bh*

The blue and yellow triangles have the same base and height so they have the same area. *We need to check this by measuring and not assume it.* *The red quadrilateral can be divided into two triangles.*	*Base of blue/yellow/red triangle = 24.6 ÷ 3 = 8.2 cm* *Height of flag is half its width. Height = 24.6 ÷ 2 = 12.3 cm* *Area of each triangle = ½ x 8.2 x 12.3 = 50.43 cm^2* *Area of each triangle = 24.6 x 12.3 ÷ 6 = 50.43 cm^2*

- *Why do you think these flags were chosen?*

- Prompts to generate questions to enable students to develop their ideas further:
  - *Why might it be useful to know the fraction of each flag shaded in each colour?*
- You might want to work out these fractions for yourself first before doing this activity with students. If you wish to check the answers, these are included at the very end of these notes. Reinforce the idea that explaining the methods and reasoning used is more highly valued than giving correct answers.

Common Issues	***Suggested questions/prompts/actions***
Students focus too much on accurate or precise measurement, at the expense of reasoning.	Encourage students to use rulers to compare dimensions rather than to record accurate measurements. *Which lengths appear to be the same as (or a multiple of) other lengths? How could you check?*
Students hint at using congruency of shapes within flags (without necessarily using the word).	Encourage students to cut up flags, or use tracing paper, to test for congruency of shapes.

Phase 3: Developing ideas

Resources:

Provide students with access to a range of flags from around the world. If they have access to laptops or tablets, they could use the website www.flagpedia.net.

Encourage groups of students to choose flags for which they think calculating the fractions of each colour (and explaining how they did it) will be interesting and challenging.

Additional guidance specific to this activity:

- This would be an ideal activity for generating posters which could be used as a display.
- Questions/prompts to facilitate group discussions/learning:
  - *For which types of shapes would it be easy/difficult to calculate the area?*

Common Issues	***Suggested questions/prompts/actions***
There may be students in the class	Encourage students to explore flags from countries relating to their own heritage or to other people's heritage that they know.
Some flags may be more challenging as they contain more complex shapes, e.g. stars (for Somalia, Vietnam) or irregular shapes (outline of the island for Cyprus).	Students may need to use more accurate measurement for these flags; divide up shapes into simpler shapes (for which they can calculate the area); or superimpose irregular shapes onto a square grid (using tracing paper) and count full/part squares to estimate their areas.

Phase 4: Formalising ideas

Resources:

Provide students with access to all flags that have been explored so far by the class (e.g. use posters if these have been produced in Phase 3).

Encourage students to produce a list of shapes that they have encountered and instructions/formulas for how to calculate the areas of each type of shape.

Additional guidance specific to this activity:

- The outputs from this activity might be kept and used as group or individual revision notes.
- Questions/prompts to facilitate a whole group discussion:
    - *What is the correct mathematical name for each shape?*
    - *Are any of the shapes special cases of more general shapes?*
      (e.g. a square is a special case of a rectangle, or right-angled trapezium …)
    - *Would the instructions/formulas need to be adapted for more general cases of the shapes?*
    - *Which types of shape are easier/more difficult to measure?*

Common Issues	***Suggested questions/prompts/actions***

Phase 5: Reinforcing ideas

Resources:

Encourage students to have a go at the following resource sheet (which is included as a separate file and is also available to download from https://maths-socialjustice.weebly.com/other-resources.html)

Fraction Squares

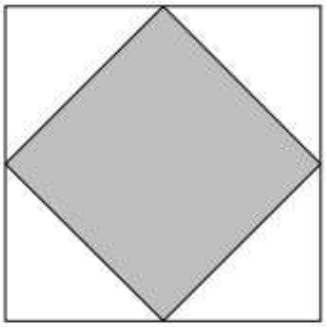
Each diagram below is made by joining corners and midpoints of a square.

For each diagram:

- Work out the fraction of the square that is shaded.
- Explain how you worked it out.

Each answer is one of the fractions at the bottom of the page.

A)



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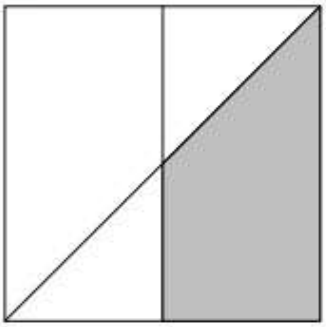

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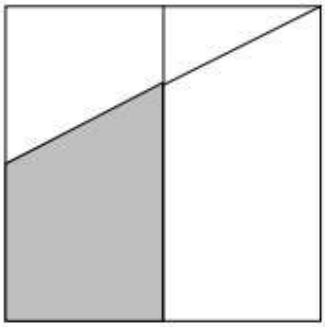

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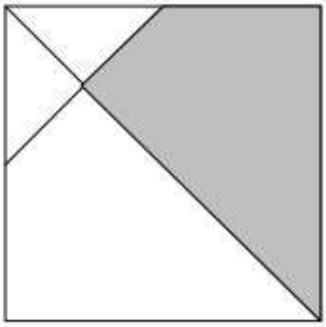

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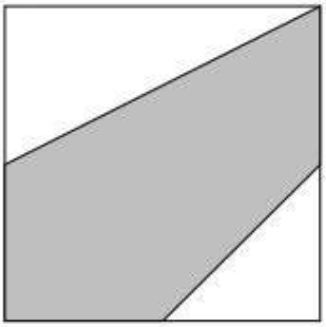

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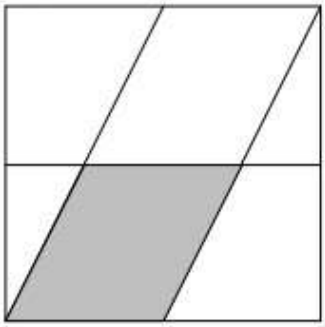

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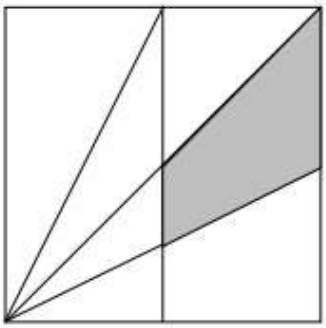

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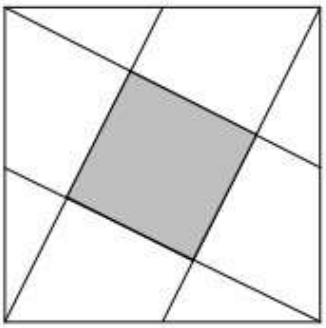

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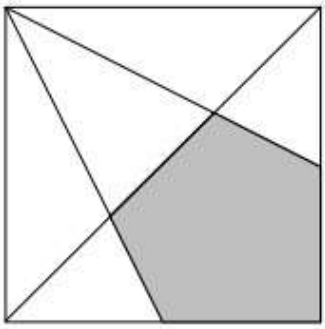

$\frac{3}{16}$ $\frac{1}{5}$ $\frac{1}{2}$ $\frac{5}{8}$ $\frac{5}{16}$ $\frac{1}{3}$ $\frac{1}{4}$ $\frac{7}{16}$ $\frac{3}{8}$

Additional guidance specific to this activity:

- Note the questions are arranged in increasing order of difficulty.
- Questions/prompts to encourage students to reflect on their learning:
    - *Complete as many of the problems as you can on your own.*
    - *Use the revision notes generated from Phase 4 to help you.*
    - *Share your solutions with others and ask them to explain any you couldn't do.*
    - *Did you use the same methods as other people used? Compare your methods.*
    - *How do these problems compare to calculating the fraction of different colours in flags?*
    - *What did you learn from doing these activities?*

Phase 6: Deepening understanding

Resources:

A4 (or larger) white card (or sugar paper), drawing instruments (rulers, protractors, set squares) and colouring pens/pencils – for students to design their own flags with interesting ways of calculating the fraction shaded in different colours.

Additional guidance specific to this activity:

- Encourage students to challenge other students to calculate the fractions for their flags (they might keep their solution separate to share with others after they have tried).

Answers for flags included in Phase 1 and 2.

- Benin: 1/3 green; 1/3 yellow; 1/3 red
- Czechia: 1/4 blue; 3/8 red; 3/8 white
- Kuwait: 1/8 black; 7/24 green; 1/4 white; 7/24 red
- Congo: 1/3 green; 1/3 gold; 1/3 red
- Switzerland: 4/5 red; 1/5 white
- Bahrain: 1/3 white; 2/3 red
- Bangladesh: 314/1500 red; 1186/1500 green
- Seychelles: 1/6 blue; 1/6 gold; 1/3 red; 1/6 white; 1/6 green