How Risky is Life?
Lesson 2: Sudden Death – the Data

Australian Curriculum: Mathematics (Year 9)

ACMNA208 Solve problems involving direct proportion. (Year 9)

ACMNA210. Express numbers in scientific notation (Year 9)

ACMMG219: Investigate very small and very large time scales and intervals. (Year 9)

ACMSP228: Identify everyday questions and issues involving at least one numerical and at least one categorical variable, and collect data directly and from secondary sources (Year 9)

Lesson abstract

Students are given the official numbers of people who died in 2015 from selected 'unnatural' causes. They compare them with their perceptions, going on to calculate the risk of dying from these causes risks in various ways numerically and also represent them visually. It emerges that unexpected deaths are very unlikely in Australia.

Mathematical purpose (for students)

In Australia, life is very safe. There is often a mismatch between "common sense" and reality in evaluating risks.

Mathematical purpose (for teachers)

Students come to understand and quantify the mismatch between "common sense" and reality in risk. They learn to represent risk in multiple ways and to interpret the information sensibly. There are opportunities to calculate probabilities, percentages, proportions and odds. Students work with large and very small numbers, use scientific notation (optional) and examine real world implications in terms of risk.

There are repeated opportunities for order of magnitude estimation of large and small quantities, drawing on common knowledge.

Lesson Length 45 minutes approximately

Vocabulary Encountered

- Proportions
- Levels of risk
- Swan diagram

Lesson Materials

- Slide show *ST7_Risk_2a_Sudden_Death_The_Data.pptx*
- Student Sheet 1 - Sudden Deaths 2015 (one per group)
- Student Sheet 2 - Levels of Risk (one per student)
- Student Sheet 3 - Swan Diagram (one per student)
- Poster paper, pens, scissors, glue.
- Newspaper clippings or screenshots of news stories that refer to risks (to be collected in advance by students and/or teacher).

We value your feedback after these lessons via https://www.surveymonkey.com/r/J8GPD7Z

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Lesson structure

- Comparing estimates with data (Collaborative small-group work – 10-15 minutes)
- Representing risks as proportions (Collaborative small-group work – 15 minutes)
- Representing risks visually (Small-group work and whole-class discussion – 15 minutes)

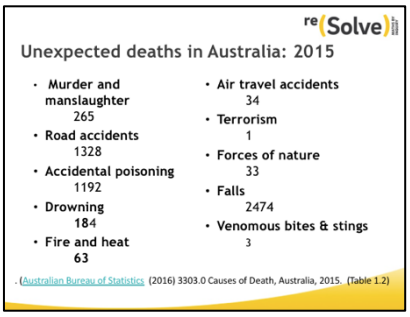
Comparing Estimates with Data

Begin by sharing a few of the newspaper clippings gathered by the class since the last lesson. The aim is to show students that the questions introduced in Lesson 1 are of concern day-to-day and to get them actively involved.

Now groups compare their estimates of the various risks from Lesson 1 with data from the Australian Life Tables.

Give each group a copy of Student Sheet 1 - Sudden Deaths 2015. (Australian Bureau of Statistics (2016) 3303.0 Causes of Death, Australia, 2015. (Table 1.2)

Show slide **Unexpected deaths in Australia in 2015**



Explain that:

- **Some** of the events we looked at in the previous lesson are much more likely to happen than others. There seems little sense in worrying much about events that will almost never happen. In this lesson, we will look at the facts.
- The cards show the same hazards as before. This time, on each card, there is a number which tells you how many people in Australia died of this cause during one year, 2015.

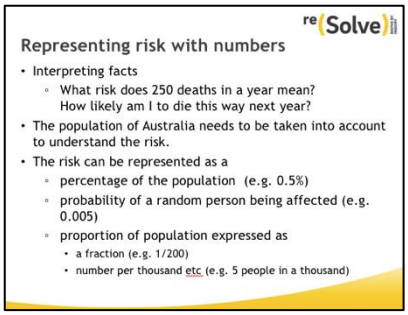
Working in their groups ask the groups to:

- cut out the cards
- place them in order, again with the most frequent at the top

Allow students time to cut out and order these causes, compare their new rank order with what they predicted in the last lesson and discuss their findings. (DO NOT PASTE THESE DOWN YET)

Representing Risks as Proportions

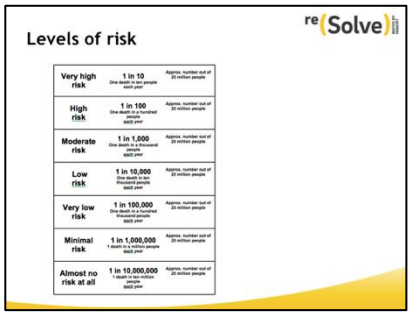
Discuss the need to relate the numbers of sudden deaths to the size of the Australian population and how this can be done (show slide **Representing risk with numbers**):



- as a percentage of the population who suffer sudden death,
- as a probability of sudden death happening to a randomly chosen person,
- as a proportion, expressed as a fraction or as something like 1 in 100. (This final very common way is used below – it is easy for people to understand.)
- as odds ('1 in 100' is the same as odds of '1 to 99') (optional).

Give each student a copy of Student Sheet 2 - Levels of Risk and show the slide **Levels of risk.** Discuss the meaning of phrases such as "1 in 100", and the verbal descriptions of each level of risk.

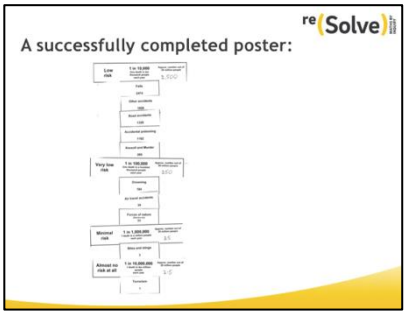
Students now fill in Student Sheet 2 - Levels of Risk, writing the number of Australians affected by a risk in each category. (It is easier if they do this in sequence, 1 in 10, 1 in 100, etc. because the number decreases by a factor of 10 each time.)



Enabling prompt

- There are about 25 million people in Australia. So how many would 1 in 10 be? (2.5 million) 1 in 100? (250,000) Is that more or less likely than 1 in 10?

Hand out scissors, poster paper and glue. Ask students to cut the completed "level of risk" sheet into strips, representing different levels of risk, and make a poster interspersing the "level of risk" cards with the data cards by comparing numbers of people affected. They should obtain a result that looks a little like the poster on the slide **A successfully completed poster**



Calculating probabilities, percentages and proportions (optional)

Ask students to calculate the risks of deaths from each cause in 2005, using the actual numbers of deaths as a:

- fraction, decimal and/or percent
- proportion (i.e. 1 in N) and/or odds
- probability.

Enabling prompt

- 265 people out of 25 million died from murder and manslaughter in 2015. That's the same as saying one person in ?
- Work out how many (=*1 in 25 000 000/265 ~ 1 in 94340*)

It is preferable to allow students to discover their own method of calculation: there are several variations.

Note: If students calculate the proportion as 265÷25 000 000 on many scientific calculators they will get: 1.06E-5. This is an opportunity to introduce or review scientific notation and appropriate accuracy.

Note: The effect of using the round number of 25 million for the population can also be discussed. The best estimate of the population in 2015 is 23 781 200 (Australian Bureau of Statistics). An estimate of today's population is given by the population clock on the Bureau's website.

Discussing the posters

Ask students to describe what they found most surprising when making the posters. Remind them of the newspaper clippings.

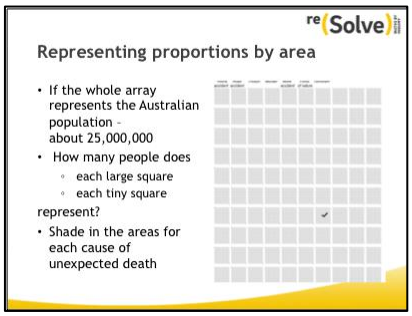
Ask students:

- Which risks do you think people worry too much about?
- Which risks do you think people worry too little about?

Representing Risks Visually

This section uses a novel representation, devised by Malcolm Swan, that displays small probabilities in a particularly vivid form.

Give students a copy of Student Sheet 3 - Swan Diagram and show the slide **Representing proportions by area**.



Explain that the whole array represents the population of Australia (25×10^6 people), and help students understand that each large square represents 25×10^4 people, and each tiny square represents 25×10^2 people.

Students' task is to colour in areas corresponding to the number of deaths from each cause. (ANS: Falls - a tiny square; all the others less ~ most little dots.)

Enabling prompt

- How many big and tiny squares are there altogether? (100, 10000)
- If there are 25 million people, how many is that for each big square? (25,000,000÷100=250,000)
- If there are 25 million people, how many is that for each tiny square? (25,000,000÷10,000=2,500)

This diagram vividly shows that in any given year the chance of dying from an unexpected cause is very small indeed! You can hardly see the shading.

Sudden Death 2015

Name: _____

Murder and Manslaughter **265**	**Air travel accidents** **34**
Road accidents **1328**	**Terrorism** **1**
Accidental poisoning **1192**	**Forces of nature** **(Storms etc)** **33**
Drowning **184**	**Falls** **2474**
Fire or heat **63**	**Venomous bites and stings** **3**

Australian Bureau of Statistics (2016) 3303.0 Causes of Death, Australia, 2015. (Table 1.2)
http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/3303.0~2015~Main%20Features~Australia's%20leading%20causes%20of%20death,%202015~3

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Levels of Risk

Name: _____

Very high risk	**1 in 10** One death in ten people each year	Approx. number out of 25 million people:
High risk	**1 in 100** One death in a hundred people each year	Approx. number out of 25 million people:
Moderate risk	**1 in 1,000** One death in a thousand people each year	Approx. number out of 25 million people:
Low risk	**1 in 10,000** One death in ten thousand people each year	Approx. number out of 25 million people:
Very low risk	**1 in 100,000** One death in a hundred thousand people each year	Approx. number out of 25 million people:
Minimal risk	**1 in 1,000,000** 1 death in a million people each year	Approx. number out of 25 million people:
Almost no risk at all	**1 in 10,000,000** 1 death in ten million people each year	Approx. number out of 25 million people:

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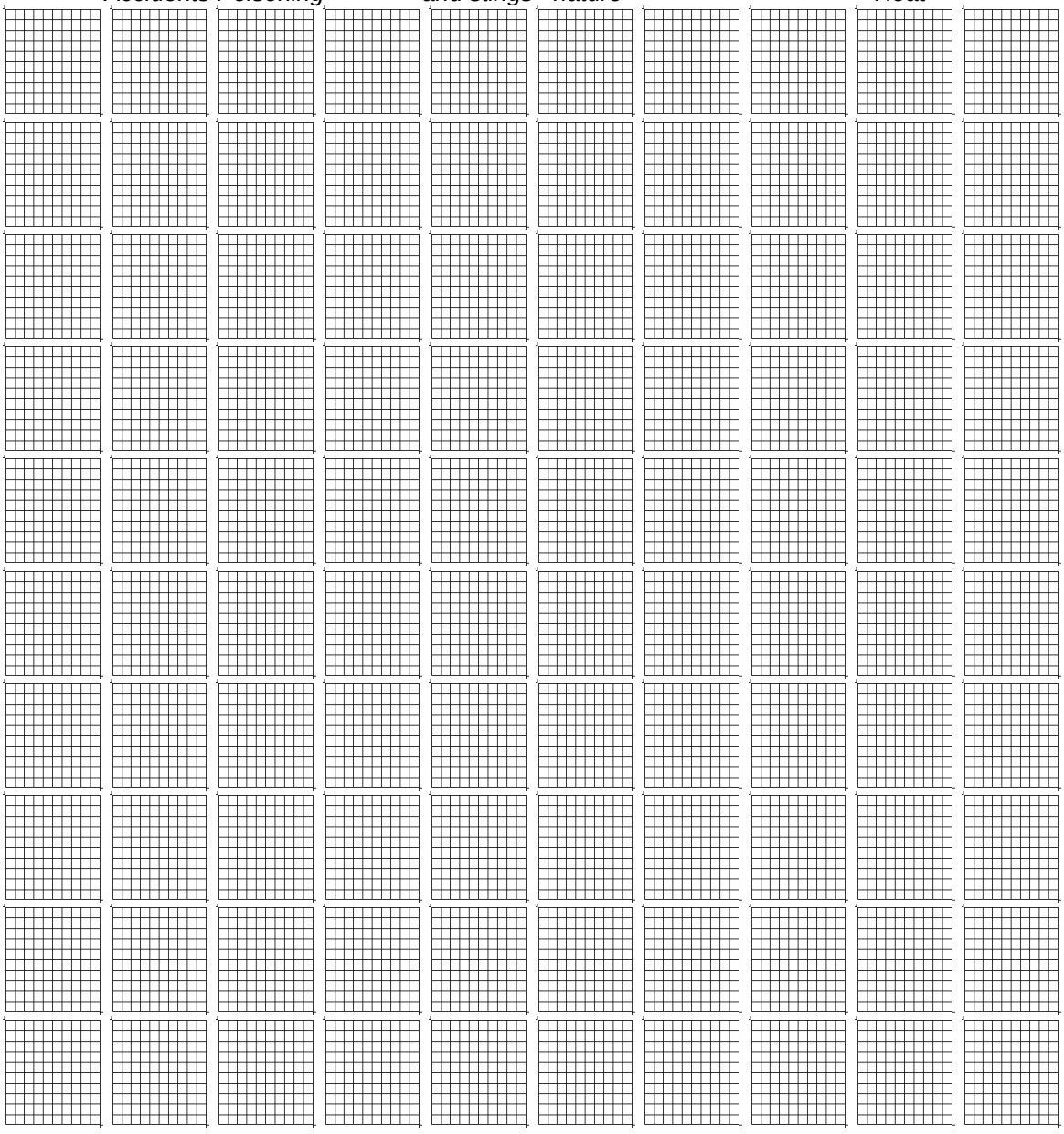
Swan Diagram

Name: _____

Imagine that this diagram shows the whole Australian population (about 25 million)

Work out how many people are represented by each big square and each tiny square. Show how many died in Australia from each cause in 2015 by shading in some squares near each cause label.

Murder *Road Accidents* *Accidental Poisoning* *Drowning* *Bites and stings* *Forces of nature* *Falls* *Air travel* *Fire, Heat* *Terrorism*



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