MATHS SESSION 6: CHANGING GAPS OVER TIME

Age range: 11–16 years

Outline
Learners will explore some ways in which access to water, sanitation and electricity in the Young Lives communities in the four countries (Ethiopia, India, Peru and Viet Nam) has developed over time. Learners will draw line graphs to represent the changes over time for different development indicators in these four countries and the UK. They will then discuss how the indicators have changed, what factors might have contributed to these changes, and any similarities and differences in the rates of change between the five countries. Finally learners will make predictions about how they think these indicators will change in the future.

Learning objectives
- To interpret data in tables and a line graph and calculate percentage changes.
- To be able to construct a line graph to show how a development indicator has changed over time in the four Young Lives countries and the UK.
- To identify some factors which might affect how a development indicator changes over time.
- To know how to use a line graph to extrapolate data.

Learning outcomes
- Learners will calculate percentage changes.
- Learners will construct line graphs to show how access to drinking water, sanitation facilities, electricity and other development indicators have changed in the four Young Lives countries and the UK over time.
- Learners will use their line graphs to make predictions about how these development indicators might change in the future.

Key questions
- How do you think the value of this indicator will change over time? Why do you think this?
- How would you describe the change in this indicator over time in each of the five countries? What factors do you think contributed to these changes over time?
- What similarities and differences are there in the rate of change between the five countries? What do you think might be the reasons for any differences?
- How do you think this indicator will change in the future? Why do you think this?

Resources
- *Maths slideshow B* (slides 21–30)
- Resource sheets:
  - *Changes in Young Lives (Completed table)*
  - *GDP per capita*
  - *Changing data 1, 2* and *3*
- Activity sheets:
  - *Changes in Young Lives / Line graph template / Interpreting a line graph*

Curriculum links

England
KS3 Mathematics
Pupils should be taught to:
Ratio, proportion and rates of change
- Solve problems involving percentage change, including: percentage increase, decrease and original value problems and simple interest in financial mathematics.

Statistics
- Construct and interpret appropriate tables, charts, and diagrams, including frequency tables, bar charts, pie charts, and pictograms for categorical data, and vertical line (or bar) charts for ungrouped and grouped numerical data.

Wales
KS3 Mathematics
Developing numerical reasoning
- Draw conclusions from data and recognise that some conclusions may be misleading or uncertain.

Using number skills
- Calculate a percentage increase or decrease.

Using data skills
- Construct a wide range of graphs and diagrams to represent discrete and continuous data.
- Interpret diagrams and graphs to compare sets of data.

Scotland
Mathematics and Numeracy
- I can choose the most appropriate form of fractions, decimal fractions and percentages to use when making calculations mentally, in written form or using technology, then use my solutions to make comparisons, decisions and choices.
  MNU 3 and 4-07a
- I can display data in a clear way. I can select appropriately from a wide range of tables, charts, diagrams and graphs when displaying discrete, continuous or grouped data, clearly communicating the significant features of the data.
  MTH 3 and 4-21a

Note:

- *These are suggested activities and resources to support your teaching rather than guide it. Additional teaching input may be required to develop pupils' knowledge, skills and understanding of some of these concepts.*
- *Learners investigate some of the changes that have taken place during the 15 years of the Young Lives project from 2000 to 2015 in* Geography session 7*.*

Activity 6.1 *(25 min)*

Changes in Young Lives

Note: Learners also explore changes in some of the Young Lives communities and the overall countries in Geography session 7*.*

- Organise learners into pairs or groups of three. Ask learners to think about the different development indicators they have been introduced to in previous sessions and about the Sustainable Development Goals that they were introduced to in the *Introduction session*. Give learners two minutes in their groups to write down all the development indicators they can think of. Possible indicators include:
  - *Life expectancy*
  - *Average income per person (GDP per capita)*
  - *Infant mortality rate*
  - *Access to an improved water source*
  - *Access to improved sanitation facilities*
  - *Access to electricity*
  - *Primary school enrolment*
  - *Number of mobile phone subscriptions per 100 people*
  - *Number of doctors per 1,000 people*
  - *Number of Internet users*
  - *CO_2 emissions per person*
- Examples are also provided on slides 22 and 23.
- Share learners' ideas as a class. Discuss how they think the values for these development indicators will have changed over time in the four Young Lives countries (Ethiopia, India, Peru and Viet Nam):
  - *Which indicators do you think will have increased in value and why?*
  - *Which indicators do you think will have decreased in value and why?*
  - *Which indicators do you think will have stayed the same in value and why?*
- Explain that researchers have been studying how some of these development indicators have changed over time in the Young Lives communities.
- Give each group a copy of the *Changes in Young Lives* table. Ask learners to look at the table and discuss what it shows.

- Ask learners to complete the table to show the percentage changes for each indicator in each country over time. A completed version of the table (with the percentage changes rounded to one decimal place) is provided in *Changes in Young Lives – Complete table*.
- Ask learners to use the data to answer the following questions for each of the indicators: *Which country has shown the most progress from 2002 to 2013? Which country has shown the least progress?*
- Discuss learners' findings using the following questions as prompts:
  - *What factors do you think have contributed to these changes over time?*
  - *How do you think access to sanitation, drinking water and electricity will change in the future? Why do you think this? What do you think will be the effects of these changes?*
  - *Do you think there is a better way of presenting this data rather than in a table? If so, what is it and why do you think this?*
- Say that the data in *Changes in Young Lives* table is quantitative data. The Young Lives researchers have also collected qualitative data to investigate how the communities, as well as the lives of the young people, have changed over time. A simple explanation of the difference between quantitative and qualitative data is provided on slide 24.
- Explain that quantitative data always involves numbers and the data is usually analysed using mathematical and statistical methods. Quantitative data is useful when researchers want to explore changes in a systematic way or make generalisations about a whole sample or population. Qualitative data does not involve numbers. It might include words, pictures, photographs and/or observations. This data often provides an in-depth picture and is particularly useful for exploring how and why things have happened or changed in a certain way.
- Explain that sources of qualitative data from the Young Lives project include individual and group interviews, as well as researchers' direct observations during their visits to the various Young Lives communities. Show slides 25 to 28 and say that this text describes some of the changes that these researchers have observed in the communities of some of the featured young people which were introduced to learners in earlier sessions. *Note that the researchers speaking here are part of a wider team of researchers in each country. Learners also explore these and other observations about the changes in some of the Young Lives communities in* Geography session 7*.*

Differentiation

- *Make it harder: Ask learners to give the percentage changes rounded to one or two decimal places.*

Activity 6.2 *(45 min)*

Changing data

- Distribute copies of *GDP per capita*. Remind learners that GDP per capita is a measure of the average income of each person in a country. Explain that the table and line graphs show how GDP per capita has changed in the UK and the four Young Lives countries over time. The table and a colour copy of the line graph are provided on slides 29 and 30.

- Point out that data is missing from some of the years for Ethiopia and Viet Nam. Discuss possible reasons for a lack of data, such as a lack of infrastructure in poorer and more isolated communities for reliable data collection.
- Explain that learners are going to explore how some other development indicators have changed over time in the four Young Lives countries and the UK.
- Organise learners into pairs and give each pair a copy of one of the *Changing data* tables. Ask learners to draw a line graph to show how their development indicator has changed over time in the four Young Lives countries and the UK.
- In their pairs, ask learners to look at their line graph and discuss the answers to the following questions:
    - *How would you describe the change in this indicator over time in each of the five countries?*
    - *What factors do you think contributed to these changes over time?*
    - *What similarities and differences are there in the rate of change between the five countries? What do you think might be the reasons for any differences?*
    - *How do you think this indicator will change in each country in the future? Why do you think this?*
    - *What do you think the value of this indicator will be in each of the countries in 2020? What about in 2050?*
- Ask learners to record their answers to the above questions by completing *Interpreting a line graph.*
- Allow time for learners to share their line graphs and findings as a whole class. Discuss learners' ideas about how they think the lives of young people in the Young Lives countries will change in the future.
- You may wish to discuss whether increasing CO_2 emissions represent 'development' or not. Discuss whether learners think increasing CO_2 emissions will be linked to a positive or negative change in the lives of young people in the Young Lives countries. *Note: Territorial CO_2 emissions include only CO_2 emissions produced within the country. This indicator does not include CO_2 emissions caused by the production of a country's imports. Some countries, such as the UK, import a lot of products. Other countries, such as India, manufacture and export a lot of products.*

Differentiation

- *Make it easier: Ask learners to use the* Line graph template *to draw their line graph.*
- *Make it harder: Ask learners to draw line graphs for more than one of the development indicators.*

Further ideas

- Ask learners to use the Internet to find other examples of quantitative and qualitative data and identify situations where one type of data may be more suitable than the other.
- Ask learners to investigate how these development indicators, for example life expectancy, are

calculated. They could also explore how other development indicators have changed over time. Useful data sources include:

- data.worldbank.org
- hdr.undp.org/en/data

- Ask learners to use Hans Rosling's *Gapminder* website (www.gapminder.org) to explore how development indicators have changed over time. Learners use *Gapminder* in *Geography activity 2.3* to investigate between-country gaps in development indicators.
- Ask learners to research the progress that has been made against the different Millennium Development Goals since they were agreed in the year 2000. Find out more: www.un.org/millenniumgoals/2014%20MDG%20report/MDG%202014%20English%20web.pdf

  Learners are supported to do this in *Geography session 7*.
- Ask learners to investigate the carbon footprints of people living in different countries around the world and the impacts of climate change on people and the planet. Find out more: www.oxfam.org.uk/education/resources/climate-challenge-11-14

Changes in Young Lives

	Access to sanitation (%)			Access to drinking water (%)			Access to electricity (%)		
	2002	**2013**	**Percentage change**	**2002**	**2013**	**Percentage change**	**2002**	**2013**	**Percentage change**
Ethiopia	22	63		54	45		36	59	
India	30	41		84	99		82	98	
Peru	77	94		50	80		65	94	
Viet Nam	49	75		51	88		84	98	

Source: Young Lives: www.younglives.org.uk

Changes in Young Lives

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Peru	77	94		50	80		65	94	
Viet Nam	49	75		51	88		84	98	

Source: Young Lives: www.younglives.org.uk

Changes in Young Lives

Completed table

	Access to sanitation (%)			Access to drinking water (%)			Access to electricity (%)		
	2002	**2013**	**Percentage change**	**2002**	**2013**	**Percentage change**	**2002**	**2013**	**Percentage change**
Ethiopia	22	63	+186%	54	45	-17%	36	59	+64%
India	30	41	+37%	84	99	+18%	82	98	+20%
Peru	77	94	+22%	50	80	+60%	65	94	+45%
Viet Nam	49	75	+53%	51	88	+73%	84	98	+17%

Source: Young Lives: www.younglives.org.uk

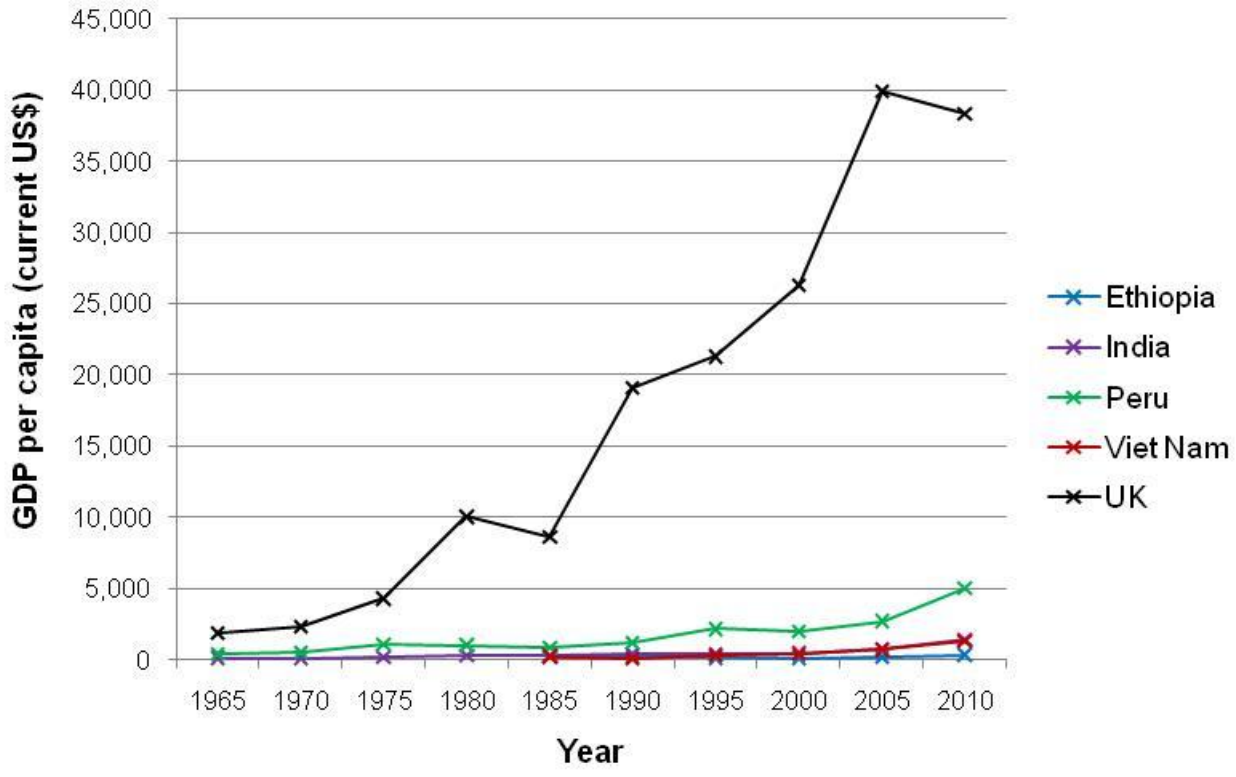
GDP per capita (current US$)

Table

Country	1965	1970	1975	1980	1985	1990	1995	2000	2005	2010
Ethiopia	-	-	-	-	233	253	134	124	162	342
India	122	115	161	272	303	375	382	452	729	1,388
Peru	433	542	1,078	1,017	824	1,178	2,163	1,967	2,714	5,056
Viet Nam	-	-	-	-	239	98	288	433	699	1334
UK	1,851	2,348	4,300	10,032	8,652	19,095	21,296	26,296	39,935	38,362

Data source: *World Bank Open Data*: data.worldbank.org

Line graph



Changing data 1

Life expectancy at birth (years)

Indicator	1980	1985	1990	1995	2000	2005	2010
Ethiopia	44	45	47	49	52	57	61
India	55	57	59	60	62	64	66
Peru	60	63	66	68	71	72	74
Viet Nam	67	69	71	72	74	75	75
UK	74	75	76	77	78	79	80

Data source: *World Bank Open Data*: data.worldbank.org

Infant mortality rate (per 1,000 live births)

Indicator	1980	1985	1990	1995	2000	2005	2010
Ethiopia	143	132	122	106	90	70	51
India	114	101	88	78	66	56	46
Peru	82	71	56	43	30	21	16
Viet Nam	47	42	37	31	26	23	20
UK	12	10	8	6	6	5	4

Data source: *World Bank Open Data*: data.worldbank.org

Changing data 2

Access to improved water source (% of total population)

Indicator	1980	1985	1990	1995	2000	2005	2010
Ethiopia	-	-	13	20	29	38	48
India	-	-	71	76	81	86	90
Peru	-	-	74	77	80	82	85
Viet Nam	-	-	63	70	77	85	91
UK	-	-	100	100	100	100	100

Data source: *World Bank Open Data*: data.worldbank.org

Access to improved sanitation facilities (% of total population)

Indicator	1980	1985	1990	1995	2000	2005	2010
Ethiopia	-	-	3	3	9	15	22
India	-	-	17	21	26	31	36
Peru	-	-	53	58	63	68	72
Viet Nam	-	-	36	45	53	61	70
UK	-	-	99	99	99	99	99

Data source: *World Bank Open Data*: data.worldbank.org

Changing data 3

Primary school enrolment (% of relevant age group)

Indicator	1980	1985	1990	1995	2000	2005	2010
Ethiopia	-	-	-	22	40	61	-
India	-	-	78	-	81	-	94
Peru	86	96	-	89	98	97	95
Viet Nam	-	90	-	-	96	90	98
UK	98	93	99	-	100	99	99

Data source: *World Bank Open Data*: data.worldbank.org

Territorial CO_2 emissions (tCO_2/person/year)

Indicator	1980	1985	1990	1995	2000	2005	2010
Ethiopia	0.05	0.04	0.06	0.04	0.09	0.07	0.08
India	0.50	0.63	0.79	0.96	1.13	1.23	1.58
Peru	1.39	1.00	0.97	0.99	1.17	1.34	1.97
Viet Nam	0.31	0.34	0.31	0.38	0.66	1.15	1.69
UK	10.30	9.92	10.36	9.56	9.46	9.32	8.05

Data source: *Global Carbon Atlas*: globalcarbonatlas.org (data accessed 16th December 2015)

Line graph template

Interpreting a line graph

Indicator: _____

- How would you describe the change in the value of this indicator over time for...?
  - Ethiopia
  - India
  - Peru
  - Viet Nam
  - UK

- Why do you think this indicator has changed in this way?

- What similarities and differences are there in the rate of change between the five countries?

- What do you think might be the reasons for any differences?

- How do you think this indicator will change in each country in the future? Why do you think this?

- What do you think the value of this indicator will be in each of the countries in 2020? What about in 2050?

	Ethiopia	India	Peru	Viet Nam	UK
2020					
2050					