Developing language and literacy skills for advanced EAL learners in STEM subjects

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Themes:

- STEM curriculum language demands
- Principles of content & language integrated learning
- Reading for information for science and maths.

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Ali

Arabic/French speaker.
In UK 2 years

Context
Year 11 GCSE
mock exam
(Edexcel 9-1)

*(c) MRSA is a bacterium that has evolved to become resistant to antibiotics.
With reference to Darwin's theory of evolution by natural selection, explain how MRSA bacteria have evolved to become resistant to antibiotics.

(Total for Question 9 = 13 marks)

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Slide 4

Language development needs

Pupil's prior know ledge

Curriculum content requirments

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Slide 5
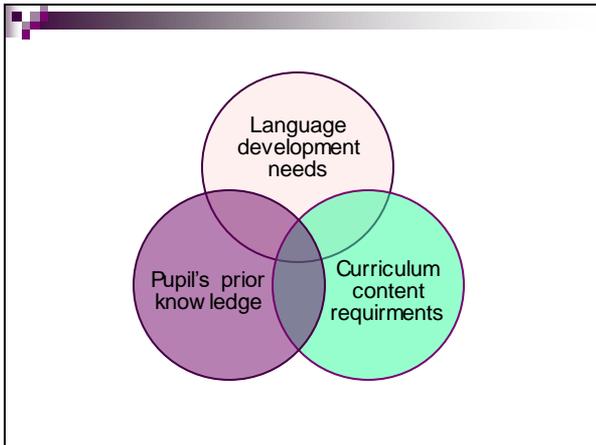
Ali's language needs

First of all MRSA infect the body. Than to heal it kill the MRSA, use antibiotic. All bacteria has extract of DNA that make them resistant to antibiotic but it is usually not adapted to protect itself from ? antibiotic that the humans takes. And their comes the theory of Charles Darwin: "only the fittest will survive" and will pass it on to its offspring. And this is how the bacterium MRSA survive, when some of them come in the body they replicated until the antibiotics killed them; But Not All of them. Rare and few of them where fitted (with extract of DNA resistant to antibiotic) to protect themselves again their enemy. And than when they replicate, they pass their resistance to their "children". And this goes on and on, until a new types of antibiotics is taken by the human, and their again the hole story repeat.

Subject – verb agreements

Determiners (the a, an, some, any)

Verb choice and tenses

Subject vocabulary

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Slide 6

Cognitive and Academic Language Proficiency (CALP)

Academic Language
- Takes 5-7 years to develop;
- Is '*context reduced'* consisting mainly of reading and writing;
- includes passive voice; concepts as agents; metaphor and nominalization.
- uses specialist or technical vocabulary derived from Greek or Latin roots,

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Teacher's version

Bacteria reproduce rapidly **via** asexual reproduction. Due to their high rate of reproduction there is more opportunity for **mutation** to **occur.** Mutation introduces **variation** to a population. Some of the mutations in the MRSA bacteria may introduce the **trait** of antibiotic resistance. If antibiotics are introduced to a population of MRSA, this **exhibits** a **selection** pressure. Bacteria with the resistance trait are better **adapted** to the new **selection** pressure and will **survive** to pass on their resistance (through hereditability in asexual reproduction). Bacteria that do not **exhibit** the resistance trait are less **adapted** to the **selection** pressure and die before reproducing. This causes levels of antibiotic resistance to rise throughout the population over **generations** meaning the MRSA bacteria has now **evolved** to have antibiotic resistance.

Academic vocabulary in bold

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Themes…

Ali	Teacher
■ First of all	■ Bacteria
■ Then	■ Due to their high rate
■ All bacteria	■ Some of the mutations
■ And	■ If antibiotics
■ And	■ Bacteria
■ Rare and few of them	■ Bacteria
■ But not all	■ This
■ And then	
■ And this	

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Verbs to Nouns - Nominalisation

■ pass on (*bacteria pass on their DNA)*

■ transmit (*bacteria transmit their DNA*)

■ transmission

(DNA transmission occurs during reproduction)

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Nominalisation Task

spoken verb	written verb	noun
work out	solve	solution
take out	extract, remove	removal, extraction
fight back	resist	resistance
make ill	infect	infection
look after	protect	protection
get used to	adapt	adaptation
pass on	transmit	transmission
put in	insert	insertion

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Register continuum

What is it about ?

everyday   specialised   technical

Who is the audience ?

informal   formal
known   unknown
familiar   unfamiliar

How shall I communicate ?

spoken   written
'here and now'   distant
shared context   unseen context

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Language functions in STEM

The greater the mass, the longer the stretch

comparing

An equilateral triangle has 3 equal sides and 3 equal angles

defining and classifying

Heavy rainfall caused widespread erosion

expressing cause and effect

I think weight will increase with height

predicting

Mammals give birth to live young and suckle them on milk

generalising

When acid was added to the test tube, bubbles were produced

recounting

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Scientific Language Function	Typical grammatical features	Sample science texts
Name or identify apparatus, parts of body, plants, living things etc	Concrete Nouns	Clamp, pipette, arm, leg, ant, bee, flower, tree
Describe and classify things	Relational verbs (in present simple) Adjectives, including colours	A cat **has** fur. A fox **is** a mammal. Copper sulphate crystals **are blue.**
Observe and describe what is happening	Present continuous verbs	The candle **is burning.** The liquid **is fizzing.**
Write instructions	Imperative verbs Sequencing connectives	**First pour** in the liquid, **and then add** the powder. **Next, stir** with a glass rod.
Make predictions	Verbs in future tense Conditional sentences	I think it **will break**. **If** you add acid the mixture **will fizz**.
Report what you found out	Past tense verbs (regular and irregular)	The mixture **turned** blue. The spring **stretched.**
Compare things	Comparative and superlative adjectives	This one **is bigger than** that one. Wood is not **as strong as** metal. The carpet is **the roughest** surface.
Make generalizations and give specific examples	Plural nouns and present simple verbs, indefinite articles	**Birds have** wings and lay eggs. An example of a bird is a penguin.
Explain how and why a phenomenon occurs	Nominalisations (abstract nouns) Passive verbs	**Evaporation** occurs when water particles **are heated** so much that they change state.

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Content-led language planning

Learning Objectives	Language Functions and Structures	Vocabulary
• Use mathematical names for 2 D shapes • Use mathematical vocabulary to describe position	• Describing • Present tense verbs • Prepositions • Adverbs of direction	• circle • triangle • rectangle • square • pentagon • next to, above, below, between, on the left, to the right

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The Maths 'Register'

- Long noun phrases
- Formal language
- Word problems
- Use of determiners

(a, an, the, each, some, any)

- 'Greek and Latin' vocabulary

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Long noun phrases in Maths

Example Questions:

Find *the volume of a cylinder with base of radius 5cm and height 40cm.*

Given *a cylinder with base of radius 5cm and height 40cm,* find *the volume of the cylinder.*

Find *the size of angle ABC in the triangle ABC where B is 10 cm, BC is 5cm and AC is 12 cm.*

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Informal v formal language

- split
- turn
- flip
- same
- holds
- cross

- divide
- rotate
- reflect
- congruent
- has capacity
- intersection

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Sequencing Instructions

To construct a triangle with dimensions of 10cm, 7cm and 8 cm:
First draw a line of 10 cm.
Then set the pencil and compass exactly 7 cm apart.
Place the compass point at **one** end of **the 10cm** line.
Draw an arc above **the line**.
Next, set the compass and pencil at 8 cm wide.
Place the compass point at **the other** end of **the 10 cm line**.
Draw **another** arc.
Use a ruler to join **each** end of the 10 cm line to the point where the two arcs cross.
Label the sides of the triangle with the correct length in cm.

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Words are not that simple….

Mathematical Vocabulary	Examples
subject technical words	hypotenuse, isosceles
number (value) words	eleven, thirteen, tenth
specialised (tier 2) words	difference, product, problem
operational words	add, plus, equals, subtract
other instructional words	plot, sketch, calculate, insert
similar words but different functions	square, square root
homophones	ate and eight, for and four
articles and pre-modifiers	**a** line, **the** line, **each** line
symbols	=, £, ≥, +, <, %

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3 tier vocabulary model

Low frequency subject specialist or technical vocabulary - e.g. condensation, congruent, fartlek, gigabyte

Tier 3

Medium frequency for academic language - e.g. coincidence, variable, function, quantitative

Tier 2

High Frequency words in everyday use, e.g. desk, pen, weather, write, read

Tier 1

Beck, McKeown, Kucan 2002
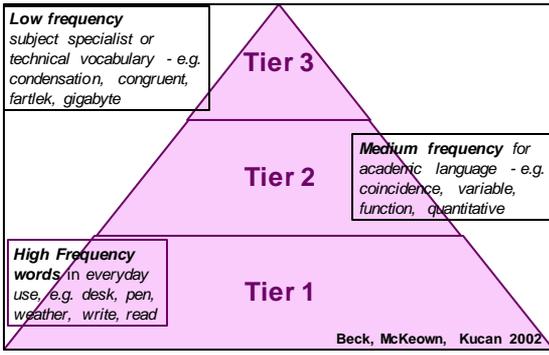
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Developing Academic Vocabulary

- Advanced EAL learners need to develop their academic vocabulary within and across subject areas. Some of these words are not subject specific.(*e.g. factor, evaluate, quantitative*)
- Look at this website to see the academic word lists and strategies for teachers and learners to develop academic vocabulary.

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Academic Word List

http://www.ealconsulting.co.uk/word_search/

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Recommended Reading

100 IDEAS for Secondary Teachers — Supporting EAL Learners — Catharine Driver & Chris Pim

Writing Science — Literacy and Discursive Power — M.A.K. Halliday and J.R. Martin

Multilingualism in Mathematics Classrooms — Global Perspectives — Richard Barwell

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