Introductory Module: Flowers and bees rely on each other for their survival and are mutually rewarded.

LESSON: Adaptive Speciation of Honey Bees: Some Multiplication and Algebraic Thinking

Activity Purpose:

1) To develop an understanding that living things have structural features and adaptations that help them to survive in their environment and that growth and survival of living things are affected by physical conditions of their environment.

2) To describe results for continuing number sequences, explaining the multiplicative transformation of one number into another and explaining how simple algebraic modelling can be used to predict future results within a natural system.

Student success criteria

Questioning and predicting:

1. With guidance students will pose clarifying questions and make predictions about a scientific investigation on the adaptive speciation of honey bees.

Processing and analysing data and information:

2. Students will construct and use representations in tree diagrams to represent and describe patterns or relationships in on adaptive speciation of insects
3. Students will compare their own data with algebraic predictions and use simple mathematical modelling as evidence when developing explanations.

Applying mathematical reasoning:

4. Students will find unknown quantities in number sentences involving multiplication, continue and create sequences involving multiplication of whole numbers, describing the rules used to create a sequence of adaptation and diversification of organisms.

Communicating:

5. Students will communicate their ideas and explanations on adaptation and speciation of honey bee organisms using scientific representations including diagrams, written descriptions and simple algebraic models.

Suggested Time: 60 – 90 minutes

Teacher Notes

A. Common alternative conceptions (misconceptions):

Students' understandings of natural diversity and evolutionary adaptation may be informed by a variety of factors including family background, culture, religious belief and education to this point. Some discussion about the physical and genetic similarities between living things could open the discussion. It may also be

necessary to explain the very long time periods involved in evolutionary progression – it takes 1.5 million years to develop one new species from a given ancestral gene set!

In addition, algebraic thinking / introductory algebra will likely be new to students at Year 5 and 6 level; this activity will need careful explanation accordingly. Teachers may wish to remind students of the use of 'boxes and triangles' to represent missing integers in equations when explaining the use of alphabetic pronumerals as algebraic terms.

B. Curriculum Links

Australian Curriculum (Science), Levels 5 and 6	
Biological Sciences	**1.** Living things have structural features and adaptations that help them to survive in their environment (ACSSU043) **2.** The growth and survival of living things are affected by physical conditions of their environment (ACSSU094)
Questioning and predicting	• With guidance, pose clarifying questions and make predictions about scientific investigations (ACSIS231), (ACSIS232)
Processing and analysing data and information	• Construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships in data using digital technologies as appropriate (ACSIS090), (ACSIS107)
Communicating	• Communicate ideas, explanations and processes using scientific representations in a variety of ways, including multi-modal texts (ACSIS093), (ACSIS110)
Australian Curriculum (Mathematics), Levels 5 and 6	
Patterns & Algebra	• Find unknown quantities in number sentences involving multiplication and division and identify equivalent number sentences involving multiplication division (ACMNA121) • Continue and create sequences involving whole numbers, fractions and decimals. Describe the rule used to create the sequence (ACMNA133)

C. Resources

- ***Optional:*** A good introduction to the life of honey bees - https://www.youtube.com/watch?v=UHYvrO_PJFU
- ***Optional:*** A good introduction to allopatric (adaptive) speciation using a (fictional) species called 'Lumptys': https://www.youtube.com/watch?v=Q2vsG77PZ80
- ***Optional:*** A short, basic introduction to what algebra is – narrated by a young learner and ideal for 'de-mystifying' the term 'algebra' for students: https://www.youtube.com/watch?v=OU87O69sTLM
- ***Essential:*** Student work booklets / work units – "Adaptive Speciation of Honey Bees: Some Multiplication and Algebraic Thinking"
- ***Essential:*** Whiteboard of Smartboard for developing students' responses and for explanatory purposes.

D. Teaching process

Section	What students are doing	What the teacher is doing
Intro / Hook ***(5 minutes)***	Listening and participation in class discussion about natural diversity and speciation. Key questions to think about / share responses are: • **What is 'natural diversity'?** • **Why are living things so diverse? Why so much diversity?** • **How and why did living things get like this on our planet?**	Leading discussion about natural diversity and speciation. Key questions to ask and share responses are: • What is 'natural diversity'? • Why are living things so diverse? Why so much diversity? • How and why did living things get like this on our planet?
Optional: **Background 1** ***(10 minutes)***	Watch Youtube clip on honey bees (as background) and/or on allopatric speciation.	Show Youtube clip/s (see above) on honey bees (as background) and/or on allopatric speciation.
Section A - Introduction – Honey Bee Adaptations ***(20 minutes)***	Read through (independently, in a small group or with the teacher) of Section A in Student work booklet, 'Introduction – Honey Bee Adaptations'. Complete item on page 3 of booklet. Share responses with peers. The key question to understand here is: **'What is adaptive variation and why does it occur'?**	Lead guided reading / facilitate individual or small group reading of Section A in Student work booklet, 'Introduction – Honey Bee Adaptations'. Lead or assist students to complete items on page 3 of the booklet. Discuss answers between class members.
Optional: **Background 2** ***(5 minutes)***	Watch Youtube clip on introduction to algebra (as background) to 'demystify' the concept. **Algebra is just a tool that helps us solve problems in mathematics!**	Show Youtube clip/s (see above) on introduction to algebra (as background). Explain that algebra is a mathematical tool that helps us describe phenomena or make predictions or make 'models' of real world problems.
Section B – Working Algebraically ***(20 minutes)***	Work through Section B of the workbook first with the teacher, then with a friend / partner. If unsure / unclear about a concept, seek clarification from peers or the teacher. The key question to understand here is: **'How can multiplication and algebra be used to describe the way in which diversity of species results from 'adaptive variation'?'**	Carefully explain pages 3 – 5 (Section B) in student booklet. This may require some scaffolding and demonstration on the whiteboard or smartboard to assist students with the concept of using algebraic variables to represent numbers in a problem (or 'model') that could change.
Activity 1 – Understanding ***(20 minutes)***	With a partner, work through Activity 1 on page 6 of the workbook. Draw the insect, invent three new variations to your insect and then do the maths!	Assist students as needed in completing Activity 1 on page 6 of the workbook, ideally working in pairs.
Activity 2 ***(Extension) (10-15 minutes)***	If finished Activity 1, have a go at Activity 2, which takes the maths a little further. Discuss answers with peers and then with the teacher. Review responses.	Assist students who finish Activity 1 with Activity 2. This introduces the additional concept of using indices to simplify long multiplicative sequences, and using the x^y key on the calculator; teachers may need to bone up' on this prior to the lesson if unsure.
Wrap up ***(5 minutes)***	Wrap up the lesson by reiterating that: • Living things develop **adaptations** that help them to survive in their environment; • **Adaptive speciation** is the process through which the Earth's living creatures have become so diverse; and • We can see how **algebraic modelling** and **multiplication** can be used to describe the way in which living things **speciate** into a complex variety of diverse ancestors over a long period of time.	

E. Assessment Opportunities (need to align with curriculum links)

Success Criteria	Possible Assessment
Questioning and predicting: 1. With guidance students will pose clarifying questions and make predictions about a scientific investigation on the adaptive speciation of honey bees (ACSIS231), (ACSIS232), (ACSSU043), (ACSSU094)	• Teacher observation of students' participation in partner, small group and class discussion (eg. A – E scale); • Completed responses to Activity 1 (eg. A – E scale): (a) conception of insect (b) description of adaptive variations (c) mathematical modelling of speciation
Processing and analysing data and information: 2. Students will construct and use representations in tree diagrams to represent and describe patterns or relationships in on adaptive speciation of insects (ACSIS090) 3. Students will compare their own data with algebraic predictions and use simple mathematical modelling as evidence when developing explanations (ACSIS107)	• Student completion of tree diagram on page 3 of booklet and algebraic formulation on pp.4-5 (eg. A – E scale) • Completed responses to Activity 1 (eg. A – E scale): (a) conception of insect (b) description of adaptive variations (c) mathematical modelling of speciation
Applying mathematical reasoning: 4. Students will find unknown quantities in number sentences involving multiplication, continue and create sequences involving multiplication of whole numbers, describing the rules used to create a sequence of adaptation and diversification of organisms (ACMNA121), (ACMNA133)	• Completed responses to Activity 1, third section (mathematical modelling of speciation) (eg. A – E scale); • Completed responses to Activity 2 (eg. A – E scale)
Communicating: 5. Students will communicate their ideas and explanations on adaptation and speciation of honey bee organisms using scientific representations including diagrams, written descriptions and simple algebraic models (ACSIS093), (ACSIS110)	• Overall completion of and participation in work unit, including thoroughness of completion, accuracy of responses and active and cooperative participation in discussion and partner work (eg. A – E scale).