Adventures in Biocontrol

Summary
Students play a game of Snakes and Ladders to learn about some of the successes and challenges developing biocontrol in New Zealand.

Learning Objectives
Students will be able to:
- Describe the steps of finding a new biocontrol agent.
- Explain why a potential biocontrol agent may be rejected.
- Identify 3 challenges to developing a new biocontrol agent.

Suggested prior lessons
What is a weed?
Cultivating weeds
Choose your weapon
Web of life

Curriculum Connections
Science, levels 3-8
Social studies, levels 3-7

Vocabulary/Concepts
biocontrol agent, containment, Environmental Protection Authority, establish, natural enemy, release

Time
1 hr

Materials
- copies of Adventures in Biocontrol game board (1 per group of 4 students)
- small objects for game pieces
- dice (1 per group of 4 students)

Background information

The process of finding, testing, approving, and releasing a biocontrol agent is long and complex. Successes and failures can happen at every step along the way. Students play this biocontrol version of Snakes and Ladders and learn some of the good and bad things that can happen along the way to a successful biocontrol programme. All the events encountered along the way are real events that have happened in the course of Landcare's biological control of weeds research.

Activity

Watch the video about the search for Japanese honeysuckle biocontrol agents (http://www.youtube.com/watch?v=ziEL2XfK-8c). Discuss with the students some of the challenges that faced researchers in their search for natural enemies of Japanese honeysuckle. What problems did researchers face? How did they overcome those problems?

Discuss or have students read about the process for finding new biocontrol agents in New Zealand (http://www.landcareresearch.co.nz/science/plants-animals-fungi/plants/weeds/biocontrol/education/biocontrol-information/finding-biocontrol-agents).

Explain that, though the process is straightforward, surprises can happen at any step of the way to a successful biocontrol agent.

Divide the class into groups of four students. Give each group a Biocontrol

Challenge board game, a die and four game pieces. Explain that the game is played like Snakes and Ladders—players start at square 1 and role the die to move around the board. If they land on a square with text, they should read the text aloud. If they land at the base of a ladder, they climb to the square at the top of the ladder. If they land on the head of a snake, they slide down to the square at the snake's tail. Depending on your time constraints, you can play until one student reaches the end (square 72), or students can continue around the board until time runs out (the winner being the person who goes around the board the most times).

After playing the game, ask students what sorts of things happened to them along the way. What were some good things that happened? Some bad things? Explain that all the things that happened in the game are events that have actually happened in real life.

Assessment/Extension

1. Students write a fictional newspaper story about the search for a biocontrol agent. Stories should include:
   - information about the weed
   - information about the biocontrol agents tested
   - a description of how scientists went about finding a biocontrol agent
   - description of at least two challenges researchers faced
   - a conclusion that tells of the success (or failure) of the biocontrol project.
2. Students research and write a report on a real biocontrol agent released in New Zealand. Reports should include:
   - information about the weed
   - information about the biocontrol agent
   - a description of how scientists went about finding the agent
   - a description of at least one challenge researchers faced
   - a conclusion that tells of the success (or failure) of the biocontrol project. If the project is not yet complete, the conclusion can tell what the current status of the project is, and what the next steps are.

   Information for this research project can be found on the Landcare Research Biocontrol of weeds website (http://www.landcareresearch.co.nz/science/plants-animals-fungi/plants/weeds/biocontrol)
3. Students create a flow chart of the process of finding a biocontrol agent. An example flow chart can be found at http://www.landcareresearch.co.nz/science/plants-animals-fungi/plants/weeds/biocontrol/education/biocontrol-information/finding-biocontrol-agents

Curriculum connections

Science—Nature of Science
Levels 3 & 4

Understanding about science

- Appreciate that science is a way of explaining the world and that science knowledge changes over time.
- Identify ways in which scientists work together and provide evidence to support their ideas.

Communicating in science

- Begin to use a range of scientific symbols, conventions, and vocabulary.

Levels 5 & 6

Understanding about science

- Understand that scientists' investigations are informed by current scientific theories and aim to collect evidence that will be interpreted through processes of logical argument.

Levels 7 & 8

Understanding about science

- Understand that scientists have an obligation to connect their new ideas to current and historical scientific knowledge and to present their findings for peer review and debate.

Social Studies
Level 3

- Understand how groups make and implement rules and laws.
- Understand how people make decisions about access to and use of resources.

Level 4

- Understand how the ways in which leadership of groups is acquired and exercised have consequences for communities and societies.
- Understand how exploration and innovation create opportunities and challenges for people, places, and environments.
- Understand that events have causes and effects.
- Understand how formal and informal groups make decisions that impact on communities.
- Understand how people participate individually and collectively in response to community challenges.

Level 5

- Understand how systems of government in New Zealand operate and affect people's lives, and how they compare with another system.
- Understand how economic decisions impact on people, communities, and nations.
- Understand how people's management of resources impacts on environmental and social sustainability.

Level 7

Economics

- Understand how economic concepts and models provide a means of analysing contemporary New Zealand issues.
- Understand how government policies and contemporary issues interact.

Vocabulary/concepts

Biocontrol agent – An organism used to control a weed. Most biocontrol agents are insects or fungi.

Containment – A place where new organisms are contained, isolated from other organisms, upon arrival in New Zealand. Containment allows scientists to ensure new organisms do not carry diseases, and to study the organisms in New Zealand without risk to the New Zealand environment or economy.

Environmental Protection Authority (EPA) – The agency within the New Zealand government that regulates new organisms. The EPA reviews applications to release new organisms and either approves the release, denies the release, or asks for additional information.

Establish – To survive and reproduce.

Natural enemy – An organism that attacks a weed in its native habitat.

Release – To let large numbers of a new biocontrol agent go in suitable habitat.

Adventures in Biocontrol

The person who gets around the board the most times in 1 hour wins!

Get started ↑ Find suitable agents ↑ Test agents thoroughly ↑ Import agents into containment ↑ Get permission to release agents ↑ Mass produce agents ↑ Release agents widely ↑ Monitor establishment success of agents ↑ Evaluate success of programme

65 **Miss a turn** while you are inundated by the media enquiring about this wonderful new agent everyone is talking about.	**66** Despite assurances from the land owner, your assessment trial plots have been sprayed again!	**67** The agent you sweated so hard over has become a favourite food of native predators and is rendered completely useless.	**68**	**69**	**70** An economist shows that your successful control project has paid for itself at least 10 times over. You are a star!	**71**	**72** Congratulations! You have successfully controlled your target weed! Now you have been asked to tackle another... **Return to start**
64	**63** You look everywhere but can't find any trace of your control agent and must accept that it has failed to establish. You now have to find a new agent.	**62**	**61**	**60** You can't believe your eyes when you see your control agent everywhere you go. It doesn't get any better than this!	**59** Your new agent has been accused of attacking other plants. **Miss a turn** while you clear your agent's good name.	**58**	**57** You eagerly revisit several release sites and find that they have either been cleared to make way for a house, covered in volcanic ash, sprayed, flooded, or burnt.
49	**50** The courier entrusted to deliver your agents manages to lose several parcels. **Miss a turn** trying to track them down.	**51**	**52** **Miss a turn** while you convince worried airline staff that your luggage is not harmful to the other passengers and that not all insects are bad.	**53**	**54**	**55** Regional council staff assist with finding release sites, and many hands make light work of releasing the agents far and wide.	**56**
48 For some strange reason you end up with only male offspring and must request another shipment from Europe.	**47**	**46**	**45** The automatic watering system breaks down over Christmas and the plants needed for mass-rearing die. **Miss a turn** while you grow more.	**44**	**43** Your new agent reproduces prolifically beyond your wildest dreams!	**42**	**41**
33 **Miss a turn** when your company decides to restructure. Morale is low and your budget is cut, but you still soldier on towards your goal.	**34**	**35** Some people object to your application to release your agent. **Miss a turn** attending a public hearing.	**36**	**37** In order to keep everyone happy you agree to test one additional plant species.	**38**	**39**	**40** You prepare a stunning application for release which is approved in record time.
32 Receive a large shipment of your potential agent that thrives even under the artificial conditions in containment.	**31**	**30**	**29** Pathology tests reveal that your newly arrived shipment is infected with a strange fungal disease and must be destroyed. **Miss a turn.**	**28**	**27**	**26**	**25** **Miss a turn** while you complete safety testing of some native plants that won't grow overseas.
17	**18** Your heart sinks when you discover that your most promising agent has the ability to seriously damage a native icon species.	**19**	**20**	**21** Safety testing suggests that your agent might slightly damage a non-target plant. **Miss a turn** while you consult widely to see if this would be tolerable.	**22**	**23**	**24** Hooray, your most promising potential agent refuses to set up house on anything other than your target weed!
16 Surveys turn up some promising agents but you know nothing about them. **Miss a turn** while you delve into their private lives.	**15**	**14** Political unrest in Eastern Europe delays your visit to look for potential agents. **Miss a turn**.	**13**	**12** Travel all over NZ surveying your target weed. You find a promising natural enemy has recently arrived, saving you the hassle of importing it.	**11**	**10**	**9** Many hours of research bear fruit when you discover that the natural enemies of your target weed have been well studied and used in another country.
1 Decide to tackle a serious weed problem.	**2**	**3**	**4** **Miss a turn** while you sort out conflicts of interest. Not everyone hates your target weed as much as you do!	**5**	**6** Things are not always as they appear! **Miss a turn** while you do genetic studies to sort out the identity of your agent.	**7** Many months of negotiation pay off when you secure extra funding from an international consortium. Progress can now be made far more quickly.	**8**