What controls my health?

Secondary: (ages 11 – 14) Science

This 25-lesson unit engages students in investigations to understand the importance of both genetic and environmental factors in their risk for disease. Students start the unit by experiencing the phenomenon of Type 2 diabetes through the eyes of a peer recently diagnosed with the disease. They develop an initial model to answer the question, "What caused Monique's diabetes?" Students discover that diabetes, like many common diseases, is caused by a combination of both genetic and environmental factors. Students also investigate how lifestyle options like healthy foods and exercise help prevent or reduce diabetes. The unit includes several opportunities for students to construct, test, revise and share their models to explain the investigated phenomena, while performing experiments and using computer simulations. For their final assignment, students conduct an action research project to improve their school or neighbourhood to help prevent or reduce diabetes

Time allocation	About 25 lesson periods; 9-11 weeks (plus a 20 hour action research project; approximately 3-4 weeks)
Subject content	Develop inquiry and modelling skills to be able to construct a scientific explanation based on evidence for how environmental and genetic factors influence health.
Creative and critical thinking	This unit has a **creativity** and **critical thinking** focus: • Consider several perspectives on what controls health • Reflect on the limits of an endorsed position • Propose, plan, and carry out an inquiry/action research project
Other skills	Persistence/Perseverance, Respect/Tolerance of difference
Key words	diabetes; genetics; environmental factors; inquiry; simulation; modelling; lifestyle; disease; populations; action research

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Products and processes to assess

The unit provides opportunities for students to develop their collaborative, creative, critical thinking, modelling and scientific explanation skills by engaging in sharing ideas, and constructing and revising models to explain what controls their health. They conduct an action research (inquiry) project which can be presented to their peers, family, and the broader public. At the highest levels of achievement, students are highly engaged in generating ideas and moving through structured, guided, and open investigations, including asking new questions, raising several hypotheses, and discussing the possible outcomes. Students present well-expressed models and show how they can be used to explain and predict phenomena, and demonstrate good awareness of the value, usefulness and limitations of their explanations. They provide full and detailed feedback on other students' models, including suggestions for revision, new insights, and relevant ideas to test the model. Additionally, they use their models to inform their inquiry projects. Students fully engage in sharing results and findings from their inquiry projects and offer thoughtful arguments about the implications of potential actions.

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Teaching and Learning plan

This plan suggests potential steps for implementing the activity. Teachers can introduce as many modifications as they see fit to adapt the activity to their teaching context.

Step	Duration	Teacher and student roles	Subject content	Creativity and critical thinking
1	Lesson periods 1 and 2	***Why does Monique have diabetes?*** The students watch a video of a young girl, Monique, who has Type 2 diabetes. Students generate their own questions about Monique's health and are introduced to the driving question of the unit, "What controls my health?". Students develop an initial model that explains a health phenomenon of their choice.	Developing a model to explain a health phenomenon Exploring factors that affect health	Generating ideas for questions Proposing and modelling an explanation to a scientific problem
2	Lesson periods 3, 4, 5 and 6	***How can we describe Monique's diabetes?*** The students watch a video in which Monique talks about her diabetes. The students read about the case study of Monique having a glucose tolerance test and they take the role of lab technician. The students perform an insulin test on simulated blood plasma samples and analyze and interpret data to determine if the person has Type 1 or Type 2 diabetes. The students read scientific texts to describe patterns in and evidence about mechanisms and cause and effect of diabetes. The students write a scientific explanation based on the evidence in the form of a lab report to explain the results of Monique's blood test. *The students develop a visual representation to integrate their findings with scientific information about the mechanism of diabetes and how it affects body systems.* The students revisit the ***Driving Question Board (DQB)*** and reflect upon their learning. The students revise their models and add the biological aspect of diabetes to their model.	Developing knowledge of Type 1 and Type 2 diabetes and glucose tests	Observing and describing relevant information Reflecting on uncertainty and the limits of the endorsed solution
3	Lesson periods 7, 8, 9, 10 and 11	***How does Monique's family affect her diabetes?*** The students examine pictures of a family to identify some genetic factors of characteristics that might be inherited. The students use beads to simulate the inheritance of risk factors for diabetes. They identify the offspring as having high, medium, or low risk of diabetes based on the number and type of risk factors inherited. The students collect data	Genetic factors that impact health Analysing data to understand risk factors	Finding alternative perspectives on a scientific problem Reflecting on uncertainty and the limits of the endorsed solution

		on tongue rolling and arm span. They use this data to explore what genes are and how they work. The students revisit the ***Driving Question Board (DQB)*** and reflect upon their learning and revise their models and add the effect of genetic factors on Monique's diabetes.		
4	Lesson periods 12, 13, 14, 15 and 16	***How does where Monique lives and what she does affect her diabetes?*** The students investigate the effect of environmental factors on the growth/survival of plants using an online simulation. Students collect data, share and discuss their results, and draw evidence-based conclusions. The students link the plant simulation to diabetes and discuss the environmental factors that affect health. The students revisit the ***Driving Question Board (DQB)*** and reflect upon their learning and revise their models and add the effect of environmental factors on Monique's diabetes.	Investigating the effect of environmental factors on the growth of plants	Finding alternative perspectives on a scientific problem Generating ideas for an experiment Reflecting on uncertainty and the limits of the endorsed solution
5	Lesson periods 17, 18, 19, 20 and 21	***How do Monique's characteristics and environment affect her diabetes?*** In a scaffolded process that includes structured, guided and open inquiry, students investigate the effect of both genetic information and environmental factors on the health of sand-rats using an online simulation. They plan and carry out an experiment using the simulation, collect and analyze data, and draw evidence-based conclusions. Then they share and discuss their results with their peers. The students revisit **the *Driving Question Board (DQB)*** and reflect upon their learning. The students revise their models and add the interaction of environment and genetic factors on Monique's diabetes.	Investigating effect of genetic and environmental factors on health Using simulations Designing and conducting experiments Modelling the effect of genes and environment on one's health	Finding alternative perspectives on a scientific problem Making new connections between their data and a driving research question
6	Lesson periods 22, 23, 24 and 25	***What can Monique do to make her environment healthier?*** The students will study different types of food. They will also calculate and visualize the amount of sugar in each food product. The students will inspect the serving size and the number of servings size per package of given food products. The students will use argumentation based on evidence to critique Monique's snack choices. The students will revise their models by adding the amount of sugar in various foods as examples. Then, they will share their models with the whole class to finalize their own model of Monique's diabetes. Through class discussions, the	Learning about nutrition Calculating and visualizing the amount of sugar in their diet	Comparing perspectives on a scientific problem Reviewing alternative opinions, reflecting on strengths and weaknesses, and proposing a new combined solution

		students will develop a consensus model. This model can be used to explain and predict Monique's diabetes.		
7	Approximately 20 hours (may also take place out of class time)	**Community action projects: *How can we work together to make our environment healthier?*** *The students will generalize the model: diabetes to* health issues, Monique to ourselves as humans. The students will address possible scenarios related to gene-environment interactions and use their models to explain the cases. The class transforms into a research group whose goal is to answer an inquiry question regarding a public health issue in the students' environment. First, students develop and choose their inquiry question, design and develop their research tools, then plan and carry out their investigations. After completing their investigations, the students analyse the data and draw conclusions, share their findings with their peers and broader community, draw conclusions regarding their inquiry question while addressing ethical issues, and suggest solutions and potential actions based on their findings. The students revise their models and add an action component and its effect on their health. The unit can be tied up with a reflective discussion on what the students have learned about what controls their health.	Building inquiry skills in science Planning and carrying out a scientific investigation Analyzing data Communicating findings	Generating ideas for relevant inquiry questions Envisioning a programme of action that is personally novel Reflecting on steps taken and what they have learned about a driving research question

Resources and examples for inspiration

Web and print

- Monique video: https://vimeo.com/8036457
- The Concord Consortium's Building Models STEM Resource Finder and SageModeler: https://learn.concord.org/building-models
- Diagnosing Diabetes kit: http://www.sciencetakeout.com/product/diagnosing-diabetes/
- Flower pot simulation: https://concord.org/hioh/plant-growth/
- Sand rat simulation: https://concord.org/hioh/sand-rats/
- What Controls My Health curriculum: https://hioh.education/middle-school

Other

- Visit to local farmers market
- Community summit to present results of community action projects

Opportunities to adapt, extend, and enrich

- This unit links with a second middle school unit on gene-environment interactions, natural selection, and mutation. See https://hioh.education/middle-school for the middle school Substance Use Disorder Unit.
- This unit also links to two high school units on gene-environment interactions and evolution. See https://hioh.education/high-school for those units.
- The final community action project (7) conducted in the school or neighbourhood and reported back to family and community members may link with math (data analysis and graphing) and social studies curriculum.
- The nutrition lesson (6) may link with health curriculum.

Creativity and critical thinking rubric for science

- Mapping of the different steps of the lesson plan against the OECD rubric to identify the creative and/or critical thinking skills the different parts of the lesson aim to develop

	CREATIVITY Coming up with new ideas and solutions	Steps	CRITICAL THINKING Questioning and evaluating ideas and solutions	Steps
INQUIRING	Make connections to other scientific concepts or conceptual ideas in other disciplines	2,5	Identify and question assumptions and generally accepted ideas of a scientific explanation or approach to a problem	1,7
IMAGINING	Generate and play with unusual and radical ideas when approaching or solving a scientific problem	1,4,7	Consider several perspectives on a scientific problem	3-6
DOING	Pose and propose how to solve a scientific problem in a personally novel way	1,7	Explain both strengths and limitations of a scientific solution based on logical and possibly other criteria (practical, ethical, etc.)	6,7
REFLECTING	Reflect on steps taken to pose and solve a scientific problem	7	Reflect on the chosen scientific approach or solution relative to possible alternatives	2,3,4,7