EDVANTAGE INTERACTIVE

BC Senior Science Project

Implementation Guide

Hello,

Thank you for requesting a copy of the Edvantage Interactive BC Science Chemistry and Physics Implementation guide. At Edvantage Interactive we have developed this guide to provide you with support as you plan how to align the BC Science Chemistry and Physics programs to the new BC Science curriculum. During the 2018/2019 school year we have been talking with educators across the province to determine the scope of the changes needed in our programs. I would recommend taking a few minutes to watch my keynote address at our BC Science Institute on October 19, 2018. You can find a recording at https://youtu.be/RCCnP_0mh0M. You will note that I observed we're already doing a very good job teaching science in BC and that we should proceed with prudence to ensure we don't discard the excellent practices we currently employ. For example, this curriculum seems to suggest that educators have just discovered Inquiry as a method of teaching and that it impacts positively on student learning. I would argue Science teachers have known this for decades and our practice reflects this method of teaching. Therefore, many of curricular competencies, while new to other subject areas, is familiar with most science teachers.

The one area of significant change in this curriculum is the inclusion of First Peoples perspectives. This is a long overdue addition to our curriculum, and it is a challenge for science teachers to find authentic examples that bridge traditional knowledge and western science thought. I am the first to admit I have significant learning to accomplish before I can identify authentic examples. Our journey into understanding First Peoples perspectives at Edvantage Interactive has started through a collaboration with the Heron Group affiliated with Royal Roads University. Our plan to begin understanding and incorporating First Peoples perspectives for the upcoming school year is twofold: First, we will work with the Heron Group to include a land acknowledgement custom to the location of your school. This is an important first step in building our program to properly reflect the words and intent in the curriculum. Second, we have built a matrix to align the cross-cutting concepts in the curriculum with major themes within First Peoples perspectives. The Heron Group has approved this framework. We will use this framework to assist us in identifying examples that align to both traditional knowledge and the Chemistry and Physics curriculum. As you can imagine, this work takes time so these examples will be incorporated into our resources as they become available. We will also make them available at Edvantagescience.com in the Teacher Support section. Finally, look for future announcements related to in-service support during the 2019/2020 school year.

The Guide consists of three parts. The first part shows the alignment between the Big Ideas, Content Learning Standards and the relevant sections within the BC Science program. The second part provides a planning guide for the Curricular Competencies. Both parts are designed to be used together during your planning. By selecting the appropriate learning standards and aligning them to our books, you can rest assured that you are addressing the competencies within the curriculum. The third part includes an example for a Physics unit on Motion as an illustrative example that uses the planning tools provided in parts one and two.

Finally, please remember you are welcome to customize your BC Science program. This means you can add material, take out material or add QR codes to align your digital resources to your book. We are always available and happy to help. I can be contacted at lionel@edvantageinteractive.com at any time if you wish to discuss your implementation ideas. Have a great summer break and I look forward to working with you next school year.

Lionel Sandner
Edvantage Interactive

BC Science Chemistry 11

I. To be aware of during planning, instruction, assessment and evaluation

Core Competencies *Evident in all Learning*					
❑ Communication	❑ Thinking		❑ Personal and Social		
	❑ Creative	❑ Critical	❑ Identity	❑ Awareness	❑ Social

II. To consider during planning, delivering, formative and summative assessments

Learning Standards			
Big Ideas	**BC Science Alignment**	**Content and BC Science Alignment**	**Curricular Competencies**
Atoms and Molecules	❑ Chp 1: Skills and Processes of Chemistry ❑ Chp 2: The Nature of Matter ❑ Chp 5: A Closer Look at Matter	❑ dimensional analysis – Chp 1 ❑ quantum mechanical model and electron configuration – Chp 5	 * To be addressed as appropriate to the lesson
Mole	❑ Chp 3: The Mole	❑ the mole – Chp 3 ❑ analysis techniques – Chp 3	
Chemical Reactions	❑ Chp 4: Expressing and Measuring Chemical Change ❑ Chp 6: Relationships and Patterns in Chemistry	❑ reactions – Chp 4 ❑ green chemistry – Chp 4 ❑ stoichiometric calculations using significant figures – Chp 4 ❑ analysis techniques – Chp 4 ❑ valence electrons and Lewis structures – Chp 6 ❑ chemical bonding based on electronegativity – Chp 6 ❑ bonds/forces – Chp 6	
Solubility	❑ Chp 7: Solution Chemistry	❑ solubility of molecular and ionic compounds – Chp 7 ❑ stoichiometric calculations in aqueous solutions -Chp 7 ❑ analysis techniques – Chp 7	
Organic Chemistry	❑ Chp 8: Organic Chemistry	❑ organic compounds – Chp 8 ❑ applications of organic chemistry – Chp 8	
		❑ local and other chemical processes – Throughout book	

BC Science Chemistry 12

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Reaction Rate	❑ Chp1: Reaction Kinetics	❑ reaction rate – Chp 1 ❑ collision theory – Chp 1 ❑ energy change during a chemical reaction – Chp 1 ❑ reaction mechanism – Chp 1 ❑ catalysts – Chp 1	
Dynamic Equilibrium	❑ Chp 2: Chemical Equilibrium	❑ dynamic nature of chemical equilibrium – Chp 2 ❑ Le Châtelier's principle and equilibrium shift - Chp 2 ❑ equilibrium constant (K_{eq}) – Chp 2	
Solutions	❑ Chp 3: Solubility Equilibrium	❑ saturated solutions and solubility product (K_{sp}) – Chp 3	
Acid and Bases	❑ Chp 4: Acid-Base Equilibrium ❑ Chp 5: Applications of Acid-Base Reactions	❑ relative strength of acids and bases in solution – Chp 4 ❑ water as an equilibrium system – Chp 4 ❑ weak acids and weak bases - Chp 4 ❑ titration - Chp 5 ❑ hydrolysis of ions in salt solutions - Chp 5 ❑ applications of acid-base reactions - Chp 5	
Oxidation and Reduction	❑ Chp 6: Oxidation-Reduction and its Applications	❑ the oxidation-reduction process - Chp 6 ❑ electrochemical cells - Chp 6 ❑ electrolytic cells- Chp 6	
		❑ quantitative relationships - Throughout book	* To be addressed as appropriate to the lesson

BC Science Physics 11

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Learning Standards			
Big Ideas	**BC Science Alignment**	**Content and BC Science Alignment**	**Curricular Competencies**
Motion	❑ Chp 1: Kinematics ❑ Chp 4: Vectors	❑ horizontal uniform and accelerated motion - Chp 1 ❑ projectile motion - Chp 1 ❑ vector and scalar quantities - Chp 4	 * To be addressed as appropriate to the lesson
Forces	❑ Chp 2: Forces ❑ Chp 3: Newton's Laws of Motion	❑ contact forces and the factors that affect magnitude and direction - Chp 2 ❑ mass, force of gravity, and apparent weight - Chp 2 ❑ Newton's laws of motion and free-body diagrams - Chp 3 ❑ balanced and unbalanced forces in systems - Chp 3	
Energy	❑ Chp 5: Energy ❑ Chp 6: Electricity	❑ conservation of energy; principle of work and energy -Chp 5 ❑ power and efficiency - Chp 5 ❑ simple machines and mechanical advantage - Chp 5 ❑ applications of simple machines by First Peoples - Chp 5 ❑ thermal equilibrium and specific heat capacity - Chp 5 ❑ electric circuits (DC), Ohm's law, and Kirchhoff's laws - Chp 6	
Waves	❑ Chp 7: Wave Motion ❑ Chp 8: Sound	❑ generation and propagation of waves - Chp 7 ❑ properties and behaviours of waves - Chp 7 ❑ characteristics of sound - Chp 8 ❑ resonance and frequency of sound - Chp 8	
		❑ graphical methods in physics - Throughout book	

BC Science Physics 12

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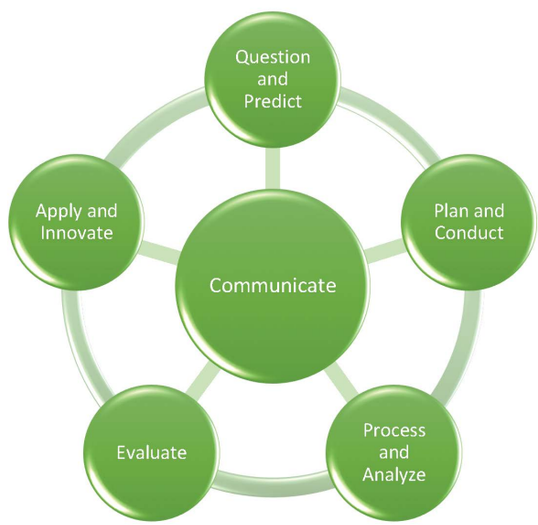
Measurement of Motion	❑ Chp 1: Vectors and Static Equilibrium ❑ Chp 2: Kinematics Review ❑ Chp 4: Special Relativity	❑ static equilibrium - Chp 1 ❑ frames of reference - Chp 4 ❑ relative motion within a stationary reference frame - Chp 4 ❑ postulates of special relativity - Chp 4 ❑ relativistic effects within a moving reference frame - Chp 4	 * To be addressed as appropriate to the lesson
Momentum	❑ Chp 3: Momentum and Energy	❑ gravitational potential energy - Chp 3 ❑ Impulse and momentum - Chp 3 ❑ conservation of momentum and energy in collisions - Chp 3	
Circular Motion	❑ Chp 5: Circular Motion and Gravitation	❑ uniform circular motion: centripetal force and acceleration; changes to apparent weight - Chp 5 ❑ gravitational field and Newton's law of universal gravitation - Chp 5 ❑ gravitational dynamics and energy relationships - Chp 5	
Fields	❑ Chp 6: Electrostatics ❑ Chp 7: Magnetic Forces ❑ Chp 8: Electromagnetic Induction	❑ electric field and Coulomb's law - Chp 6 ❑ electric potential energy, electric potential, and electric potential difference - Chp 6 ❑ electrostatic dynamics and energy relationships - Chp 6 ❑ magnetic field and magnetic force - Chp 7 ❑ electromagnetic induction - Chp 8 ❑ applications of electromagnetic induction - Chp 8	
		❑ graphical methods in physics - Throughout book ❑ First Peoples knowledge and applications of forces in traditional technologies - Throughout book	

BC Science Chemistry Curricular Competencies Planning Chart

Applying and innovating

- ❑ Contribute to care for self, others, community, and world through individual or collaborative approaches
- ❑ Cooperatively design projects with local and/or global connections and applications
- ❑ Contribute to finding solutions to problems at a local and/or global level through inquiry
- ❑ Implement multiple strategies to solve problems in real-life, applied, and conceptual situations
- ❑ Consider the role of scientists in innovation

Questioning and predicting

- ❑ Demonstrate a sustained intellectual curiosity about a scientific topic or problem of personal, local, or global interest
- ❑ Make observations aimed at identifying their own questions, including increasingly abstract ones, about the natural world
- ❑ Formulate multiple hypotheses and predict multiple outcomes

Planning and conducting

- ❑ Collaboratively and individually plan, select, and use appropriate investigation methods, including field work and lab experiments, to collect reliable data (qualitative and quantitative)
- ❑ Assess risks and address ethical, cultural, and/or environmental issues associated with their proposed methods
- ❑ Use appropriate SI units and appropriate equipment, including digital technologies, to systematically and accurately collect and record data
- ❑ Apply the concepts of accuracy and precision to experimental procedures and data:
  - significant figures
  - uncertainty
  - scientific notation

Evaluating

- ❑ Evaluate their methods and experimental conditions, including identifying sources of error or uncertainty, confounding variables, and possible alternative explanations and conclusions
- ❑ Describe specific ways to improve their investigation methods and the quality of their data
- ❑ Evaluate the validity and limitations of a model or analogy in relation to the phenomenon modelled
- ❑ Demonstrate an awareness of assumptions, question information given, and identify bias in their own work and in primary and secondary sources
- ❑ Consider the changes in knowledge over time as tools and technologies have developed
- ❑ Connect scientific explorations to careers in science
- ❑ Exercise a healthy, informed skepticism and use scientific knowledge and findings to form their own investigations to evaluate claims in primary and secondary sources
- ❑ Consider social, ethical, and environmental implications of the findings from their own and others' investigations
- ❑ Critically analyze the validity of information in primary and secondary sources and evaluate the approaches used to solve problems
- ❑ Assess risks in the context of personal safety and social responsibility

Processing and analyzing data and information

- ❑ Experience and interpret the local environment
- ❑ Apply First Peoples perspectives and knowledge, other ways of knowing, and local knowledge as sources of information
- ❑ Seek and analyze patterns, trends, and connections in data, including describing relationships between variables, performing calculations, and identifying inconsistencies
- ❑ Construct, analyze, and interpret graphs, models, and/or diagrams
- ❑ Use knowledge of scientific concepts to draw conclusions that are consistent with evidence
- ❑ Analyze cause-and-effect relationships

Communicating

- ❑ Formulate physical or mental theoretical models to describe a phenomenon
- ❑ Communicate scientific ideas and information, and perhaps a suggested course of action, for a specific purpose and audience, constructing evidence-based arguments and using appropriate scientific language, conventions, and representations
- ❑ Express and reflect on a variety of experiences, perspectives, and worldviews through **place**

BC Science Physics Curricular Competencies Planning Chart

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Unit Planning for Physics 11: Kinematics - Projectile Motion

The following pages outline an example for creating a mini-unit on Projectile Motion that will last four to six classes. As the students are novice learners with this concept, time and care will be needed to align their current understandings of gravity and motion. Using the chart on page 10, I'm ensuring that I've addresses relevant core competencies of communication and critical thinking. I will use future lessons to address other core competencies. I then identify the content learning standards I will cover and how they align to the appropriate Big Idea.

Next, I need to consider what Curricular Competencies I will focus on. You will notice that I've created a graphic organizer to frame the Curricular Competencies. This graphic organizer serves two functions. It shows the 'interconnectedness' of the different categories of Curricular Competencies. And it reminds me that I don't teach all the Curriculum Competencies all the time. Rather I will focus on specific areas so that during the whole course I can provide students with learning opportunities to address all the Competencies. For this lesson, the highlighted Curricular Competencies will be the focus. Since it's early in the course, I will focus on Planning and Conducting and Communicating competencies. As the course progresses, I will move my focus to other aspects of Inquiry.

The general flow of the lesson will follow the Explore - Develop - Apply instructional model built directly into the BC Science Physics 11 resource. Each of three phases has a specific learning purpose. The Explore phase provides opportunities for the students to activate prior knowledge, become motivated and focus on the ideas to be investigated. The Develop phase provides opportunities to develop a deeper understanding of key concepts and experience hands-on activities to support conceptual understanding. Finally, the Apply phase provides for opportunities to have the student demonstrate their understanding and extend their learnings into areas that are of interest to them. Below is a suggest outline of activities needed to address the highlighted competencies.

Explore

- Project Motion Warm Up activity

Develop

- Class discussion and notes on the Parabolic Nature of projectile motion including assigned word problems
- Projectile Motion Lab including PhET simulation - focus on conclusion writing with CER framework
- Video on Falling Objects

Apply

- Calculate initial speed of Foam Arrow task

BC Science Physics 11

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