Adult Basic Education

Science

Physics 1104

Motion

Curriculum Guide

Prerequisite: Grade 9 Mathematics (or equivalent)

Credit Value: 1

Physics Concentration

Physics 1104
Physics 2104A
Physics 2104B
Physics 2104C
Physics 3104A
Physics 3104B
Physics 3104C

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To the Instructor

I. Introduction to Physics 1104

This course introduces students to concepts related to motion. Starting with the familiar concept of speed, students increase their understanding of motion in Physics through the use of graphs and problem solving. The concepts introduced here are fundamental for all Physics courses. You will find further elaborations for teaching and assessment strategies in the Science 1206 Curriculum Guide from the Department of Education.

Students taking this course need to know how to solve for unknowns, draw scale diagrams and use a scientific calculator. If students don't have these prerequisite skills, the skills will have to be taught as students need them in the course.

II. Curriculum Guides

Each new ABE Science course has a Curriculum Guide for the instructor and a Study Guide for the student. The Curriculum Guide includes the specific curriculum outcomes for the course. Suggestions for teaching, learning, and assessment are provided to support student achievement of the outcomes. Each course is divided into units. Each unit comprises a **two-page layout of four columns** as illustrated in the figure below. In some cases the four-column spread continues to the next two-page layout.

Curriculum Guide Organization:
The Two-Page, Four-Column Spread

Unit Number - Unit Title	
Outcomes Specific curriculum outcomes for the unit.	**Notes for Teaching and Learning** Suggested activities, elaboration of outcomes, and background information.

Unit Number - Unit Title	
Suggestions for Assessment Suggestions for assessing students' achievement of outcomes.	**Resources** Authorized and recommended resources that address outcomes.

III. Study Guides

The Study Guide provides the student with the name of the text(s) required for the course and specifies the sections and pages that the student will need to refer to in order to complete the required work for the course. It guides the student through the course by assigning relevant reading and providing questions and/or assigning questions from the text or some other resource. Sometimes it also provides important points for students to note. (See the *To the Student* section of the Study Guide for a more detailed explanation of the use of the Study Guides.) The Study Guides are designed to give students some degree of independence in their work. Instructors should note, however, that there is much material in the Curriculum Guides in the *Notes for Teaching and Learning* and *Suggestions for Assessment* columns that is not included in the Study Guide and instructors will need to review this information and decide how to include it.

IV. Resources

Essential Resources

Science 10
Nelson Science 10 Teacher's Resource for Unit 3 - Motion

Recommended Resources

Science 1206: Motion Curriculum Guide:
http://www.ed.gov.nl.ca/edu/sp/sh/sci/sci1206/unit4.PDF

Nelson Publishing Web Site: *http://www.science.nelson.com*

Computerized Assessment Bank for Nelson Science 10, Nelson.

Other Resources

Center for Distance Learning and Innovation: http://www.cdli.ca/

Physics tutorials on the web: http://www.physicsclassroom.com/Default2.html

Great physics links:

http://www.sciencejoywagon.com/physicszone/phylinks.htm

Physics Central: http://www.physicscentral.com/

Physics Note-A-Rific:
http://www.studyphysics.ca/index_files/Page618.htm

V. Recommended Evaluation

Written Notes	10%
Labs/Assignments	20%
Test(s)	20%
Final Exam *(entire course)*	50%
	100%

The overall pass mark for the course is 50%.

Motion

Unit 1 - Investigating Speed

Outcomes

1.1 Analyze measurements to determine their uncertainty

- 1.1.1 Identify the number of significant figures in a measurement.
- 1.1.2 Identify exact numbers.
- 1.1.3 Use significant figures in calculations.
- 1.1.4 Round measurements to the correct number of significant digits.
- 1.1.5 Rearrange equations with three variables.
- 1.1.6 State the SI units for length and time.
- 1.1.7 Convert between units of measurements using conversion factors.

Notes for Teaching and Learning

You may choose to have the student complete the Activity on page 341 of the text before starting the unit.

An excellent resource is the *Teacher's Resource: Motion* for Motion. Pages 16 - 20 cover the material for this section.

Students should be encouraged to correctly use their calculators. Scientific calculators and scientific notation should be emphasized.

Students will need to be comfortable in manipulating variables and rearranging equations. The mathematics instructor might be invited to be involved in this first part of the unit.

This text uses conversion factors for converting units. This method causes many students problems, but it is used extensively in this text and also in the Physics and Chemistry texts in Level 2 and 3. This method of converting is also known as the unit-factor method or dimensional analysis. There are many web resources available for drill in this area as it is a common problem area for students.

As the text does not provide any solutions, it will be necessary to provide students with answers to numerical questions so they can work independently.

Unit 1 - Investigating Speed

Suggestions for Assessment

Students should complete the problems on page 349. You may want to provide students with the numerical answers to the questions, so they can work independently. Answers to these questions are provided on page 20 of the *Teacher's Resource: Motion*.

Activities
Students can complete the activity on page 341. In addition to giving them the opportunity to measure and record, this can also be used as a introduction to significant figures.

Resources

Science 10: pages 344 - 349; 689; 702 - 704

Teacher's Resource: Motion: pages 3 - 20

www.cdli.ca: Science 1206: Unit 4: Section 01: Lessons 01 and 02

Unit 1 - Investigating Speed

Outcomes

1.2 Analyze the differences between distance, time and speed.

1.2.1 Define average speed, instantaneous speed and uniform motion.

1.2.2 Solve problems using the formula for average speed.

Notes for Teaching and Learning

One problem students will encounter here is with the difficulty in understanding how equations represent relationships and how equations can be rearranged to determine what is unknown.

Stress that students should write down their givens first before attempting to solve problems. Also stress that units must be the same before mathematical operations can be performed. That is if speed is in km/h and distance is in meters, then the distance must be converted to km **or** the speed to m/h before proceeding to solve.

Unit 1 - Investigating Speed

Suggestions for Assessment

Question 11 is a higher level problem which may be assigned for evaluation.

Blackline Masters 9.5 (a), 9.5(b), and 9.5 (d) can be used for extra problem solving. The answers to these Blackline Masters are found on 9.5 (c) and 9.5 (e).

Resources

Science 10: pages 354 - 359

Blackline Masters 9 (a) - (e)

Science 10:: *Teacher's Resource: Motion*: pages 27 - 33.

www.cdli.ca: Science 1206: Unit 4: Section 01: Lessons 01 and 02

Unit 1 - Investigating Speed

Outcomes

1.3 Construct and analyze distance versus time graphs.

1.3.1 Plot graphs of distance versus time for motion.

1.3.2 Calculate the slope of a line using the formula:

slope = rise / run

or

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1}$$

1.3.3 Calculate the speed of an object using distance versus time plots.

Notes for Teaching and Learning

Students are going to need graph paper for this and several subsequent sections of this course. Many students have problems setting up the scale of the x and y axes - either not making each block of equal value or choosing a scale that will either not fit data or have data very cramped.

Before a student starts to work through this section of the text, you may want to sit down with Blackline Master 9.7 (a) on page 3-248 and discuss the graphs, slopes and how to set up a graph on graph paper.

If your students have graphing calculators available, you may choose to use Blackline Master 9.7 (b) and teach them how to graph and obtain information from the calculator.

You will find extra material including problems are available through the Center for Distance Learning and Innovation: Science 1206, Unit 4, Section 1, Lesson 1.

Information for the Case Study is suggested in the *Teacher's Resource: Motion*.

Note: Chapter Review Questions are suggested at the end of Unit 2 in the Study Guide.

The Appendix in the Science 1206 Curriculum Guide offers several alternative methods for the lab.

For the Core lab which is Investigation 9.10, the *Teacher's Resource: Motion* from Nelson provides some guidelines for the lab. Alternative methods for doing this lab are available through the Center for Distance Learning and Innovation: Science 1206, Unit 4, Lesson 1, Lab #1.

Unit 1 - Investigating Speed

Suggestions for Assessment

Monitoring their graphs and solutions to their written work in Section 9.7 is essential.

Students are expected to complete and pass in for evaluation purposes Case Study 9.8 and Investigation 9.10.

Investigation 9.10 is a Core Lab and should be completed and assessed for the final mark.

Resources

Science 10: pages 362 - 365; 366 - 368; 372 - 373

Blackline Masters 9.7 (a) - (e)

Science 10: Teacher's Resource: Motion: pages 37 - 52

www.cdli.ca: Science 1206: Unit 4: Section 01

Physics 1206: Curriculum Guide: pages 122 - 139.

Unit 2 - Investigating Acceleration

Outcomes

2.1 Analyze motion in terms of speed and acceleration.

2.1.1 Define acceleration, constant acceleration and average acceleration.

2.1.2 Solve for speed, time or acceleration using the formula $a_{av} = \Delta v/\Delta t$

2.1.3 Solve for average speed using the formula $\Delta v = v_2 - v_1$

2.1.4 Solve for initial, final speed or acceleration using the formula $a_{av} = \frac{v_2 - v_1}{\Delta t}$

Notes for Teaching and Learning

You may want to copy and review with students the Blackline Masters 10.3(b) and 10.3(c).

Some information on graphs is available on page 100 of the Science 1206 Curriculum Guide.

Suggestions for Assessment

Check students notes to ensure they are working through the problems correctly. You may choose to ask students to submit question 15 on page 389 for grading purposes.

Additional problems for evaluation are available on Blackline Master 10.3 (d).

Resources

Science 10: pages 384 - 389

Blackline Master 10.3(d)

Teacher's Resource: Motion: pages 70 - 75

Science 1206: Curriculum Guide: pages 100 and 101

Unit 2 - Investigating Acceleration

Outcomes

2.2 Analyze speed versus time graphs.

2.2.1 Determine acceleration using slope of the line from a speed versus time graph.

2.2.2 Determine the distance traveled during a time interval from the area under the line for a speed versus time graph.

Notes for Teaching and Learning

In question 2.10, the graphs students are asked to sketch are **not** the same as in the book. This requires them to think a little more about shapes of the graphs and not just write what is in the text.

You may want to review Blackline Masters 10.4 (a) and (b) with the student when the student starts this section or provide them as additional examples.

Unit 2 - Investigating Acceleration

Suggestions for Assessment

You may ask students to submit question 11 for grading.

You may ask students to submit Case Study 10.6 for evaluation.

Resources

Science 10: pages 390 - 393

Blackline Masters 10 (a) and (b)

Teacher's Resource: Motion pages 76 - 81

Unit 2 - Investigating Acceleration

Outcomes

2.2.3 Differentiate between instantaneous speed and constant speed.

2.2.4 Draw tangents to points on curved lines and determine their slope.

2.2.5 Use distance versus time graphs to determine the instantaneous speed for a given time.

2.2.6 Determine average speed for an accelerating object.

Notes for Teaching and Learning

The student may need to be supplied with graph paper. Also many students may not be familiar with the concept of drawing tangents to curves and using that line to get a slope. You may have to provide them with several plots for practice. You may choose to make these plots without units to give them practice before they apply the concept to motion. The Teachers's Resource recommends using direct squared relationships for plotting. Below you'll find a suggested set of data that you could use:

X	$Y = X^2$
0	0
5	25
10	100
15	225
20	400

Unit 2 - Investigating Acceleration

Suggestions for Assessment

You might choose to ask the students to answer the Challenge - Question #3 on page 401.

You may want to create your own ticker tape and ask students to use the information to determine the acceleration.

Resources

Science 10: pages 398 - 401

Blackline Masters: 10.8 and 10.9(a)

Teacher's Resource: Motion: pages 89 - 93

Unit 2 - Investigating Acceleration

Outcomes

2.2.7 Draw tangents to points on curved lines and determine their slope.

2.2.8 Use distance versus time graphs to determine the instantaneous speed for a given time.

2.2.9 Determine average speed for an accelerating object.

Notes for Teaching and Learning

Section 10.8 will be a challenge for most students as the concept of where the data is coming from will be very difficult for them to visualize.

Blackline Masters 10.8 and 10.9 can be provided to the students to work through so they can obtain the results in Table 1 on page 403 of the text.

One area of confusion will be that the units for speed and time graphed are different from those measured and you may have to review with them converting from ms (milliseconds) to s (seconds) and mm (millimeters) to m (meters).

If you have access to the provinces Center for Distance Learning and Innovation site, Physics Tutorial section on ticker tapes might be a good resource for this section: http://www.physicsclassroom.com/Class/1DKin/U1L2b.html

This is found under Tutorial resource of the Unit 4 of Science 1206 - The Physics Classroom (Lesson 2 - Ticker Tape Diagrams).

Unit 2 - Investigating Acceleration

Suggestions for Assessment

At this point the students should be given their first quiz on Chapter 9 and 10.

Test questions should include the following:

- A description of motion for graphs of d-t and v-t.
- Calculations of speed, time and distance using both formulas and graphs.
- Calculations of acceleration, time and speed using formulas and graphs.
- Calculations of instantaneous speed for constant and continuously accelerating objects.
- A question or two on making the connection e.g fuel economy and driving or cell phone usage and driving or ATVs.

You may choose to complete Investigation 10.9. Guidelines are available in the Teacher Resource for this. It is not a Core Lab.

Resources

Nelson supplies a Computerized Test Bank which may be helpful in preparing these tests.

Blackline Masters 10.8 and 10.9

Unit 3 - Vectors

Outcomes

3.1 Demonstrate an understanding of vector and scalar quantities.

3.1.1 Differentiate between vector and scalar quantities.

3.1.2 Give examples of vector and scalar quantities.

3.1.3 Define displacement.

3.1.4 Use the formula $\Delta \vec{d} = \vec{d}_2 - \vec{d}_1$ to determine the displacement of an object.

3.1.5 Express vector quantities as both symbols and vectors.

3.1.6 Add or subtract vectors to determine displacement

Notes for Teaching and Learning

The concept of vectors is not one most students are familiar with. Some may have experience using maps and you can draw on this.

You might want to draw from their experience with location in their community i.e the "east end" of a city or town or large buildings may have wings designated "south" "north" etc.

Point out that clearly identifying a position depends on the reference point. What is north for one could be south for the person sitting opposite.

Some students will have difficulty with the concept that going for a walk of 5 km and ending up in the same location means that while the distance traveled is 5 km, the displacement is zero.

Vector addition and subtraction is only done on a simple graphical scale to determine final displacement as in Question 7 (a) and (b) - (iii). This is so the difference between velocity and speed can be understood by students.

Suggestions for Assessment

Ask students to express vector quantities as symbols and vectors as illustrated in the text in Figure 5.

Resources

Science 10: pages 414 - 417

Teacher's Resource: Motion: pages 114 - 117

Blackline Master 11.1 (b)

www.cdli.ca: Science 1206: Unit 4: Section 01, Lesson 01

Unit 4 - Velocity and Acceleration

Outcomes

4.1 Demonstrate an understanding of velocity.

4.1.1 Define velocity, constant and average velocity.

4.1.2 Differentiate between speed and velocity.

4.1.3 Calculate velocity, displacement or time using the formula $\vec{v} = \frac{\Delta \vec{d}_R}{\Delta t}$

Notes for Teaching and Learning

Students are going to have a problem here as they will have difficulty recognizing the difference in calculations involving speed and those involving velocity. Many will question why they should bother to differentiate between the two concepts. The difference is well illustrated on the bottom of page 435. You may want to take students through this example very carefully with Blackline Master 11.7 (b).

Many of the problems in Section 11.7 involve solving for displacement with vector addition involving vectors at 90° angles to each other. Be careful not to assign these problems to students as they are not expected to solve displacements of this type. This material will be part of Physics 2104 A.

Unit 4 - Velocity and Acceleration

Suggestions for Assessment

Blackline Masters 11.7 (c) has problems that could be used for these outcomes.

Resources

Science 10: pages 432 - 436

Blackline Masters 11.7 (b) and (c)

www.cdli.ca: Science 1206: Unit 4: Section 02, Lesson 02

Teacher's Resource: Motion: pages 137 - 142

Unit 4 - Velocity and Acceleration

Outcomes

4.2 Demonstrate an understanding of velocity using graphs.

4.2.1 Draw position-time graphs from given data.

4.2.2 Calculate the velocity of an object from a position-time graph if the velocity is constant.

4.2.3 Calculate the instantaneous velocity of an object using the slope of a tangent for an object which is constantly accelerating.

Notes for Teaching and Learning

You may need to review finding slope of a line, particularly negative slopes. Many students automatically change their negative slopes to positive numbers as they think it is not correct.

You may want to use the Blackline Master 12.1 (b) to illustrate how to find constant velocity and instantaneous velocity.

Suggestions for Assessment

Blackline Master 12.1(c) could be used for extra assessment of position-time graphs.

Resources

Science 10: pages 446 - 451

Teacher's Resource: Motion pages 161 - 166

Unit 4 - Velocity and Acceleration

Outcomes

4.3 Demonstrate an understanding of acceleration using graphs.

4.3.1 Calculate one of velocity, acceleration or time using the formula: $\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$

4.3.2 Calculate the average velocity using either a graph or the equation $\vec{v}_{av} = \frac{\vec{v}_1 + \vec{v}_2}{2}$

4.3.3 Calculate the average velocity, from a graph of velocity versus time or the formula $\vec{v}_{av} = \frac{\Delta \vec{d}_R}{\Delta t}$

Calculate acceleration from a graph or the formula $\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$

Notes for Teaching and Learning

Students will only be determining the constant acceleration form the slope of linear (positive or negative) velocity-time graphs.

Remember that a negative vector acceleration indicates direction in this course **not** speeding up or slowing down.

Emphasize using units, including direction in all problem solving.

Further information for the Case Study is available in the *Teacher's Resource: Motion*.

Information for Investigation is also available in the *Teacher's Resource: Motion*.

Unit 4 - Velocity and Acceleration

Suggestions for Assessment

You may want to assign Blackline Master 12.2 (c) for evaluation when students have completed this section.

Student should submit the Case Study on Technology and Skiing.

Students should submit lab report for Core Lab #2; "Speeding Up and Slowing Down".

Resources

Science 10: pages 452 - 457; 458 - 459; 460 - 461

Teacher's Resource: Motion: pages 167 - 172; 173 - 175

www.cdli.ca: Science 1206: Unit 4: Section 02

Core Lab #2: Section 10, pages 460 - 461

Unit 4 - Velocity and Acceleration

Outcomes

4.4 Solve various types of problems involving acceleration.

4.4.1 Calculate one of the variables, acceleration, initial velocity, final velocity or time.

4.4.2 Use velocity time graphs.

4.4.3 Construct velocity time graphs for data.

4.4.4 Use velocity time graphs to determine the displacement of an object.

4.4.5 Calculate one of the variables displacement, initial velocity, final velocity or time using either a graph of velocity time or the equation

$$\Delta \vec{d} = \left(\frac{\vec{v}_1 + \vec{v}_2}{2} \right) \Delta t$$

Notes for Teaching and Learning

While this section of the text uses the formula $\Delta \vec{d} = \vec{v}_1 \Delta t + \frac{1}{2} \vec{a} (\Delta t)^2$, students are not responsible for this. Students are expected to complete the outcomes indicated to your left, but not derive or use the above equation.

Blackline Masters 12.6 (a) and (b) can be used to assist students in their understanding of the sample problems.

Unit 4 - Velocity and Acceleration

Suggestions for Assessment	Resources
Blackline Master 12.6 (e) can be given to students to use for solving Problem 4 on page 472.	*Science 10:* pages 462 - 465
Additional Exercises are available on Blackline Master 12.6(f).	*Teacher's Resource: Motion:* pages 179 - 183
A final evaluation is needed at this point. Again the Nelson Computerized Test Bank should be used. Because Unit 3 was not evaluated by testing before, the material from this unit should make up at least 50% of this evaluation.	Blackline Masters 12.6(a) - (g)