# Adult Basic Education (ABE)

## Level III Mathematics

# Mathematics 2102A

# Surface Area/Drawing and Design/Volume and Capacity Curriculum Guide

**Student Resource:** *Math at Work 11. McGraw-Hill Ryerson. 2012. ISBN 13:978-1-25-901237-2*

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| **Level III General College Profile Mathematics (General)** |
| Mathematics 1102A: Consumerism and Travel/Measuring Length/Measuring Area |
| Mathematics 1102B: Getting Paid/Angles |
| Mathematics 1102C: Pythagorean Relationship/Trigonometry |
| **Mathematics 2102A: Surface Area/Drawing and Design/Volume and Capacity** |
| Mathematics 2102B: Interpreting Graphs/Banking and Budgeting |
| Mathematics 2102C: Slope/Right Triangles and Trigonometry |
| Mathematics 3102A: Measurement and Probability/Data/Linear Relationships |
| Mathematics 3102B: Real-Life Decisions/Properties of Figures |
| Mathematics 3102C: Transformations/Trigonometry |

Newfoundland Labrador

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# General Information

### *Introduction*

**Mathematics 2102A** when completed with **Mathematics 2102B and C** is equivalent to the Newfoundland and Labrador senior high school **Mathematics 2202 (Applied**) course.

### *Pre-requisite*

Students must have completed **Mathematics 1102C**.

### *Resources*

The student resource for this course is*:*

- *Math at Work 11. McGraw-Hill Ryerson. 2012. ISBN 13:978-1-25-901237-2*

The instructor resources for this course are:

- *Math at Work 11 Teacher's Resource. McGraw-Hill Ryerson. 2012. ISBN 13:978-1-25-901239-6*
- *The Online Teacher's Resource Centre*
- *Math at Work 11 Teacher's Resource CD-ROM*

Instructors may also supplement with other resources at their discretion.

### *Study Guide*

The Study Guide provides the student with Required Work for the course. It guides the student through the course by assigning relevant reading and exercises from the student resource. Sometimes the Study Guide provides important points for students to think about, to remember or to note. The Study Guide is designed to give students some degree of independence in their work. There is information in the Curriculum Guide applicable to teaching, learning and assessment that is not included in the Study Guide. Instructors should review this information and decide how to use it when teaching students.

Instructors can also exercise professional judgment and make minor alterations to the Required Work in the Study Guide. For example, an instructor may decide that it is unnecessary to assign students all the exercises to complete within each lesson.

### *Curriculum Guide*

The Curriculum Guide includes the specific curriculum outcomes and achievement indicators for the course. The specific curriculum outcomes are listed numerically, and the achievement indicators are listed alphabetically. Suggestions for teaching, learning and assessment are also provided to support student achievement of the outcomes. Some of these suggestions will also be repeated in the curriculum guides for other mathematics courses as appropriate. The curriculum guide also states the pre-requisite for each Level III mathematics course.

# Mathematics 2102A Outcomes/Achievement Outcomes

***Unit 1: Surface Area***

1. Solve problems that involve SI and imperial units in surface area measurements and verify the solutions.
    a) Explain, using examples including nets, the relationship between area and surface area.
    b) Explain how a referent can be used to estimate surface area.
    c) Estimate the surface area of a 3-D object.
2. Solve problems that require the manipulation and application of formulas related to:
        i. volume and capacity
        **ii. surface area**
        iii. slope and rate of change
        iv. simple interest
        v. finance charges
    a) Solve a problem that involves determining the surface area of 3-D objects, including pyramids and spheres.
    b) Solve a contextual problem involving the application of a formula that does not require manipulation.
    c) Solve a contextual problem that involves the surface area of 3-D objects and that requires the manipulation of formulas.
    d) Solve a contextual problem involving the application of a formula that requires manipulation.
    e) Illustrate, using examples, the effects of dimensional changes on surface area.
3. Solve problems by applying proportional reasoning and unit analysis.
    a) Explain the process of unit analysis used to solve a problem.
    b) Explain, using an example, how unit analysis and proportional reasoning are related.
    c) Solve a problem using unit analysis.
    d) Solve a problem within and between systems, using proportions or tables.

***Unit 2: Drawing and Design***

1. Solve problems that involve scale.
    a) Determine contexts in which a scale representation is used.
    b) Determine, using proportional reasoning, the dimension of an object from a given scale drawing or model.
    c) Construct a model of a 3-D object, given the scale.
    d) Draw, with and without technology, a scale diagram of a given object.
    e) Solve a contextual problem that involves scales.
2. Model and draw 3-D objects and their views,
    a) Draw a 2-D representation of a given 3-D object.
    b) Draw to scale top, front and side views of a given 3-D object.
    c) Construct a model of a 3-D object, given the top, front and their side views.
    d) Draw a 3-D object, given the top, front and side views.
    e) Determine if given views of a 3-D object represent a given object, and explain the reasoning.
    f) Draw, using isometric dot paper, a given 3-D object.
    g) Draw a one-point perspective view of a given 3-D object.
    h) Identify the point of perspective of a given one-point perspective drawing of a 3-D object.
3. Draw and describe exploded views, component parts and scale diagrams of simple 3-D objects.
    a) Draw the components of a given exploded diagram, and explain their relationship to the original 3-D object.
    b) Sketch an exploded view of a 3-D object to represent the components.
    c) Draw to scale the components of a 3-D object.
    d) Sketch a 2-D representation of a 3-D object, given its exploded view.

***Unit 3: Volume and Capacity***

1. Solve problems that involve SI and imperial units in volume and capacity measurements.
    a) Explain, using examples, the difference between volume and capacity.
    b) Identify and compare referents for volume and capacity measurements in SI and imperial units.
    c) Identify a situation where a given SI or imperial volume unit would be used.
    d) Estimate the volume or capacity of a 3-D object or container, using a referent.
2. Solve problems by applying proportional reasoning and unit analysis.
    a) Write a given volume measurement expressed in one SI unit cubed in another SI unit cubed.
    b) Write a given volume measurement expressed in one imperial unit cubed in another imperial unit cubed.
    c) Write a given capacity expressed in one unit as another unit in the same measurement system.
    d) Solve a problem, using unit analysis.
    e) Determine the volume of prisms, cones, cylinders, pyramids, spheres and composite 3-D objects, using a variety of measuring tools such as rulers, tape measures, calipers, micrometers, and displacements.
    f) Determine the capacity of prisms, cones, cylinders, pyramids, spheres and composite 3-D objects, using a variety of measuring tools and methods such as graduated cylinders, measuring cups, and measuring spoons.
    g) Illustrate, using examples, the effects of dimensional changes on volume.
    h) Describe the relationship between the volumes of:
        i. cones and cylinders with the same base and heights.
        ii. pyramids and prisms with the same base and height.
3. Solve problems that require the manipulation and application of formulas related to:

i. **volume and capacity**
ii. slope and rate of change
iii. simple interest
iv. finance charges

a) Solve a contextual problem that involves the volume of a 3-D object, including composite 3-D objects, or the capacity of a container.
b) Solve a contextual problem involving the application of a formula that does not require manipulation.
c) Solve a contextual problem involving the application of a formula that requires manipulation.
d) Describe, using examples, how a given formula is used in a trade or an occupation.
e) Create and solve a contextual problem that involves a formula.
f) Identify and correct errors in a solution to a problem that involves a formula.

## *Recommended Evaluation*

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| Written Notes (Including all the Required Work) | 10% |
| Assignments | 30% |
| Tests/Quizzes | 60% |
| **Total** | **100%** |

Instructors have the discretion to make minor changes to this evaluation scheme.

# Unit 1: Surface Area—Suggestions for Teaching and Learning

- Instructors may need to review unit conversions with students.
- Instructors should note that this unit will cover the surface areas of rectangular prisms, triangular prisms, cylinders and cones.
- Instructors should also use referents, net diagrams and formulae to estimate and calculate the surface area of pyramids and spheres.
- Instructors should ensure that students can work with referents in both SI and imperial units.
- Instructors should allow students the opportunity to explore with nets in order to generalize formulas and using symbolic representations to calculate surface area.
- Ensure that students are able to recognize the difference between the height of a right pyramid and its slant height. The height refers to the perpendicular height from the apex to the base, and slant height is the altitude of the triangular face.
- Students should be aware of practical applications of surface area such as siding for a new house, paint required to cover walls and ceiling, and shingles for a roof.
- Students should also understand how to find a missing measurement when given the surface area.
- Discuss with students how increasing/decreasing the dimension(s) of an object changes the surface area.
- Ensure students understand that sometimes in problems it is necessary to convert given measurements into common units.
- Ensure students understand that sometimes they will have to use the Pythagorean Theorem to determine the slant height for use in the surface area formula.
- Ensure students know how to alter the surface area formula for a cone with no top.
- Discuss with students that the surface area of a sphere is the area of four circles.
- Discuss the effect of changing the dimensions on the surface area of a sphere.

# Unit 1: Surface Area—Suggestions for Assessment

- Instructors can use the BLM's on the CD-ROM to further reinforce the unit concepts.
- The BLM's on the CD-ROM can be useful for developing unit tests and the final exam.
- Instructors have discretion to combine the last unit test with the final exam if beneficial to the student.
- Students must pass the final exam with a minimum grade of 50% to receive credit for this course.
- Instructors should encourage students to reflect on the math concepts in this unit to relate to everyday life.
- Instructors should engage students in discussions to verbalize student thinking on the math concepts.
- Instructors should require students to always show complete calculations with correct units when relevant.
- Instructors can use their own professional judgment to design assessment tools (additional exercises, word problems, assignments, reflections, math journals, etc.) to meet individual student needs.

# Unit 2: Drawing and Design—Suggestions for Teaching and Learning

- Ensure students are familiar with examples of real-world applications of scale concepts such as maps, sewing patterns, car models, and construction blueprints.
- Review proportional reasoning with students.
- Ensure students are able to determine the dimensions of a reduced or enlarged object. Emphasize the importance of setting up and solving proportions in doing these types of problems.
- Discuss with students the importance of units in scale diagrams. Students should understand that it may be required to convert different units in both the metric and imperial systems.
- Discuss with students where approximation might provide sufficient information and when a scale diagram might be needed.
- Discuss with students that furniture assembly is an excellent example of a real-world situation where 2-D components are put together to form a 3-D object.
- Instructors can model how to draw a cube using isometric dot paper. After drawing a single cube, draw a series of cubes linked together, and then extend to more complex shapes using isometric dot paper.
- Discuss with students the difference between views and isometric drawings. An isometric drawing shows the structure in space, whereas a view shows it flat.
- Discuss with students the difference between a perspective drawing versus an isometric drawing. Although both look give a representation of a 3-D object, isometric drawings do not look as realistic.
- Discuss with students careers requiring the ability to read and interpret different types of diagrams.
- Discuss with students that an exploded diagram used in a parts diagram or manual would be a perspective drawing, whereas an isometric exploded diagram would be useful when constructing an object.

## Unit 2: Drawing and Design—Suggestions for Assessment

- Instructors can use the BLM's on the CD-ROM to further reinforce the unit concepts.
- The BLM's on the CD-ROM can be useful for developing unit tests and the final exam.
- Instructors have discretion to combine the last unit test with the final exam if beneficial to the student.
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# Unit 3: Volume and Capacity—Suggestions for Teaching and Learning

- Discuss with students the difference between volume and capacity. Volume is the measure of space an object occupies, and capacity is the amount a 3-D object can hold.
- Hollow objects have volume and capacity, but solid objects only have volume.
- Volume is measured in cubic units. Ensure students express all answers in proper cubic units.
- Students will use proportional reasoning as they solve problems with SI and imperial units, Ensure students verify their conversions.
- Ensure that students know and understand the volume formulae for cylinders, prisms, cones and pyramids.
- Ensure to conceptualize composite 3-D objects volume problems by discussing practical, real-life trades and occupational examples.
- Ensure that students are able to find and correct calculation errors. Some common errors are incorrect substitution of values for variables, incorrect re-arrangement of the formula in the order of operations,

# Unit 3: Volume and Capacity—Suggestions for Assessment

- Instructors can use the BLM's on the CD-ROM to further reinforce the unit concepts.
- The BLM's on the CD-ROM can be useful for developing unit tests and the final exam.
- Instructors have discretion to combine the last unit test with the final exam if beneficial to the student.
- Students must pass the final exam with a minimum grade of 50% to receive credit for this course.
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