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Writing Code to Calculate the Volumes of Prisms and Cylinders

So far, you've written code for applications that calculate the area of rectangles and circles.

These are two-dimensional shapes, which is why the areas are measured in square units, such as *square centimetres* (cm^2).

When you start to work with 3-D objects, such as prisms and cylinders, you can visualize creating an object by stacking copies of the base in layers that are each 1 unit tall until you reach the height.

A **layer** is repeated.

height
← length →
depth
area of the base
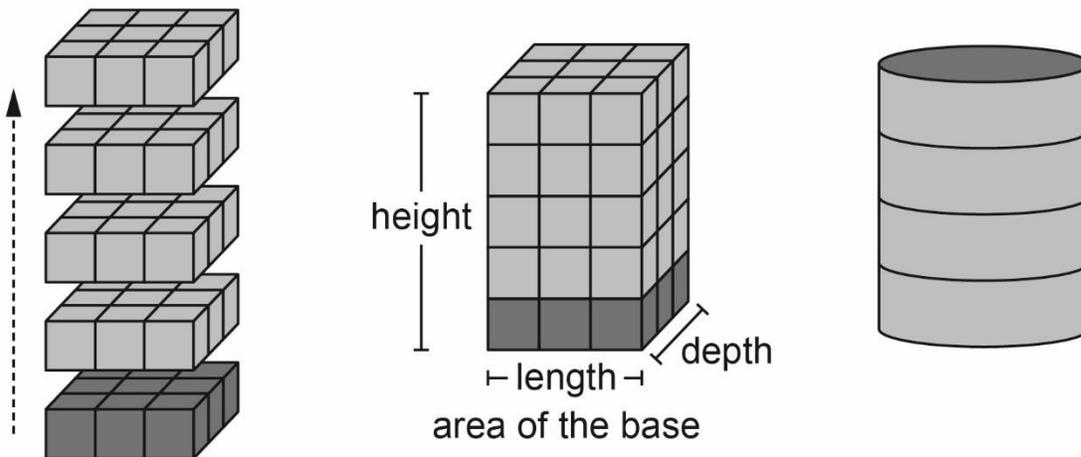
From the diagrams, you can see that the volume of each object is equal to the area of the base multiplied by the height.

$$\text{volume} = \text{base area} \times \text{height}$$

Because you are multiplying three dimensions (the base length, base width, and height), volumes are measured in cubic units, such as *cubic centimetres* (cm^3).

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**Writing Code to Calculate the
Volumes of Prisms and Cylinders** (cont'd)

Part 1: Calculating the Volume of a Rectangular Prism

When the base of a prism is a rectangle,
we call it a *rectangular prism*.
In code, the formula for the area of a
rectangular prism is:

volume = baseArea * height
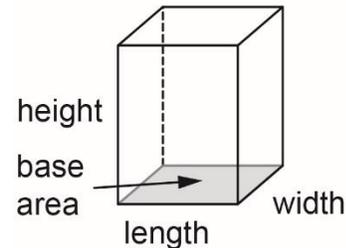
Here's a link to the application you created in Scratch that uses
subprograms to calculate the area of a rectangle.

https://scratch.mit.edu/projects/805451173/editor/

You will modify the application by adding a volume calculation.
Go to the link and alter the code, based on the pseudocode provided
on the following page.

The dimensions of the rectangle that the user enters now represent
the dimensions of the base of a rectangular prism. You will need to
add blocks to the **obtainInput** subprogram to ask the user to enter a
height as well.

Notice in the pseudocode, the variable called **area** in the rectangle
application is renamed **baseArea**.

To rename a variable, right click on the variable name under
Variables and select **Rename variable** and enter the new name.

Mathology 7, *Coding*
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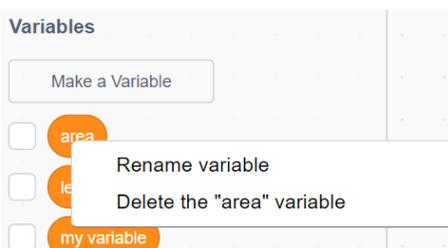
Writing Code to Calculate the Volumes of Prisms and Cylinders (cont'd)

Pseudocode: Calculating the Volume of a Rectangular Prism

Obtain Input Subprogram

```
subprogram obtainInput
    output "Enter the base length of the prism in
            centimetres:"
    length = user input
    output "Enter the base width of the prism in
            centimetres:"
    width = user input
    output "Enter the height of the prism in centimetres:"
    height = user input
```

Calculate Base Area Subprogram

```
subprogram calculateArea
    baseArea = length * width
```

Calculate Volume Subprogram

```
subprogram calculateVolume
    volume = baseArea * height
```

Output Info Subprogram

```
subprogram outputInfo
    output "The base area is  ", baseArea, " square
            centimetres."
    output "The volume is ", volume, " cubic
            centimetres."
```

Main Program

```
output "I'll calculate the volume of your rectangular
        prism."
run obtainInput subprogram
run calculateArea subprogram
run calculateVolume subprogram
run outputInfo subprogram
```

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Writing Code to Calculate the Volumes of Prisms and Cylinders (cont'd)

Your main program should look like this when completed:
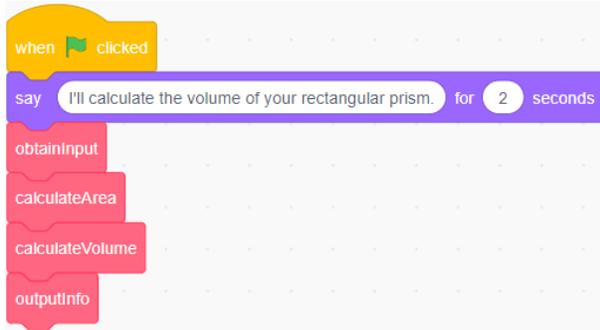
1. Try out your application by using it to determine the volume of a rectangular prism with each set of dimensions.
   The first one can be calculated mentally and serves as a way to check whether your code is correct.
   a) length: 10 cm, width: 10 cm, height: 10 cm
   b) length: 25 cm, width: 17 cm, height: 8 cm
   c) length: 125 cm, width: 64 cm, height: 32 cm

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Writing Code to Calculate the Volumes of Prisms and Cylinders (cont'd)

Part 2: Calculating the Volume of a Cylinder

Here is an image of the completed Scratch code for an application to calculate the volume of a cylinder:
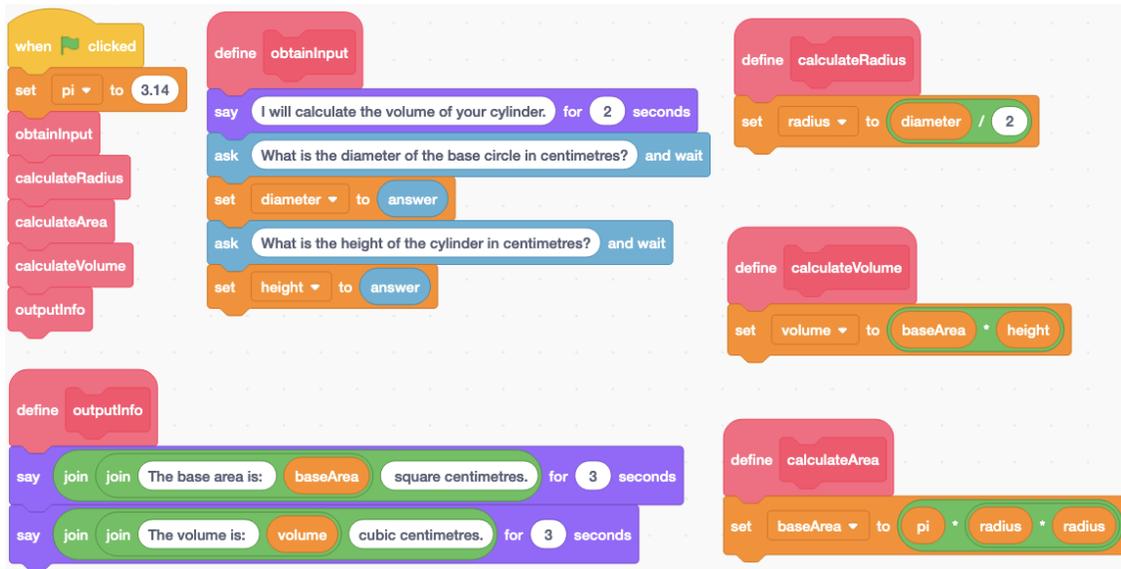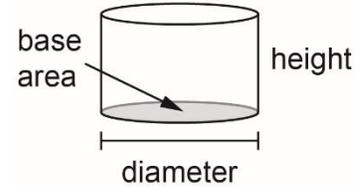
1. Pseudocode for this application is provided here and on the next page but some parts are missing.
   Fill in the blanks to complete the missing parts.

Obtain Input Subprogram

```
subprogram obtainInput
    output "What is the diameter of the base circle in
    centimetres?"
    diameter = user input
    output "What is the height of the cylinder in
    centimetres?"
    height = user input
```

Calculate Radius Subprogram

```
subprogram calculateRadius
    radius = diameter/2
```

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Writing Code to Calculate the Volumes of Prisms and Cylinders (cont'd)

Calculate Base Area Subprogram

```
subprogram calculateArea
    baseArea = pi * radius * radius
```

Calculate Volume Subprogram

```
subprogram calculateVolume


    _____
```

Output Info Subprogram

```
subprogram outputInfo
    output "The area is  ", baseArea, " square
            centimetres."
    output "_____"
```

Main Program

```
pi = 3.14
output "I'll calculate the volume of your cylinder."
run _____ subprogram
run _____ subprogram
run _____ subprogram
run _____ subprogram
run _____ subprogram
```

2. Here is a link to the completed application for calculating the volume of a cylinder in Scratch.

   https://scratch.mit.edu/projects/805563755/editor/

   Use the application to determine the volume of a cylinder with each set of dimensions.
   a) diameter: 20 cm, height: 10 cm
   b) diameter: 34 cm, height: 50 cm
   c) diameter: 120 cm, height: 88 cm

Writing Code to Calculate the Volumes of Prisms and Cylinders (cont'd)

Additional Challenge

Write code for an application to calculate the volume of a triangular prism.

You might find it helpful to begin by writing pseudocode.

As you plan your code, think about what information you need to determine the area of the base triangle.