π day at SNOLAB

Educator Resource

Background

SNOLAB is Canada's deep underground research laboratory, located in Vale's Creighton mine near Sudbury, Ontario, Canada. At 2km underground, SNOLAB is the deepest cleanest lab in the world. It provides an ideal low background environment for the study of extremely rare physical interactions. SNOLAB's science program focuses on astroparticle physics, specifically neutrino and dark matter studies, though its unique location is also well-suited to biology and geology experiments. SNOLAB facilitates world-class research, trains highly qualified personnel, and inspires the next generation of scientists.

This resource

This worksheet allows students to explore finding the volumes associated with one of the dark matter experiments located at SNOLAB, called DEAP-3600. This activity is well suited to **Grade 7 and Grade 8** students according to the Ontario Curriculum.

Grade 7

- Spatial Sense - Measurement
  - E2.2 solve problems involving perimeter, area, and volume that require converting from one metric unit of measurement to another
  - E2.7 show that the volume of a prism or cylinder can be determined by multiplying the area of its base by its height, and apply this relationship to find the area of the base, volume, and height of prisms and cylinders when given two of the three measurements

Grade 8

- Spatial Sense - Measurement
  - E2.3 solve problems involving the perimeter, circumference, area, volume, and surface area of composite two-dimensional shapes and three-dimensional objects, using appropriate formulas

Additional Resources

Looking for more about SNOLAB? Visit the Outreach page on our website or reach out to our team: outreach@snolab.ca

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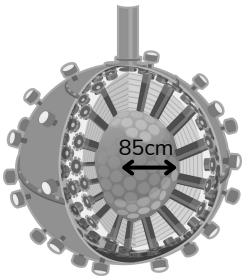
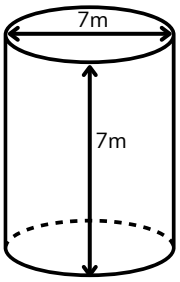
Question Sheet

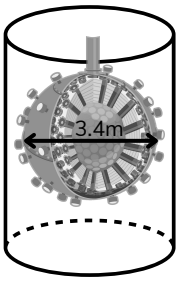
Several of the experiments deep underground at SNOLAB are spherical in shape. Using a sphere makes the experiment symmetrical which can help with data analysis. One spherical experiment at SNOLAB is the DEAP-3600 dark matter experiment. The DEAP-3600 experiment is filled with something called argon, which would interact with dark matter passing through the experiment. To determine how much argon is needed for the experiment, what is the volume of the experiment inner sphere if it has a radius of 85cm? Give the answer in cubic metres.



In order to shield the experiment more, it is placed in a large cylindrical tank that is filled with very clean water, called ultra-pure water. What is the volume of the tank that is 7 meters tall and has a 7-meter diameter?



When it is built, the experiment stainless steel shell takes up some of the volume of the cylinder. To calculate the accurate volume of water needed we can subtract the volume of the outer spherical shell, diameter 3.4m, from the cylinder volume. So, what is the volume of water needed?



Amazing! Now that we know the volume of water needed the project planner can ensure that the required amount of ultra-pure water is available!

Volume of a sphere: $V = \frac{4}{3} \pi r^3$	Volume of a cylinder: $V = \pi r^2 h$

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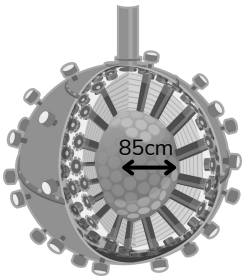
Answer Key

Several of the experiments deep underground at SNOLAB are spherical in shape. Using a sphere makes the experiment symmetrical which can help with data analysis. One spherical experiment at SNOLAB is the DEAP-3600 dark matter experiment. The DEAP-3600 experiment is filled with something called argon, which would interact with dark matter passing through the experiment. To determine how much argon is needed for the experiment, what is the volume of the experiment inner sphere if it has a radius of 85cm. Give the answer in cubic metres.

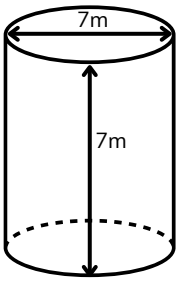


Formula: $V = \frac{4}{3}\pi r^3$

$V = \frac{4}{3}\pi(0.85)^3$

$\boxed{V = 2.57m^3}$

In order to shield the experiment more, it is placed in a large cylindrical tank that is filled with very clean water, called ultra-pure water. What is the volume of the tank that is 7 meters tall and has a 7-meter diameter?

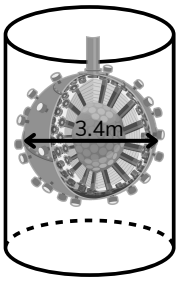


Formula: $V = \pi r^2 h$

$V = \pi(3.5)^2(7)$

$\boxed{V = 269.4\ m^3}$

When it is built, the experiment stainless steel shell takes up some of the volume of the cylinder. To calculate the accurate volume of water needed we can subtract the volume of the outer spherical shell, diameter 3.4m, from the cylinder volume. So, what is the volume of water needed?



Formula: V = Volume of Cylinder - Volume of Sphere

$V = 269.4 - \frac{4}{3}\pi r^3$

$V = 269.4 - \frac{4}{3}\pi(1.7)^3$

$V = 269.4 - 20.6$

$\boxed{V = 248.8\ m^3}$

Amazing! Now that we know the volume of water needed the project planner can ensure that the required amount of ultra-pure water is available!

Volume of a sphere: $V = \frac{4}{3}\pi r^3$	Volume of a cylinder: $V = \pi r^2 h$