Create a Cavern – Student Activity

What created these interesting flat topped "hills" in Kalgoorlie? Please explain your answer.

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Does the volume of the rock piled at the surface represent the amount of empty space mined out below? Please explain your answer.

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Removing rock to form a cavity causes stress to the walls of adits, drives, shafts and stopes. Broken wall and roof rock is usually supported by pit props, weld mesh, concrete and bolts to guard against collapse.

The hanging wall (angled roof) of the open stope created by gold mining at Hannan's Mine near Kalgoorlie is supported by pit props. The old props had to be replaced by fresh new ones when the mine was re-opened for tourists.

Rock and even unconsolidated soil and sand can support small cavities without collapsing.

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<u>AIM</u> **To find if wet sand can maintain a cavity without collapsing.**

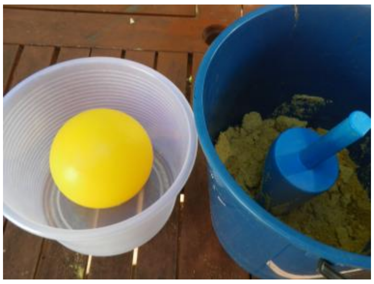
Students are asked to do a trial run before designing a proper experiment to see if the proximity of an earthquake will affect the ability of sand/soil to maintain a cavern.

Materials per group

- A large beaker (over 1000mL) bucket or container (See below for alternatives)
- Clean damp sand or soil
- 3 balloons
- A long skewer

Method

1. Inflate the balloons and tie them off. They should have different diameters but be small enough to fit easily inside your container with at least 3cm of sand piled on top.
2. Place a little sand on the bottom of the container, place the balloon on top and fill with sand until the balloon is covered with at least 3cm sand.
3. Tamp down the sand firmly.
4. Insert the skewer to deflate the balloon.
5. Observe and report what happens



Why did the sand not collapse when the balloon was punctured? ____________________________

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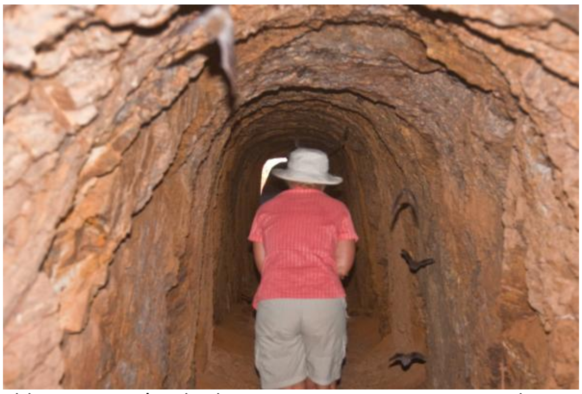
Add more sand/soil until the cavern lid collapses.



Miners and architects learned from Nature that burrows with rounded roofs remained stronger longer than those with flat roofs and that arched roofs permitted wider cavities below. The compressional pressure is diverted from the roof to the walls. The deeper the mine the greater this pressure from overburden becomes.

A gold prospector's adit driven into greenstones near Yalgoo. Note escaping resident micro-bats .

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Scientists often run a trial version of an experiment before they collect data. Why would they do this?

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Extension - Adjust, adapt, improve

Redesign this experiment to make it a "fair test".

What is your hypothesis? ____

What is the dependent variable? ____

What is the independent variable ____

Which variables have been controlled? ___________________________________

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How did you ensure your measurements were accurate? _____________________

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How did you ensure your measurements were precise? ______________________

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What data did you collect? ____

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What conclusions can you draw from the data? ____________________________

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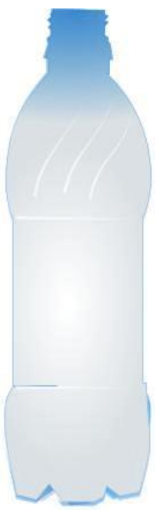
Further extension - Pressure increases with depth.

Method

- Take an empty cool drink container and make three holes in a vertical line down its side.
- Fill a measuring jug or another empty bottle with water.
- Go outside onto a grassed or concrete area.
- With the holes on the side of the bottle pointing away from your body, rapidly fill the bottle with water.
- Observe the waterspouts and draw your observations on the bottle provided (right)



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Discussion

How can you tell that pressure increases with depth in this experiment?

Is there any other data you could collect that would support the hypothesis that the lowest spout was under greatest pressure?

Interesting fact

The ***Pascal*** (Pa) is named after the French philosopher and scientist Blaise Pascal. It is a measurement of force per unit area. One Pa is the pressure one newton exerts on one square meter.
Standard atmospheric pressure at the surface of the earth is 101325 Pa.
A megapascal MPa is 1,000,000Pa.
Pressure at the foot of a 3km mine can be 80Mpa (9x greater than at surface)
Pressure at the foot of a 4km mine can be 110MPa (108.6x greater than at surface)

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