

Tunnels



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There is a large network of train tunnels under New York City called subways.

What Are Tunnels?

Early in history, Romans built tunnels to carry water. They built tunnels to carry away waste. Tunnels still provide these services. They're also built for **transportation**. They carry heavy things over great distances. Trains and cars increased the need for tunnels. Tunnels were also built for **mining**. Engineers study how to dig tunnels. They design bigger, better tunnels.



A tunnel opening is called a portal.

Tunnels are tubes. They're **passageways**. They're built through land. They're built underwater. They're built through mountains. Engineers study the ground. They study materials. They study how to carve out tunnels. They use tools. They study **forces**. They study how to support **load**. They make sure tunnels are stable and safe.



Think!

Think about the dangers of building tunnels. What are the dangers? How was it more dangerous in the past? How is it safer today?



Soft ground tunnels are used for subways and water.

How Do Soft Ground Tunnels Work?

Soft ground tunnels are built through soil. They're weak at the openings. Soil falls apart. This could collapse in tunnels. So, engineers use **shields**. These shields are steel tubes. They're placed at the opening. They push into soil. Forces travel from the ground. They push on the tunnels' sides. Shields stop tunnels from falling down. They hold back soil.



Tunnel linings are made of iron or concrete.

Workers clear out the area. They add a **lining**. Then, they move the shields. They work on the next section.

Like all tunnels, soft ground tunnels are **arches**. Their arches go all the way around. **Pressure** pushes on all sides of tunnels. Arches provide the best support. Load squeezes forces together. It moves down. It spreads out. Arches adjust for future load changes.



Rock tunnels, like this one in Fraser Canyon, British Columbia, Canada, are used as railways or roadways.

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