

GEO THERMAL DRILLERS SAVE PLANET EARTH



DRILLING ENGINEER

Drilling for Geothermal Energy!

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WELCOME MAGMA DRILLERS!

Welcome to the magma drillers game! During this game you will learn to interpret scientific data to make a decision about where and how you should drill in magmatically active areas.

You will also learn what behaviour is expected of scientists, and you will be asked to sign a code of conduct.

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SCIENTIST CODE OF CONDUCT

Based on the NASA Astronaut Code of Professional Responsibility

COMPETENCE | NGANA “MĀ TE HINGA, KA TUTUKI”

There is uncertainty involved with new scientific endeavours, so try your best to be prepared for your role. Failure is part of the design cycle on the pathway to success.

TEAMWORK | MANI TAHI “MAHIA TE MAHI KO HOROTAI TE WHIWHI”

Scientific endeavours are the result of collaboration and the end result reflects the strength of the team.

INTEGRITY | NGĀKAU PONO

As responsible scientists, it is important that you seek to support your ideas with evidence and look for evidence supporting others' explanations. Be open to critique of your ideas.

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RELATIONSHIPS | WHAKAWHANAUNGATANGA

Science is hard work, so be open to new learning, trust each other. Be aware of how your words and actions affect other people.

PERSONAL BEHAVIOUR | TINO RANGATIRATANGA

Accept personal responsibility for your behaviour. Be respectful and supportive of your team members and others during this mission.

STEWARDSHIP | KAITIAKITANGA

Resources are precious –as a responsible citizen it is important that you use resources wisely and take steps to reduce your impact on local communities, and protect the important natural features of our planet.

Name: _____ **Signature:** _____

Date: _____

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Your role: Drilling Engineer

Drilling engineers make important decisions regarding the way drillholes are designed, such as deviating the drillhole, how to protect the drillhole from collapsing, and choosing the right drill



bit. This means that their job is paramount to not only the safety of everybody working on site, but also ultimately to the success of a drilling project.

The drilling engineer will use knowledge of rock strength and fractures in the rock to assess the stability of the rock that is being drilled into. They use this information to decide how deep to drill a section of a drillhole before lining the hole with steel and cement, known as the casing. Drillhole stability is important as the drillhole might collapse, trapping your equipment downhole. An even bigger hazard is the possibility of a blowout due to overpressured gases at depth- if the hole is not properly lined, then you might get an explosion at the surface!

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Mission 1: Renewable Energy

It is the year 1974, the Beatles have broken up, the world is running out of energy resources and excuses to party and, new innovative groups of people were developing amazing ideas like Rap music, Star wars and geothermal power.

You are part of a hand-picked team of heroes with puffy hair, moustaches and glitter where it doesn't belong put together to try to save the world's energy problems through guardianship of our resources. In remote Northern Iceland, an area where heated water from deep in the earth reaches the surface, Icelanders are trying to follow in the footsteps of the brave New Zealand and Italian pioneers to harness Earth's natural heat to make energy.

In order to complete this mission, you will have to watch both the introduction video and the drilling engineer video.

In this mission, you will be asked to collaborate with other scientists in order to extract renewable energy out of the ground. Your job, as an engineer, will be to use the knowledge you have gained to help

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decide on the depth of the casing, in order to prevent hole collapse and blowouts.

The casing design and the information on the following pages will help you answer the ensuing questions. Once you are confident about your answers to those questions, you will be able to report back to your team and help make a final decision on where and how to drill.

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Rock properties

Some types of rocks are prone to collapsing if left unsupported for too long. It is important to get casing down the hole and secure it in place with cement.

In geothermal areas, minerals in rock can change to clay quite frequently, due to the presence of acidic and hot water. As rock alters to clay, the rock becomes weaker. If clay is present in the hole, it is important to line it with an appropriate casing.

Question 1 – Rock properties

What type of rock is prone to collapse?

- A. Volcanic rocks
- B. Volcanic rocks with hot neutral fluids
- C. Clay with hot acidic fluids
- D. None of the above

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Casing provides safety

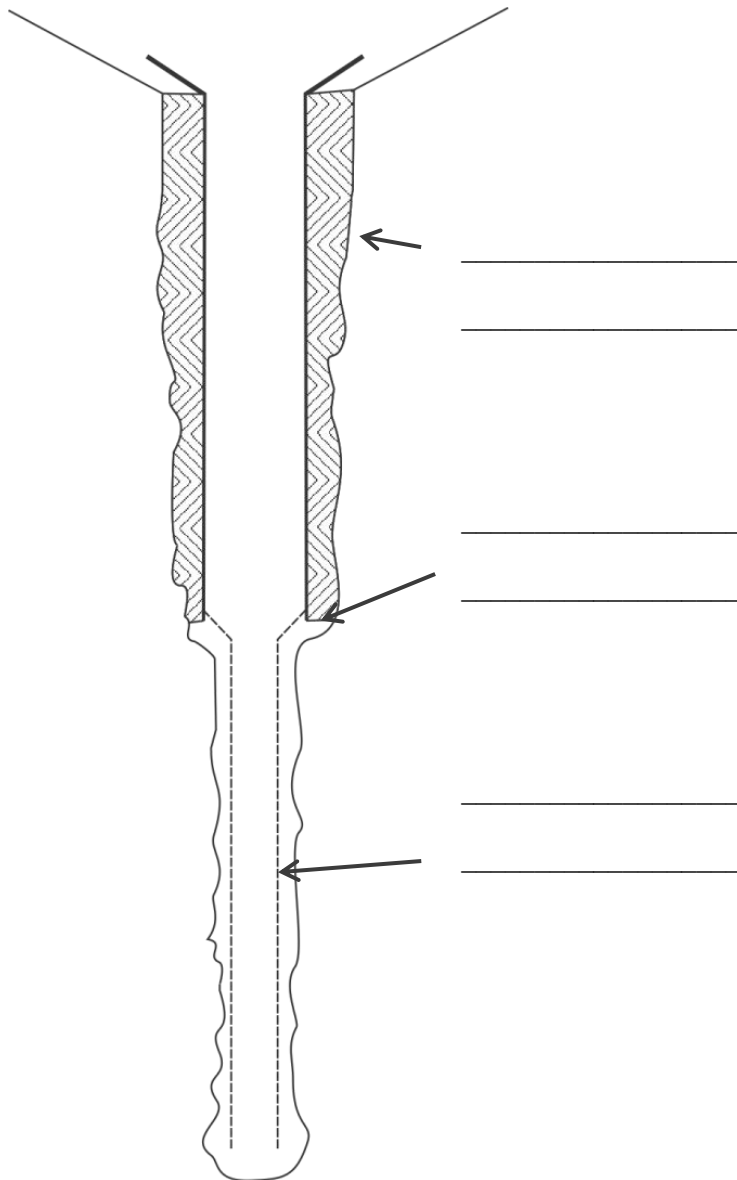
As an engineer, your first priority should be to ensure that the well design is safe as it is drilled for everybody and everything involved. Safety measures should be included in your design. In geothermal areas, your main concern is uncontrolled pressure blowouts, resulting from a sudden increase in the water pressure the well. Luckily, the steel casing that is used to line geothermal wells is very effective at containing well pressure. You should carefully consider the possibility of sudden changes in pressure when deciding what depth to case the well.

Question 2 – Casing design

Commonly how deep are geothermal wells and what types of casing do they use for what parts? Label the diagram of a drillhole on the next page, and put approximate depth you expect a borehole to be.

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Schematic diagram of a drillhole with casing.



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Question 3

What could happen if you drill too deep before setting the casing?

Question 4

What 2 factors determine the depth at which the steel casing and concrete are set at?

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Well done. Stop here and consult with your team
before moving on!

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Drilling Plan Evaluation

Take a moment to think about how your first mission went. What did your team do well when making your drilling plan?

What is one thing your team could do better when planning together for the next mission?

Did everyone feel that they contributed to the final plan?

- 1 2 3 4 5

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**CURIOUS
MINDS** 
HE HIHIRI I TE MAHARA



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