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Do We Really Need the Moon?

By Unknown

There are many moons in the solar system, but none like ours.
It exerts an extraordinary influence on Planet Earth,
keeping our world in balance.
But why is it so powerful?
I want to explore the relationship we have with our closest neighbour,
to see how the Moon has sculpted our planet and shaped our evolution.
Without the Moon, would we even be here?
'I'm Maggie Aderin-Pocock.
'I'm a space scientist and a lunar fanatic.
'I've always been mad about the Moon,
'convinced it plays a huge role in our lives.'
But I've always taken for granted that it is where it is
in the night sky, a quarter of a million miles away.
In this film I'm taking nothing for granted.
I'm going to find out what would happen if the Moon wasn't where it is now.
What if the Moon was in a different position,
closer or further away?
How different would our world be?
The Moon is a ball of rock out in space,
but it has the power to create great tides here on Earth.
This is Loch Etive on the west coast of Scotland.
Twice a day, the Moon drags 66 million tonnes of sea water through this loch.
The result, white water rapids.
The head of the loch is like a bottleneck.
Water is funnelled through a very narrow channel.
And for an hour or two, this becomes one of the wildest, wettest rides in the world.
These are the Falls of Lora.
That's what the locals call them.
In Gaelic, "Lora" means "noisy"
because as the tidal waters rush out of the loch, it gets very, very loud!
Kayakers come from all across the world to take the challenge of these waters.
But they have to paddle like mad just to keep up.
Even our outboard engine is struggling with the flow.
This is what the power of the Moon looks like up close.
My love affair with the Moon began as a child.
I wish I was a spaceman
The fastest guy alive...
I was born in 1968, in the age of Apollo.
I took my first steps as Neil Armstrong took his giant leap.
Of course I was too young to know what was going on.
But the images became seared in my mind.

From an early age, I wanted to go to the Moon.
At school I struggled because I'm dyslexic.
But then I discovered science, and something clicked.
I wanted to become a scientist.
And sure enough, today I build satellites.
It's a mix of engineering and physics and I love it.
But now that I'm a space scientist, hardly anyone is talking about the Moon any more.
It used to be the new frontier,
our future.
Now it's seen as quaint, old-fashioned, irrelevant.
I think that's wrong,
completely wrong.
I'm still mad about the Moon,
not just because I want to be an astronaut and go there one day.
No.
I'm mad about the Moon because the more I find out about it,
the more extraordinary it seems.
The way its presence can conjure up this torrent of water,
and these waves.
And how does it do this?
With the help of gravity.
Gravity is a great universal force of attraction.
It keeps us firmly in our place on Earth
and keeps the Moon in orbit around us.
But while the Earth is attracting the Moon,
the Moon is also attracting the Earth,
pulling at our oceans.
So I have a set of scales, a metal block and a powerful little magnet.
You see, the force of gravity is very similar to magnetism.
They're both forces of attraction.
If I put the metal block on the scales,
you can see it weighs 1.3 kg.
When I put the magnet in and nudge it closer,
the block appears to weigh less.
You can see the needle moving.
That's because the magnet is attracting the metal towards it,
pulling it upwards, off the scales.
And that's what the Moon's doing.
It's pulling on the oceans, moving them upwards, away from the surface of the Earth.
The gravitational force of the Moon causes the oceans to bulge slightly.
And as the Earth spins,
this bulging produces high and low tides.

The size of the tides
depends on the distance between the Earth and the Moon.
The laws of physics are very clear about this.
The closer two things are, the more they attract each other,
the greater the gravitational force.
So we get the tides we do because the Moon is where it is, nearly a quarter of a million miles away.
But what if the Moon were closer?
If the Moon were a just a little closer than it is today
the tidal bulge would grow.
Low tides would be lower,
high tides would be higher.
And any low-lying coastline would be flooded.
But what if the Moon were much closer?
Five times, 10 times, 20 times closer than it is today.
How would that affect the tides and life here on Earth?
Another rush hour in London.
But this evening, as the sun sets,
a huge Moon rises,...
..20 times closer than normal.
This super-sized Moon exerts a super-sized gravitational force,...
..400 times stronger than we're used to.
And it creates a mighty tidal bulge.
Sea water pours across the British Isles,
London is flooded.
Hours later, the same tidal bulge hits the east coast of America.
And the story is the same.
It's New York's turn to disappear underwater.
A city submerged,...
..and all the work of the Moon.
Eventually, of course, the tide subsides.
And the waters retreat.
This scenario may seem rather far-fetched, like the plot of some disaster movie.
But something similar has happened.
Once upon a time, when the Moon was newly formed,
it really was so close, and it really was so powerful.
Let me take you back to the earliest days of our planet,
At this time, the Earth had no Moon,
it was orbiting the Sun alone
and it was being assaulted by rocks and comets.
Today, there are no scars left from this cosmic pinball.
But to get a sense of the damage that was done,
I've come to the Arizona Desert,...

..to a great hole in the ground.
This is a beautiful crater,
a near perfect circle a mile in diameter.
It was formed when a meteorite crashed into the Earth a mere 50,000 years ago.
That's nothing on the timescale we're talking about,
but it's amazing how much damage that one passing rock can cause.
The early Earth was bombarded with rocks. It must have been mayhem.
And then along came something much, much bigger.
Another planet the size of Mars, drifted into the path of Earth.
It was on a collision course.
It hit the young Earth with a glancing blow.
Imagine the power released by such a collision.
The impact sent a mass of liquid rock into orbit.
This debris coalesced into a ball.
And the Moon was formed,
just 14,000 miles away from the early Earth.
This was the closest point it could have been.
Any closer, and gravity would have pulled the debris crashing back to Earth,
and our moon wouldn't exist.
Today the Moon is just a rock reflecting the sun's light,
but back then it was a molten sphere, burning brightly.
It must have looked amazing, an enormous orange disc in the sky.
Imagine the scene.
The first moonrise over the early Earth.
Our world was no longer alone.
It had a huge, powerful neighbour.
And ever since, this has been a very different type of planet.
The collision that created the Moon reset the basic chemistry of Earth.
And Earth Mk II was a place on which life could begin.
The collision released huge quantities of metal from the Earth's core,
one particular metal that would help change the atmosphere of our planet.
I'm talking about iron.
Iron is incredibly reactive.
Leave some out in the garden and it will rust.
It also combines with other chemicals to release gases
such as methane, carbon monoxide and hydrogen.
Today we see these gases as toxic and rather unpleasant.
But in the early Earth this was the very stuff of life.
In the 1950s, American chemist Stanley Miller did a classic experiment.
He took a cocktail of these gases and tried to simulate conditions on the early Earth,
adding electricity to mimic the power of lightning.

And what emerged, to everyone's surprise, was a flask of slime,
which turned out to be full of amino acids.
Like iron, amino acids are essential for life.
They are the raw material from which proteins are made.
And this great chemist was able to produce them using gases that were available on the early Earth.
The collision that formed the Moon helped set the scene for life to begin.
But there was still a way to go.
Life didn't start immediately after the collision.
It took up to 700 million years for the first living cells to emerge.
During this time, the Earth was cooling down.
It formed a rocky surface, water vapour condensed to form oceans.
And these oceans were being tugged by the Moon.
They were becoming tidal.
According to the latest theory from one leading chemist,
these early tides may have been the trigger
that kick-started life into action.
This seems like a very odd place to do some chemistry.
- Why are we here?
- On the beach?
To investigate the effect of tides on chemistry taking place on the very early Earth, billions of years ago.
'Professor John Sutherland believes the ebb and flow of the tides
'may have played a crucial role in the origin of life.
'And he's going to show me how it could have happened.
We have to do some chemistry here.
'He's mixing up the sort of basic chemicals found in the first oceans and adding water.
'He's reproducing a tidal pool in his flask.'
And that's your starting tidal pool at high tide.
Then the tide goes out, the sun shines on the pool and starts drying it out.
And rather than wait for that to happen here, because that would take a long time, I'm going to speed it up by using a burner here.
So what are we trying to mimic?
We're trying to mimic here the,...
the power of the Moon in chemistry on Earth.
So the Moon is responsible for the tides, the tides are filling these ponds up and then, when the tide goes down, the sun shines, dries it up.
It's an inexorable process of wetting and drying and warming
and that is driven by the Moon.
Having created a soup of chemicals, washed and dried them, there's still one thing missing.
I'm going to now transfer this into

this other reaction vessel.
He exposes the chemicals to a blue lamp
that radiates ultraviolet energy
simulating the sun's light shining on the early Earth.
And as a result, he's changing the very structure of the chemicals,...
..creating, as if from nothing, elements of RNA, ribonucleic acid,
an essential component of all living cells.
So we are, in this setup, making some of the building blocks of life?
Yes! Just from simple tidal conditions and simple organic chemistry.
- But it's all driven by the Moon?
- It's ultimately all driven by the Moon.
Life on Earth driven by the Moon.
life probably began in what he called a "warm little pond".
At the time, it was mere speculation.
But now we think he might be right.
These tidal pools represent Darwin's warm little ponds.
Primordial chemistry labs where the raw materials of life can come together.
And all beautifully orchestrated by the tidal power of the Moon.
Once the first creatures had emerged in the oceans 3.8 billion years ago, evolution was in full flow.
And ever since, the Moon has continued watching over us,...
..casting a protective veil.
When I was a teenager, I wanted a telescope so badly,
mainly to look at the Moon, but I couldn't afford a decent one,
so at the age of 14, I went to an evening class and I learnt to make my own.
Now my telescope worked on a similar principle to this one, using a mirror to reflect the light.
It took months to grind and polish those mirrors, but it was so worth it.
I remember the first night when I pointed the telescope up at the Moon and I could see the craters in amazing detail.
And the first thing you notice is you're always looking at the same craters.
This is because the Moon spins very slowly, one rotation every 29 days, and that's exactly the same speed as the Moon orbits the Earth.
So as the Moon travels around us, it's always showing us the same face.
So we never see the far side, or the so-called dark side of the Moon.
If we could, we'd see that it's riddled with craters.
In fact, we now know there are more craters on the far side of the Moon than the nearside
which is bit of a relief
because each of them was formed by an asteroid impact
that could otherwise have crashed into Earth

and stopped life in its tracks.
The Moon, which helped start life, may also have preserved it.
Our guardian angel.
This idea, that the Moon looks after us, is ancient.
and placed them in a great circle.
They didn't have metal tools,
let alone cranes.
It was a remarkable thing to do.
It's been suggested that they were building a sort of observatory
to mark a rare lunar event.
Every 18.5 years, the Moon drops in the sky for a couple of weeks, and barely makes it above the horizon.
It's known as a lunar standstill and it last happened in 2006, and it won't happen again until 2024.
Bizarrely, the people who built Callanish
probably knew about the lunar standstill
and they aligned their stones to witness it.
From this angle you can see the Moon rise above those hills over there and drop between those stones.
It must look spectacular.
To line up the stones accurately,
they could only check their position every 18.5 years,
at the next lunar standstill.
It seems incredibly complex, so why do it?
Across the ancient world, people revered the Moon
and made up stories about the mysterious power of this disc in the night sky.
Some stories have survived the test of time.
Think of the classic werewolf movie.
MAN SHOUTS, CREATURE GROWLS
It's all about the strange, terrible magic of the Moon.
Even today, it is often said that the full Moon casts a spell over us.
I see a bad moon rising...
It sends us a bit crazy.
It's Friday night and I'm out with the police.
It's always a busy time with people partying in clubs and bars.
But tonight is also a full Moon.
Does that make any difference?
Over the years, there have been many studies.
Some claim to show a link between the crime rate and a full Moon.
They suggest that people become wilder and more violent when the Moon is full.
It's called the Transylvania Effect.
One police force in the south of England

was so convinced, they put extra officers on the beat at a full Moon,
just in case.
But is it true? Does the Moon really change our behaviour?
Well, sadly, I don't think so.
For every study claiming an effect, there are many more dismissing it.
The theory probably stems from the fact that when the Moon is full, the sky is much, much brighter.
In the past, before electric lights, people were more likely to go out on a bright night,
so there was more chance for trouble.
These days, alcohol is surely a far more important factor
than the light of a full Moon.
But even if the Transylvania Effect is a bit of a myth,
the Moon is still very powerful.
There are many animals which react instinctively to the light of the full Moon.
They become more active, more vocal,
more fertile.
Most remarkable of all are these tropical corals.
Every year they synchronise their reproductive cycle,
so on one night they all spawn together.
And for these corals, it's triggered by the full Moon.
The Sargasso Sea, off the coast of Bermuda.
Marine biologist Dr Anne Cohen is studying how the Moon affects the growth of corals.
She's looking for a species known as Diploria strigosa,
the brain coral.
Every 29 days, on a full Moon,
brain corals grow a new layer of skeleton on top of the old.
This growth spurt is dictated by the monthly orbit of the Moon.
It's like clockwork.
And the skeletal layers can be used as a lunar calendar,...
..a record of time passing.
So, this is the coral that we pulled out of the water today.
And if we look under the microscope,
you can see very fine ridges
and we know that these are formed on the lunar cycle, these are monthly bands.
- So it's a bit like the rings of a tree, you can use that to date it.
- That's right.
And we can count about 65 monthly bands in this coral,
which makes it just over five years old.
That's pretty amazing!
'But some corals are even more revealing.

'They allow us to peer into the distant past
'and find out something extraordinary about the power of the Moon.
'This is a fossil coral from the Devonian era.
'It's 400 million years old
'but still beautifully preserved.
'As well as monthly growth bands, there are annual bands
'and even daily bands, a quarter of a millimetre apart.'
So this coral grew about a quarter of a millimetre every day 400 million years ago.
And if we took the time to count up all these daily growth bands,
within the year we'd find...
not 365 days
but in fact in this coral there are 400 bands every year.
- 400 bands?
- Per year.
- So that means that there were an extra 35 days every year?
- That's right.
That's quite mind-boggling.
'If there were really 400 days in the year back then, how long was each day?'
If you do the sums, and take the total number of hours in a year
and divide by 400 days, then you come to the conclusion
that in the Devonian period, when this fossil was alive,
a day actually lasted 21 hours and 55 minutes.
Now I must admit I find that really weird.
The fact that in the past, a day wasn't 24 hours.
The length of a day is simply the time it takes for the Earth to spin once and go from one sunrise to the next.
If, in the past, days were shorter,
then the Earth must have been spinning faster.
In fact, back in time, back billions of years,
the planet was spinning so fast
that each day lasted just five hours.
But why should the spin of the Earth have changed over time?
Because of the Moon.
When the Moon formed, it was so close to the Earth,
and pulling so hard that it acted as a brake on our planet.
The gravitational pull of the Moon was slowing the Earth's spin
and it's still doing so.
As the Earth spins,
the effect of friction between the ocean bulge and ocean floor
causes the Earth's spin to slow down.
It means days have been getting longer.
What was once was five hours now lasts 24.

We humans have been around for such a short time,
about 200,000 years,
that we've only ever known 24 hour days.
Our body clocks are completely geared for that length of day.
And yet, we only have 24-hour days because of the Moon.
It's amazing to think that the very rhythms of our planet
have been set by this ball of rock out in space.
But what about the Moon itself?
How has it been affected by the spin of the Earth?
One of the first things you learn in physics is that for every action
there is an equal and opposite reaction.
As the Earth has been slowing down all these years,
something else has been accelerating,
and that's the Moon.
And to compensate for its acceleration,
something's been happening to its orbit at the same time.
Imagine the centre of this roundabout is the Earth, and I'm the Moon in orbit.
As we speed up, I get slung outwards,
and I feel as if my body wants to move into a wider orbit.
And that, more or less,
is what's been happening to the Moon.
To balance out its acceleration, it's been spiralling outwards,
into a wider and wider orbit.
But is it still spiralling away?
Or has it stopped?
There's one way to find out.
Apache Point Observatory in New Mexico...
..one of America's largest telescopes.
It's also one of the last outposts of the Apollo programme.
Besides having a lot of fun on the Moon,
the Apollo astronauts were running a series of scientific experiments.
And on three of the missions they left behind retro-reflector units,
packed with small mirrors.
This one is from Apollo 15.
And ever since, astronomers have been firing lasers at them
to keep track of exactly how far away the Moon is.
So once we're all centred up on Apollo 15,
I can open the shutter and we're ready to shine the laser.
Dr Russet McMillan carries out the laser ranging at Apache Point.
So you're now sending pulses of laser-light out towards the Moon.
That's right, they're going to travel to the Moon,
get reflected, come back, and get detected by our detector.
So how much of the light do we actually get back?

Well, we're sending out about 100 quadrillion photons with each pulse.
If we're lucky, for each pulse we might get back one photon.
One photon back?
One photon out of 100 quadrillion going out.
A photon is a tiny particle of light and 100 quadrillion is...
a phenomenally large number!
But by capturing just a few photons,
it's possible to measure
the distance between the Earth and the Moon
down to the last millimetre.
As of right now, the distance to the Moon
is 393,499km,
precisely.
Astronomers have been using lasers to measure the Moon's distance for nearly 40 years now.
And what they're finding amongst all those photons is a very clear pattern.
The Moon, which has been drifting away from us for billions of years,
is still drifting,
at a speed of 3.78 cm a year.
In human terms,
that's about the same speed that our fingernails grow!
Does it matter that the Moon is drifting away from us?
Well, for one thing,
if it keeps going, we'll lose a great natural wonder.
One of the benefits of astronomy is you get to stay up very late.
And if you don't go to bed at all, you can catch the Moon setting
while the sun rises.
What an amazing sight.
There the rising sun, and opposite the setting Moon.
They both look exactly the same size,
but that's an optical illusion.
Let's take these two balls.
The golf ball is much smaller than the tennis ball
and you can tell that when they are side by side.
But if I move the golf ball towards you,
you can see it's getting bigger and at this point,
they look to be the same size.
Now, it's exactly the same with the Sun and the Moon.
The Moon is actually 400 times smaller than the Sun.
But it's also 400 times closer,
and so they appear to be the same size.
And that's what gives us the most mesmerising sight,
a total eclipse.
Because the Moon's disc is the same size as the Sun's,

they line up perfectly,
with just a halo of solar gases spilling out around the rim.
I always thought there must be some astronomical reason for this,
something in the physics to make it so.
But no, it's just a cosmic coincidence.
It happens because right now,
the Moon is just the right distance from Earth.
But in the future, as the Moon keeps drifting away,
its disc will be too small to cover the sun
and we'll lose the magic of the total eclipse.
And then what?
As the Moon moves away from us, how will life change here on Earth?
New York City.
The sun went down an hour ago,
and the Moon is rising.
It may look familiar enough
but this Moon is smaller than normal in the night sky.
That's because it's further away.
Not much, an extra 10%,
just 24,000 miles.
But that makes a big difference.
The spin of the Earth has slowed down
and days are getting longer.
The sun will not rise here for another 20 hours.
The entire Western hemisphere has to endure a very long night.
While on the other side of the world,
there's an extra-long day.
But things get worse.
If the Moon were to really move by that 10%,
then the very stability of the planet would be threatened.
You see, the Moon,
which controls our tides and the spin of the earth
serves another critical function.
It keeps us stable.
To understand why, meet hoop wizard Jack Ryan.
As Jack runs rings around me, look how he keeps that ball spinning.
- Jack, what's the secret?
- Speed.
You got to keep it fast, it's got to be going fast.
- Would you like to try?
- I'd love to. What do I do?
Just stay still. Let me see your finger.
There you go.
So the ball is just like planet Earth.

The faster it spins, the more stable it is.
- But what happens if it slows down?
- Let's see.
That's lots of wobble and, ooh, I lose control.
So that's just like the Earth -
when it's spinning very fast, it's very stable, but as it slows down,
it loses stability and starts to wobble like crazy.
Ever since the great collision that formed the Moon,
the Earth has been tilted,
spinning at 23 degrees.
This tilt has played a crucial role in shaping our climate.
If the Earth wasn't tilted, if it were upright,
then the sun's light would shine evenly over the surface throughout the year.
Always overhead at the equator,
and barely reaching the North and South poles.
The temperature would be constant throughout the year,
there'd be no summer or winter.
No variation at all.
But because of that 23 degrees tilt,
the light hitting the Earth's surface varies throughout the year.
It's this variety of light that's so important.
It means that throughout the year,
conditions on the planet are always changing.
In our summer, the light favours the northern hemisphere,
giving us warmer temperatures and longer days.
But six months later,
as the Earth travels to the other side of the sun,
the light now favours the southern hemisphere,
leaving us in the cold and dark with shorter days and longer nights.
In other words, we have seasons.
The life cycle of so many animals and plants
is driven by the beat of the seasons.
A burst of life in spring.
Balmy days of summer.
Migration in autumn.
A fight for survival in winter.
But the Earth only stays at this 23 degree tilt
because of the Moon's stabilising effect.
As the Moon keeps drifting away, the angle of the tilt will change.
And over time, the Earth will wobble.
And what will happen then?
It's possible we'll go the same way as Mars.
Mars - our planetary neighbour.

Today, it spins at an angle of 25 degrees,
very similar to Earth.
But it used to spin at a very different angle,
anything up 60 degrees.
You see, unlike Earth,
Mars has no large moon to keep it stable
so it wobbles chaotically.
It could almost tip over onto its side.
We may suffer the same fate if our Moon moved just that 10% further away.
It makes me wonder what would our world be like?
Probably very wet.
If the Earth tipped over and spun on its side,
then for three months of every year the poles would be exposed
to direct unrelenting sunshine.
Pretty quickly, the ice caps would melt.
And a huge amount of fresh water would flood the world's oceans.
Sea levels would rise by more than 60 metres.
Every coastal city in the world would be gone.
And inland areas that survived would be transformed.
Las Vegas is dark
and very cold.
It's minus 20.
Because the sun is pointing at Antarctica,
Vegas is in the grip of a freezing winter.
But in the spring, the snow melts,
the sun rises higher and higher in the sky.
Over the summer, the sun never sets.
In autumn, it's high in the sky.
And then it drops below the horizon again.
And the freezing winter returns.
Could we survive?
Probably, with enough air conditioning and artificial light.
But what of other life forms?
Dr Lynn Rothschild is an astro-biologist working for NASA.
Death Valley is the hottest place in North America.
And it turns out that as the Moon recedes from the Earth,
as it goes away,
there are going to be times that the Earth
tips over further on its side,
and what's going to happen then is that there are going to be
parts of the Earth that become excruciatingly hot in the summer,
much hotter than Death Valley is today.
And in the winter these same places are going to be bitterly cold,
much colder than your freezer.

There are organisms that can survive at reasonably low temperatures,
think of penguins and whales, and so on.
But high temperature is extremely tricky.
When you get up at about 70 degrees centigrade which is hot,
but it's nowhere near the boiling temperature of water, chlorophyll breaks down
so all the greenery you see around you would be gone.
So that means no photosynthesis?
Absolutely, so no photosynthesis, and that's what drives life on Earth today, photosynthesis.
Now, as you go up even beyond that,
your nucleic acids end up breaking and unravelling,
and this is your very genetic material.
So, clearly, you cannot survive without these.
There are some microbes with a very unusual genetic structure
which can live in deep-sea vents and geysers
at temperatures over 100 degrees.
But they can't cope anywhere cooler.
And that's the problem.
If the Earth tips over,
the seasonal shifts will be too fast and too extreme
for evolution to keep pace.
Even though there are a few organisms that can adapt to living in excruciatingly hot temperatures,
and there are plenty of organisms that can live in very cold temperatures, much colder than your freezer at home,
to have the same organism being able to shift between these extremes
during the course of a single year is nearly impossible.
And I suspect we're never going to evolve one that could do that.
Let us be clear,
we are in no immediate danger.
It will take at least a billion years
for the Moon to drift far enough away for the Earth to tip over.
So we have a little time to prepare.
But all this speculation makes me realise how lucky we are
the Moon is where it is right now.
A tiny shift and life on Earth could be so different.
And what about life beyond Earth?
Are we alone?
Or are there other planets with lifeforms similar to ours?
These radio telescopes are scanning the heavens, looking for any clues.
But where do we look?
Even our own galaxy has 100 billion stars
and each one of those stars has who knows how many planets in orbit.

I reckon, given what we now know about the Moon,
how it's influenced life here on Earth,
we should focus any future searches on planets with moons like ours.
There are many moons in the solar system
but they're not like ours.
The moons of Jupiter are too small and far away
to influence their planet.
The same is true for the moons of Saturn, Neptune and Uranus.
Only our moon is big enough and close enough to affect us,
but not so big to make life here unbearable.
It's not too big and it's not too small.
Like Goldilocks and the porridge, it's just right.
One day, I'm confident we'll find other planets with moons like ours.
But will we ever visit them?
Will we ever boldly go out into space?
If so, then the Moon has a big role to play.
So far, only 12 people have ever been there.
And they brought back a very precious cargo.
'That's 20 pounds of rock!'
'Oh, Tony, it's got some beautiful crystals in it!
'Good show.'
When geologists analysed these rocks, they learnt a great deal
about the composition of the Moon,
and the history of the solar system.
But they didn't find what they were looking for -
any sign of water.
The Moon, they declared, was bone dry.
But now, they're changing their minds.
The Moon rocks are stored in a clean room
at NASA's Johnson Space Centre in Houston.
Dr Gary Lofgren has the job of keeping them pristine,
as if they were still on the lunar surface.
So this is it, this is a piece of Moon rock?
Yes, this is a piece of lava from Apollo 17.
For me, this is a fantastic moment because I've always dreamed of
going to the Moon, and so to be this close to a piece of Moon rock,
this is brilliant.
This is spectacular. If you look, you can see all the shiny crystals
reflecting back at you.
They're all very fresh. That's one of the unique things about Moon rocks.
I was expecting it to be quite dull, but it looks so shiny.
Yeah, shiny it is, it's because there's no water there to alter and weather
the minerals.
- So no reactions?

- There's no reactions going on, that's right.
So that gave us the idea the Moon was very dry, very inert.
And we thought that for 40 years, but within the last few years,
we discovered that there is a lot of water on the Moon, in fact.
- It's water that's trapped. Because it's cold, it's frozen as ice.
- Yes.
Recently,
probes have analysed some of the darkest craters on the Moon,
at the lunar poles,
and have found that they're packed with ice -
frozen water that has come from comets crashing into the Moon over time.
It now seems there's at least 400 billion litres of water
in these craters.
Having water on the moon opens up a whole area of possibilities.
Oh, yes, it allows humans to survive.
We need water to drink and water to survive up there.
But just as importantly we can use that water
to make rocket fuel, because rocket fuel is gaseous hydrogen and oxygen,
and we can make that on the Moon.
The Saturn V rockets
used by Apollo
burnt 2,500 tonnes of rocket fuel to escape Earth's gravity
and get into space.
But if we could produce fuel from lunar water,
that would make all the difference.
It would be far more efficient to travel into deep space
by launching rockets from the Moon, not the Earth.
Perhaps, one day,
the Moon will become a springboard for exploring the solar system.
Spaceships will make the short hop from Earth and then re-fuel here
before setting off on the long journey ahead.
But if this seems a bit too futuristic,
then one man has more immediate plans for the Moon.
For 30 years, space scientist Dr David Criswell has had a dream -
to put thousands of solar panels on the Moon
and harness the energy of the Sun.
We can have solar panels on Earth, why take them to the Moon?
You want to take them to the Moon
because the sunlight on the Moon is absolutely predictable.
There's no air, there's no water, there's no mechanical vibrations,
so you don't have to build massive facilities like this.
On the Moon, you could replace these with solar arrays that are the
thickness of tissue paper.
The plan is to build thin solar panels along the rim of the Moon

so they get almost constant sunlight.
The electricity would then be transmitted back to Earth using microwaves.
He believes he can produce enough energy to meet global demand.
The Moon receives 13,000 terawatts of power,
solar power that's going to waste.
By going to the Moon, we can collect that power at the cheapest cost
and send it back here to Earth.
He's hoping to create an unlimited supply of energy
with the least environmental impact.
You see, the plan is to make everything on the Moon itself
from what's already there on the lunar surface.
When you look at the Moon, basically what you see is dust.
It's very, very finely ground-up rock and glass. You can make it into fibreglass,
you can make into containers, you can make into rods and tubes and all of that sort of stuff.
You make it sound so straightforward, so why aren't we doing it?
Well, you've got to be on the Moon, we've got to go back to the Moon.
Somehow we've lost the will to do this commitment,
going back to the Moon and making it a permanent stay, rather than just a short visit.
Now, this grand scheme would cost at least half a trillion dollars.
But that's less than oil companies spend every two years
getting oil and gas out of the ground.
There's nothing to stop us building solar-powered bases
on the Moon right now.
And I, for one, can't wait for the day.
For a few years during the age of Apollo,
we were all mad about the Moon.
It was fun,
it was exciting, and for me at least,
it was love at first sight.
But then, all too quickly, we lost interest in the Moon.
We moved on.
I think that was a mistake.
The Moon is far more important
and far more useful than we ever realised.
For billions of years, it's gazed down on us...
..shaping and changing
the course of life here on Earth.
In so many ways, the Moon has been the making of us.
Surely, it's time to re-think our relationship with the Moon,
to stop taking it for granted,
to fall in love again.

Do we really need the Moon?
Of course we do.