"The clean energy future isn't just possible and desirable – it's essential. On a vital, basic level, our decisions and actions will determine whether the Anthropocene will be an age in which human ingenuity and responsibility will allow 10 billion people to have access to modern forms of energy without compromising the vital life support systems of our planet."

***Achim Steiner,** UNEP*
Executive Director and Under-Secretary-General of the United Nations

Understanding Renewable Energy

Subject

Science & technology, Geography, Citizenship education, Social studies

Learning Outcomes

- To understand the framework of the Global Goals for Sustainable Development
- To understand what renewable energy is and how it compares to non-renewable energy
- To explore the advantages of renewable energy
- To develop innovative solutions for renewable energy

Preparation

- Read the notes to teachers about renewable energy in appendix 3
- Prepare a board to write students' suggestions
- Print or make available the case study included in appendix 4
- Prepare a template for students to use when developing an innovative renewable energy campaign geared towards convincing their school or community to switch to renewable energy sources

60 mins

11-14 years

7 AFFORDABLE AND CLEAN ENERGY

Step 1: Introduce the Global Goals

8 mins

Show students the World's Largest Lesson 2015 animated film - Part 1:
Intro to the Global Goals. http://worldslargestlesson.globalgoals.org/introduce-the-global-goals/

This will either introduce the Global Goals or serve as a good reminder of what they are and how we are all connected to them.

***Note**: There is a 3 minute cut down version of this film in English only at: https://vimeo.com/142124730*

If you aren't able to show the animation, read the script in appendix 1 or briefly summarise the Global Goals explaining:

The Global Goals for Sustainable Development are a plan developed by the United Nations and agreed upon by all countries to work towards 2030 to:

i. ***Fight** global inequality.*
ii. ***End** extreme poverty.*
iii. *And **Respect** our planet.*

Important Teaching Point
Students should clearly understand that there is a global plan for everyone no matter who they are or where they live, to find solutions to the most pressing issues for people and the planet.

Step 2 : What Can We Do To Achieve the Goals?

4 mins

Show students the World's Largest Lesson 2016 new animated film part 2 –
Take Action: invent, innovate, campaign
http://worldslargestlesson.globalgoals.org/introduce-the-global-goals/

It is a 4 minute animated film looking at examples from around the world of young people using invention, innovation and campaigning to contribute to the ambition of the Global Goals. **Note**: If you are not able to show the film then read the script from the animation in Appendix 2.

Step 3: Focus on Goal 11

2 mins

Explain to students that the rest of the lesson will focus on:
*Global Goal #7: **Affordable and Clean Energy**: Ensure access to affordable, reliable, sustainable and modern energy for all.*

Step 4: Discussion: What are renewable energy sources?

15 mins

The Earth's resources are being depleted faster than they can be replenished. In fact, humanity uses the equivalent of 1.6 planets to provide the resources that are used and to absorb waste, which means it now takes the Earth one year and six months to regenerate what is used in a year. The time for adopting and promoting more sustainable ways of living that are in harmony with nature is now. One way to do this is through the energy sources that are used around the world.

1. Begin a discussion about renewable energy – *what is renewable energy and how does it differ from non-renewable energy?*

Ask students to think broadly about the different forms of energy that are available for use (fossil fuels and non-fossil fuels), including those we interact with in our daily lives, e.g. energy from the sun, wind and water.

Agree definitions as a class and write this on the board.

> Teacher's note:
> Definitions from BBC Bitesize
> http://www.bbc.co.uk/schools/gcsebitesize/geography/energy_resources/energy_rev1.shtml
> **Renewable energy:** energy sources that once used are quickly replenished, and can be used again and again
> **Non-renewable energy:** energy sources that cannot be replaced once used up (within a human lifetime)
> **Fossil fuels:** Fuels such as coal, oil, gas which are mined from the Earth and are burnt to release energy, and greenhouse gases as a byproduct. They are formed from broken down plants and animals that died a very long time ago

2. Ask students to write down where they think their energy in their city or region comes from. Then, using a graph or pie-chart on the board, show students the actual energy sources of their city or region.

> Your local or national energy mix can be found from the relevant government department, for example:
> For Canada: http://www.nrcan.gc.ca/earth-sciences/geography/atlas-canada/selected-thematic-maps/16872
> For USA:
> http://www.eia.gov/energyexplained/index.cfm?page=electricity_in_the_united_states

Highlight the need for renewable energy as one of the main ways to help address global challenges like climate change and deforestation. Relying on renewable sources of energy means less burning trees to produce electricity. Burning trees for electricity can create more carbon pollution than coal, gas and oil and it destroys our forests and our heritage (Source: https://www.nrdc.org/resources/our-forests-arent-fuel)

3. Looking ahead: the energy mix is expected to change dramatically over the next 20 years, but will it be enough to avoid a dangerous rise in global average temperature of over 2 degrees celsius?

Detail in this video by UNEP Bloomberg New Energy Finance: https://vimeo.com/170955033
Or read 8 key findings from their 2016 report: https://www.bloomberg.com/company/new-energy-outlook/#findings

Step 5: Exploring renewable energy sources

15 mins

- *What types of renewable energy sources do you suppose there are?* Compare the different types of energy that are generated without burning fossil fuels and how they generate power.

Focus on the five main renewable energy sources:
Wind, Solar, Hydropower (water), Geothermal, Biomass (wood and wood waste, solid waste, landfill gas and biogas etc.).

When outlining renewable energy, place emphasis on how the technology can be easily transferred and managed in different parts of the world.

In recent years, we have seen a lot of South-South clean technology transfer where clean technology flows among technology intensive developing country industries are shared.
Some examples include: ceramic cookstoves, biogas digesters, cement board and jatropha biofuels.

- In 2015 investment in renewable energy increased (see Appendix 3), ask students to suggest why this might be?

Print and distribute Appendix 4, the targets for Global Goal 7 – Affordable in Clean Energy.

- Ask students to consider why leaders agreed it was important to include these in the 15 year action plan, the Global Goals for Sustainable Development.

Engage students to think about how exploring and using renewable energy can positively impact the environment and improve the lives of the 1.2 billion people (17% of the global population) who have no access to electricity.

Bring the class together to discuss the interlinkages between renewable energy and sustainable development.

- Create a spider diagram as group, by asking students to come to the front of the class and on the board or a large piece of paper, to draw and explain possible links between renewable energy and wider issues like climate change, poverty and unemployment.

For example using renewable energy:
- improves the environment (e.g. ensuring resource efficiency and minimizing environmental stress):
  - Renewable energy is the cornerstone of a future of human prosperity without environmental sacrifice. Increasing the supply of renewable energy allows us to replace carbon-intensive energy sources (e.g. fossil fuels) and reduce greenhouse gas emissions. One of the many benefits of renewable energy is improved public health (due to less air and water pollution) and environmental quality.
- contributes to economic growth (e.g. ensuring employment opportunities- link to Goal 8, decent work and economic growth)
- provides social benefits (e.g. ensuring people have access to energy as a basic human need):
  - By developing infrastructure that provides sustainable, reliable and affordable access to modern energy services, people, communities and countries can significantly improve their living standards and economic status. An example showcasing this vision is the Sustainable Energy for All Initiative (www.se4all.org).

Step 6: What Can Be Done?

10 mins

- In groups, ask students to discuss innovative actions or solutions that could contribute to more use of renewable energy sources in their community, city, country, region and/or the world.
- Prompt students to think about the role of consumers (e.g. how can consumers be persuaded to install solar panels on their roofs, for example) and what support is needed to incentivize them and help the industry grow (e.g. financial support, political support). Here, the issue of unequal access to using renewable energy sources can be raised (not everyone can afford to invest in renewable energy sources).
- Bring the class together to discuss these actions and write them on the board. Students could vote to decide on the top three actions and produce a manifesto for change in their community.

Step 7: Taking Action

10 mins

This can be extended as a homework activity.

- Ask students to design their own innovative renewable energy campaign that could convince their school managers or family/relatives to switch to renewable energy sources.

Advise students to conduct research about various innovative renewable energy solutions from different parts of the world (e.g. case study: Barefoot College, Appendix 5).

The SEED awards support entrepreneurship for sustainable development and showcase innovative renewable solutions. Useful examples can be found at:

- Alternative Energy Source for Heating (Africa, 2015): https://www.seed.uno/awards/all/2015/1824-alternative-energy-source.html
- More examples: https://www.seed.uno/awards/all.html?rd_winners_field_of_work=Energy&task=search

Discuss how students could spread the message about their actions more widely through their school or community, showing their understanding of the importance of clean renewable energy sources and the unbalanced access to this basic good.

Take Action for the Global Goals

As an educator you have the power to channel students' positive energies and help them believe that they are not powerless, that change is possible, and that they can drive it.

Taking Action - Right Now:

- ☐ Students can **write** to their local government representative, and **tell** them why the Global Goals are so important to their future and **ask** them what action they are taking toward a specific Goal.
- ☐ Ask students to **summarise** what they have learned about the **#GlobalGoals** and share it with World's Largest Lesson on Twitter @theworldslesson or Facebook

Taking Action - Deeper Engagement:

For deeper learning and impact, students can also take part in **projects** to make change for the Goals in their local communities.

Visit the "**Take Action**" page on our website: http://worldslargestlesson.globalgoals.org/take-action-title/ and find organisations, resources and lesson packs to help you get started.

Global Youth Service Day · DESIGN for CHANGE · Jane Goodall's roots&shoots · WORLD MERIT

APPENDIX 1


THE GLOBAL GOALS
For Sustainable Development
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
THE GLOBAL GOALS
For Sustainable Development

APPENDIX 1

World's Largest Lesson Part 1:
What are the Global Goals?
Read Out This Script If You Are Unable To Show The Animation

World's Largest Lesson 2015 animation

Excuse me…hello. Have you got a minute?
This is important. We need your help.
Imagine you're travelling in space.
You're looking for intelligent life.
You've been travelling for a while because space is…very spacious.
You've already spotted millions of planets with no life at all.
Lots of acid, lava that sort of thing.
But not where to go for your holidays.

And then you see it:
Earth!
A tiny island in space:
a little speck of water, rock and soil, with a thin veil of air that we can breathe.
There might be life out there in space, but here on Earth its everywhere…
On the land, in the water, in the air – plants, insects, birds fish, and every type of living creatures; some beautiful, and some frankly a bit weird.
And people, billions of people like you and me.
You know, beautiful… reasonably intelligent life.
Well just saying.

In most ways, we are just like the rest of life on earth.
We start from tiny seeds and with the right conditions we grow and mature.
To do that we all need the same basic things
No not mobile phones, trainers and Facebook.
But fresh water, clear air and healthy food.
Without those, we don't last long, no matter how smart our phones are.
The good news is that the earth has enough for all of us.

APPENDIX 1

The bad news is…
We've got some serious problems in our way.
The first is climate change.
The way we are living on earth now is damaging the very things we need to live.
The fuels we burn are chocking the atmosphere with gases we can't breathe.

We are running out of clean drinking water.
and some of it is wasted on things we don't need.
And all of this is changing the weather.
And that's not even the half of it.
The second problem is inequality.

Some people on earth have far more than they need.
And most people don't have nearly enough.
Many live in terrible poverty.
It's just not right.
Millions of people are unable to get medicines or healthcare that could stop them getting sick.
Or cure them if they do.
In some places, children complain about having to go to school.
In others, millions of others can't go to school at all.
Is that fair?
The thing is we are causing these problems.
So, we can fix them too, if we all work together and get creative.

Let me explain.
If you think about it all living things have superpowers.
Birds can fly.
We can't.
Dogs can smell things we can't which is not always a bad thing.
Plants absorb gas which we can't breathe and turn it into air which we can.
But human beings have a power that other creatures don't.
We are the most creative creatures ever.

Our heads are full of ideas and we are great at making things too.
With that power we've already changed the world over and over and solved thousands of problems.
So now we can do it again.
The good news is we have a plan.
A plan that can succeed with your help.
There is one organisation in the world that represents the people of 193 countries and is entirely dedicated to keeping us peaceful and working together.
You may have heard of it – the United Nations.

They have just announced The Global Goals for sustainable development.
These are 17 goals to protect the planet against climate change and make the world safer … fairer… and more just for everyone.
We have to achieve these goals by 2030.
The great thing about the plan is that we can check how we are doing as we go along.
Give ourselves a pat on the back if we do well and… try harder if not.
2030 isn't so far away – so we need to start right now.
There is a lot we can do if we work together and get really creative.

We can start by making these goals famous.
So find out what they are and tell EVERYONE and ask everyone to tell everyone else.
Then – and this is the exciting bit see if there's something practical you can do to actually help.
If we don't waste food, water or electricity, that could help protect the planet.
If we all stick up for people who are being treated fairly and respect each others human rights that would make a big difference too.

There are 17 goals all together.
So lots of different ways in which you can help.
We also need some new ideas and new ways of doing things.
What if being a girl or a boy made no difference in how safe you feel, the friends you have, or the places you could go?
What if we found new ways to make water clean and drinkable?
What if we could recycle all of our waste?
What else do you think we could do?
We all live on earth and we depend on the earth to live.

We have so many different cultures but, we only have one planet.
If we take care of it, and each other, and share what we produce fairly and sustainably, everything we need is right here.
Some day we may find intelligent life in other planets.
In the meantime, lets see how intelligent we can make it down here for all of us – at home, on earth.
I'm just saying.

APPENDIX 2

World's Largest Lesson Part: 2: What Can You Do?

Read Out This Script If You Are Unable To Show The Animation

Hello…. Hello….. Are you there?

I was just saying that we have to use our creative superpowers to achieve the United Nations' Global Goals. But how?

Although the earth is just a tiny speck in space, it seems enormous to us when we're on it.

The Global Goals can seem huge too. But if you focus on fixing the things where you live you can make a big difference.

There are three ways you can help. You can invent, innovate and campaign.

So buckle up and let's take a lightning flight around the world to see what young people are doing already.

In the beautiful city of Istanbul we meet Elif, she's an inventor. Like many big cities there's a lot of pollution in Istanbul.

Some caused by petroleum-based plastics. Elif wasn't happy about that and wondered what she could do. So she invented a new natural plastic made from banana skins.

No, seriously. It's cheap, easy to recycle and you can make it in your kitchen. And if you like banana desserts, you can't really lose. Unless you eat too much.

So let's talk about toilets. This is Rohit.

He lives in Bangalore in India. The population there is growing very quickly and so is all the, well, waste. A regular toilet uses 6 litres of water each time it's flushed. This is too much where water's scarce.

So Rohit invented a toilet that saves 50% of the water that ordinary toilets use. He called it the “Vacu-flush”. His invention won an International Science Prize and now he’s flushed with his own success, as it were.

Or you can be an innovator, be creative and think about how to improve the way we live. Take Urban Creators in North Philadelphia. This amazing group of teenagers reclaimed derelict land in a dangerous, run down neighborhood. They built a thriving farm where they grow fresh food and now supply hundreds of local homes and restaurants. Life Do Grow Farm has transformed the community and made it healthier and safer for everyone.

Speaking of health and safety, this is Nigeria, which has one of fastest growing populations in the world. And one of the youngest. Almost half of Nigerians are under
15. This is Team Charis a group of brilliant girls who are solving a big problem. Team Charis realized that in parts of Nigeria lots of people get sick because rubbish isn’t cleaned up properly. So they created Discardious – a phone app to report waste and have it taken away safely by eco friendly carts. See? Sometimes a healthier world is just one great idea away.

Or you can be a campaigner.
Melati and Isabel are sisters from Bali.
They’ve been on a mission to stop plastic bags from harming their beautiful island home.
Millions of plastic bags end up in the ocean. They pollute the water and harm marine life. Or they’re burned and belch filthy chemicals into the air. Melati and Isabel decided enough was enough. They organized petitions and beach cleanups and now their efforts have convinced their governor to ban plastic bags in Bali by 2018

Finally, let's go to Jordan.

This is Muzoon from Syria. She used to live in a refugee camp.

Many girls in the camp had to marry so young they had to give up their education. Muzoon thought this was a big mistake and she has waged a campaign to convince parents to keep their daughters in school and not make them marry too young.

Muzoon knows that all girls have a right to a great education. And just look at what one educated girl can achieve with enough determination.

Young inventors, innovators and campaigners everywhere are changing the world for good. And so can you. The problems we face are huge. But so are your creative superpowers. You just need to care, get creative and collaborate. If we all do that, by 2030 we really can make the global goals a reality.

I'm just saying.

Ken Robinson, May 2016

APPENDIX 3

Latest (2016) trends in renewable energy
This information is based on the *Global Trends in Renewable Energy Investment 2016* report by the United Nations Environment Programme (UNEP).

- 2015 produced a new record for global investment in renewable energy. The amount of money committed to renewables excluding large hydro-electric projects rose 5% to $285.9 billion, exceeding the previous record of $278.5 billion achieved in 2011.
- 2015 was also notable as the first year in which investment in renewables, excluding large hydro, in developing countries outweighed that in developed economies. The developing world including China, India and Brazil committed a total of $156 billion, up 19% on 2014, while developed countries invested $130 billion, down 8% .
- Other developing countries also raised their game – India saw its commitments rise 22% to $10.2 billion, while Brazil ($7.1 billion, down 10%), South Africa ($4.5 billion, up 329%), Mexico ($4 billion, up 105%) and Chile ($3.4 billion, up 151%) all joined it in the list of the top 10 investing countries in 2015.
- Renewable generation costs continue to fall, particularly in solar photovoltaics.

APPENDIX 4

	Ensure access for all to affordable, reliable, and modern energy services through new infrastructure and better technology
	Promote energy efficiency – more quickly developing technology that wastes less energy
	Increase the use of renewable energy sources globally compared with other sources of energy
	By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries
	Work together to research and develop renewable and other clean energy resources

APPENDIX 5

CASE STUDY

After having analyzed complex issues related to renewable energy, this activity provides an example of innovative alternatives, underlying that creative changes are made possible not only through high-tech but also through low tech, simple, ingenious solutions.

This case study about Barefoot College can help introduce learners to renewable energy sources and the relationship between energy consumption and climate change. This case study is rooted in the idea that big changes are possible starting from the bottom, in our own communities and through our daily habits.

Barefoot College
India's Barefoot College spreads sustainable knowledge and skills for communities, encouraging people to adapt a lifestyle that is in harmony with the environment while focusing on overall community transformation and empowerment. The Barefoot College connects rural communities to solar, water, education, professions and advocacy to help communities and individuals take control of their lives and the wellbeing of their communities.

An example of solar energy: What has been accomplished?
Solar energy provides electricity and reduces carbon emissions, but it is also a catalyst to create employment, boost income and provide self-reliant solutions for village communities. Thanks to Barefoot College's solar energy programme, 4,020 grams of harmful carbon emissions were avoided by replacing kerosene with solar as a source of clean energy for light, heat and cooking, 77 countries have trained Barefoot solar engineers and more than 14,500 households have solar systems installed.

Some of the achievements of Barefoot College include:

- Training middle-aged women from rural villages worldwide to become solar engineers. In partnership with local and national organizations, the Barefoot team establishes relationships with village elders, who help identify trainees and implement community support. Trainees are often illiterate or semi-literate grandmothers who maintain strong roots in their villages and play a major role in community development, bringing sustainable electricity to remote, inaccessible villages. Solar electrification reduces CO2 emissions, slow the negative impacts of deforestation and decrease air pollution from burning firewood and kerosene.

- Since 2000, The Barefoot College has been developing and installing solar water heaters to provide rural communities access to a sustainable, smoke-free source of hot water. The programme also generates community engagement and contributions from rural youth, who learn to build and install the heaters. Solar water heaters are made by rural Barefoot fabrication engineers and use sunlight instead of wood or gas to heat the water. They provide a continuous supply of warm water for people living in hot or cold climates. Community-manufactured solar water now serve thousands of people living in rural, remote villages in eight states of India.

- India's first ever solar powered reverse osmosis plant produces 3,600 litres of clean water daily and provides drinking water for over 1,000 villagers. The system provides potable (drinkable) water through reverse osmosis: brackish (dirty) water flows at a high pressure through a thin membrane. The purified water is free of salts and contaminants, which are stored in tanks and collected from pipes in the evening. The plant reduces the salinity of locally available water, making it safe to drink and free of any salty taste. It is powered by a 2.5-kilowatt solar generator that creates an uninterrupted supply of water without relying on the standard electric grid.

- In 2003, The Barefoot College created the Society of Women Barefoot Solar Cooker Engineers in Tilonia, Rajasthan, India. It is the first association of illiterate and semi-literate women who fabricate, install and maintain parabolic solar cookers in their homes. The parabolic solar cooker is constructed from 300 mirrors that reflect the sun's rays onto the bottom of a cooking pot to cook food quickly and sustainably. Women who once spent long hours searching for firewood can spend their time on other productive activities. Communities with solar cookers can expand their livelihood opportunities and limit the negative effects of deforestation and pollution.

To learn more about Barefoot College's solar programme, visit http://www.barefootcollege.org/solution/solar/#stats

The main findings of this story remind us of the following:
- Electricity access is not guaranteed to everybody (1.2 billion people have no access to modern electricity supply);
- Smart and simple technology can bring extraordinary improvements in the lives of millions of people (in this case access to electricity with all the related improvements to daily life);
- Renewable energy, such as solar energy can be manageable and affordable also for poor people, it is not exclusive to the wealthy;
- Renewable energy can provide a solution not just for cooking but also for education and health; and
- It can be turned into a profitable business and a social inclusion opportunity - in particular, for some of the most vulnerable people (in this case women).
- This example shows how Barefoot College has created significant employment opportunities, facilitated night schooling in the winter, regenerated wasteland through the use of solar water pumps and ensured a growing collective confidence among the communities involved to look after their own solar electrified villages.

From a woman's perspective
Read about India's Barefoot College lighting up the world by helping to bring electricity to villages around the globe by training poor women to be solar engineers.
A story by Al Jazeera (Shweta Desai, 15 Jan 2014,
http://www.aljazeera.com/indepth/features/2014/01/india-barefoot-college-lights-up-world-201411464325362590.html)