AMBER
Advancing Materials for Impact

06

nano WOW

history

Introduction

Teaching the history of science shows children that science is a human endeavour and that some major scientific discoveries have been found by chance. It allows children to associate with the lives of scientists and see that a career in science is possible. It also allows the children to understand the tentative nature of science and that in light of new observations, evidence and experimenting, science can be developmental, subject to change and consistently opening up new, exciting windows for exploration. This lesson has a comprehension piece that explores the history of Andre Geim, the scientist that discovered graphene. The story of Andre Geim highlights that creativity is needed for advancements in science. The lesson also has comprehension questions and a web quest challenge.

ICT links

Short animation on the History of Science and graphene
2 minutes 48 seconds
www.youtube.com/watch?v=dTSnnlITsVg

Webquest link: www.nobelprize.org/prizes/physics/2010/geim/interview/

Cross curricular links

- History
- English
- Art

WALT

- **Understand that scientists work hard to find more information and explore how our world works.**
- **Discuss the tentative nature of science.**
- **Understand that scientists work with other scientists to develop ideas.**
- **Understand that it is important to use creativity when experimenting.**
- **Understand that science is for everyone.**

Teaching tips

- The story could be read to the children or photocopied for them to read themselves.
- Teachers may choose to link this story with English and ask the children to complete the comprehension questions or let the children choose a journal entry instead.

Science is a human endeavour and some major scientific discoveries have been found by chance

Journal suggestions

- Write out five interesting facts about Andre Geim.
- Write out five facts about the Nobel Prize for Physics (web quest activity).
- List some problems that might occur if everybody had ‘gecko tape’.
- Draw a picture of your classroom/school with everyone wearing ‘gecko tape’ on their hands.

Scientists work with other scientists to develop ideas

Useful resources

www.condmat.physics.manchester.ac.uk/people/academic/geim/

https://graphene-flagship.eu/material/Pages/The-history-of-graphene.aspx

www.npr.org/templates/story/story.php?storyId=130353581

The story of Andre Geim

He is known for consistently experimenting with new things

Andre Geim is a Russian scientist who, alongside his colleague Konstantin Novoselov, discovered one of the most interesting materials in the world – graphene. They made this major scientific discovery using the material in your pencil and some sticky tape! Andre Geim is a very creative and successful scientist; he has always been interested in exploring science, finding out new things and learning more about the world we live in.

Andre Geim was born in Sochi, Russia in 1958. Although most of his family came from a German background, it is thought that his great grandmother was Jewish and he had to suffer prejudice in Russia because of his Jewish sounding name. Andre's father spent time in prison in Siberia.

Andre was a hard working student in school; however, he twice failed the entrance exam into his chosen university in Russia. He applied to another university, the Moscow Institute of Physics and Technology and was accepted. Geim was really interested in exploring science, finding out new things and learning more about the world we live in. He was able to avoid the compulsory two years of working in the army that every Russian man had to do because he was studying in a university. He went on to study in England and Denmark. In 1994, he became a professor in a university in the Netherlands.

While working in the Netherlands Geim met Konstantin Novoselov, who was also from Russia. Novoselov was Geim's student in the Netherlands. It was a fortuitous meeting and little did both men know that, more than a decade later, they would stand together and accept a major international prize for their work in science.

In 2001 Geim was employed as a professor of physics in the University of Manchester. Geim's wife, Irina became a lecturer in Manchester too. He liked life in England, he liked that everybody was valued the same in English universities.

Andre Geim is a very creative scientist. He is known for consistently experimenting with new things. However, not all of his ideas worked whilst some have been very effective. At times, he would work on a new idea and if his experimenting was successful he would let other scientists take over and develop the idea further, while he moved onto something new himself.

He famously created a magnetic field which allowed a little animal to levitate (float) in the air above it. He needed a good photograph to

show everybody that his invention had worked. He considered using lizards, spiders, cockroaches or hamsters but eventually he chose a little frog. The photograph made a huge impact all around the world and caused excited interest in this field of science.

Geim and his colleagues have also invented a "Gecko Tape"! Would you like to be able to scamper up a wall and across a ceiling like a gecko can? Imagine walking into your classroom and some of your friends were walking across the ceiling like Spiderman! Nanoscientists examined closely how a gecko's feet are able to cling to smooth surfaces like ceilings. Then, using the information they learned from the little gecko, they made a tape that they hope will, one day, be strong enough to put on human hands and allow us to scale walls and ceilings too!

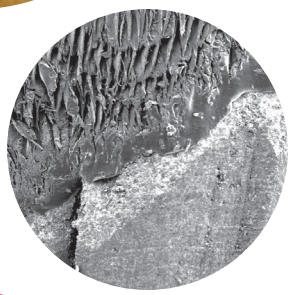
In 2003 Geim and Novoselov, while working in Manchester, discovered a new super material they called 'graphene'. In 2004, they told the world about graphene. They explained that it is a 2D material on the nanoscale and that it is only one atom thick. Graphene is stronger than steel, it is harder than diamonds, it is transparent and it allows electricity to flow very easily through it. How did they find this material? The answer is, with a lump of graphite- which is the material in your pencil that you use to write with, and some sticky tape! They stuck the sticky tape on a lump of graphite, pulled it off, and then looked at the surface of the tape under some very high powered microscopes. When we stack layers and layers of graphene one on top of the other they form graphite- the stuff in your pencil, this means that anyone who has drawn a line with a pencil has probably made some graphene themselves!

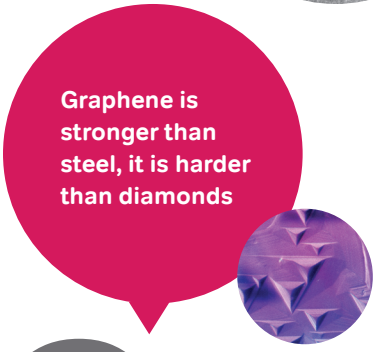
Other nanoscientists who had been trying to find new materials like graphene for years, with high powered microscopes, were amazed when Geim and Novoselov found it using such basic, everyday materials. Imagine, a major scientific discovery, with the material in your pencil and some sticky tape!

The science community greatly valued Geim and Novoselov's discovery and in 2010 they were given one of the highest honours in science when they were presented with the Nobel Prize for Physics.

Geim's discovery has sparked huge interest with science researchers all over the world. Nanoscientists in research centres such as the CRANN institute in Trinity College, Dublin are working really hard, exploring the properties of graphene and exploring how they can use it in the future.

This new super material, discovered by Geim and Novoselov, might yet play a major role in providing clean drinking water for all the people of our planet and just think...it was in our pencils all along!!





The story of Andre Geim
questions

1. Where in Russia was Andre Geim born?

2. Why did Andre fail to get into his chosen university?

3. Why was Geim and Novoselov's meeting fortuitous? What does fortuitous mean?

4. Describe one of Geim's interesting inventions.

5. List some properties of graphene?

6. What amazed other scientists about the discovery of graphene?

7. What international prize did Geim receive in 2010?

8. Is Geim a selfish scientist? Support your answer with a sentence from the text.

Webquest worksheet

1. Who is the Nobel Prize named after?

2. Find five facts about him:

3. Where and when are the prizes presented?

4. Who won the Nobel Prize for physics in 1921?

5. Who won the Nobel Prize for chemistry in 1911?

6. How many women have won Nobel prizes?

7. Who was the youngest winner?

8. Who was the oldest winner?

9. In one family the mother, father and daughter won the Nobel Prize. Who are they?

10. Why are the individuals and organisations who are awarded a Nobel Prize called 'Nobel Laureates'

Webquest worksheet
Answers

The word “Laureate” comes from the laurel wreath. The god Apollo wore a laurel wreath.

1. Who is the Nobel Prize named after?
Alfred Nobel

2. Find five facts about him

3. Where and when are the prizes presented?
December; Stockholm, Sweden

4. Who won the Nobel Prize for physics in 1921?
Albert Einstein

5. Who won the Nobel Prize for chemistry in 1911?
Marie Curie

6. How many women have won Nobel prizes?
44

7. Who was the youngest winner?
Lawrence Bragg (25)

8. Who was the oldest winner?
Leonid Hurwicz (90)

9. In one family the mother, father and daughter won the Nobel Prize. Who are they?
Marie Curie, Pierre Curie and their daughter Irene Joliot-Curie

10. Why are the individuals and organisations who are awarded a Nobel Prize called 'Nobel Laureates'?
The word "Laureate" comes from the laurel wreath. The god Apollo was represented wearing a laurel wreath. The wreaths were awarded to victors of competitions in Ancient Greece.