The balls in Newton's Cradle show the laws of **motion** (movement), which are the **foundation** (basis) of the modern science of physics. These laws help to explain both how objects move on earth and how planets move through space. They were first **formulated** (developed) by Isaac Newton in the 17th century.

I. Warm up

Watch the short video (00:00-01:00) of Newton's Cradle which shows how some of the basic laws of physics work. Then answer the questions.

1. Do the balls always move in a straight line? Why?

2. What makes the balls move faster?

3. Is there always a reaction after one ball hits another one?

Now, read the text and answer the question.

What do you know about Newton's life?

II. Vocabulary

Read the sentences and match the words in bold with their meanings. All of the sentences follow the *so/such ... that ...* structure.

e 1. I've got such strong binoculars that I can make **observations** of animals in the wild without getting close to them.

f 2. Online **criticism** can be so nasty that you just don't want to post anything anymore.

b 3. She was so stressed at work that she had a **nervous breakdown**.

c 4. The brothers' **rivalry** is so strong that it often leads to fights.

a 5. There was so much damage to that politician's **reputation** that he lost the election.

d 6. There was so much **opposition** to the idea that we decided not to go ahead with it.

a. what other people think about someone, based on what they have done in the past

b. a period of poor mental health during which people may feel very anxious and unable to lead a normal life

c. a feeling of competition between two people who each want to show that they are better than the other one

d. strong disagreement

e. watching carefully in order to learn more about something

f. saying something negative about someone or what they have done

What part of speech are all the words in the first exercise?

Now, choose the correct form of the word to complete the sentences. Explain the meaning of each correct answer and what part of speech it is.

1. After I moved to the city, my music collection really **expansion / expanded**.
2. He's got a wide range of **intellectual / intellect** interests - everything from learning Japanese to playing chess to 19th century novels.
3. I was really **influenced / influential** by one of my teachers, who encouraged me to study science.

4. Stephen Hawking's research completely **transformation / transformed** our understanding of the universe.

5. This element is really **instability / unstable** at room temperature - it just catches fire.

6. **Wealthy / wealth** individuals often give universities a lot of money.

How do you think these words will be used in the story of Isaac Newton's life?

III. Listening 1

You are going to listen to information about the life of Isaac Newton (1643-1727). Before you listen, read the sentences and try to predict which option is correct. Then listen and check your ideas.

4/8

1. Newton never really knew his father because...

   a. he died before Newton was born.

   b. he left the family when Newton was a baby.

   c. his mother never told him who his father was.

2. Newton's mother really wanted him to be a...

   a. priest.

   b. farmer.

   c. teacher.

3. The idea that...

   a. the earth was round was relatively new when Newton was a student.

   b. the earth was not created by God was relatively new when Newton was a student.

   c. the earth circled the sun was relatively new when Newton was a student.

4. Newton's famous observation of an apple...

   a. rolling across the ground helped him develop his ideas about physics.

   b. falling from a tree helped him develop his ideas about physics.

   c. growing on a tree helped him develop his ideas about physics.

5. Newton's relationship with the scientist Robert Hooke was very difficult, especially after Hooke said that Newton's ideas were not...

   a. his own.

b. correct.

c. important.

6. Newton shared his money with...

a. his family.

b. charities.

c. no one.

7. Albert Einstein agreed with...

a. all of Newton's ideas.

b. none of Newton's ideas.

c. some of Newton's ideas.

IV. Language in context

Read these sentences from the recording and explain the meaning of the words and phrases in bold.

1. In 1669, he published a paper dealing with **the branch** of mathematics known as calculus. 4/8

раздел

2. His work could be applied to explanations of **gravity and the orbits of the planets** around the sun.

гравитации и орбит планет

монетный двор

3. He ... also took up the post of head of the **Royal Mint**. In this position, he introduced a number of important reforms to banking and currency, including a move to the gold standard

V. Listening 2

Read the questions. Can you remember the answers? Listen again to check.

1. How did his relationship with his mother affect Newton later on in his life?

2. What kind of student was Newton?

3. What happened as a result of the first paper he published?

4. What happened in 1678?

5. What kind of leader was Newton when he became head of the Royal Society?

6. Name two of his intellectual interests in later life.

7. Why should we remember Newton today?

1. His mother soon remarried and left young Isaac with his grandmother. **As a result**, he felt anxious and insecure throughout his life.

2. When the university closed between 1665 and 1667, **due to** an epidemic, he continued working on his own.

   The work was well-received and **led to** a professorship at Cambridge.

3.

4. The resulting stress **contributed to** a nervous breakdown in 1678 ...

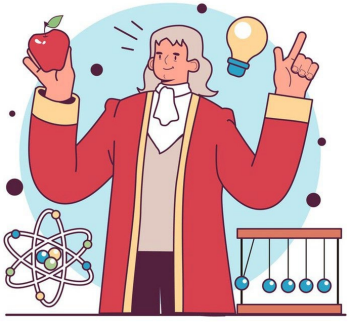
5. Newton became the leader of the Royal Society, but he allowed no opposition from anyone. **Therefore**, he was not a popular leader.

6. However, his mental health continued to be unstable. **Consequently**, his friends were often worried about him.

1. Most of the expressions in bold introduce an effect or result, but which one introduces a cause or reason? due to

2. Which of the cause-and-effect expressions in bold introduce a clause (subject + verb)? led to

3. How are the other three expressions used in the sentences?



Part B: Express this information about Newton's life using the cause-and-effect expressions in brackets. You may need to change some verbs to nouns.

1. Newton suffered from stomach problems in later life. That's why he became a vegetarian. **(due to)**

Newton become a vegeterian due to...

2. Newton wanted to see how the shape of the eye affected what he saw. ~~That's why~~ he stuck a needle into his head. **(consequently)**

Consequently

3. Newton's dog knocked over a candle and set fire to his lab by mistake. ~~That's why~~ he lost a lot of his work. **(as a result)**

As a result

4. Newton's cats often interrupted his work by scratching at the door. That's why he invented the cat flap. **(led to)**

Newton's cat used to interrupt his work by scratching at the door and that led to Newton inventing the cat flap

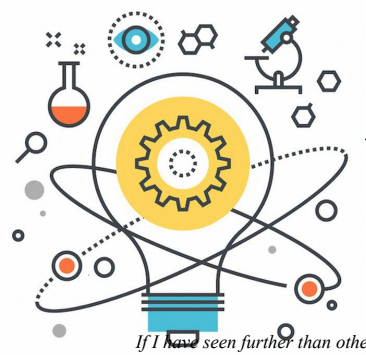
5. In the 17th century, the country was changing from the old Julian calendar to the modern Gregorian calendar. ~~That's why~~ he has two birthdays. **(therefore)**

Therefore

6. Newton used a lot of mercury in his experiments. ~~That's probably why he suffered from~~ mental health problems. **(contributed to)**

and that contributed to

Which extra information from this exercise do you think is the most surprising or interesting?



If I have seen further than others, it is by standing upon the shoulders of ***giants****.* (a giant is a very tall and powerful being; in this context it refers to someone of very great intelligence.)

Gravity may put the planets into motion, but without the divine Power (God), it could never put them into such a circulating motion as they have about the Sun; and therefore, for this as well as other reasons, ***I am compelled to ascribe this System to*** (I have to explain that this system is caused by) *an intelligent Agent.*

I do not know what I may appear to the world; but to myself I seem to have been only like a boy playing on the seashore, and diverting myself now and then in finding a smoother pebble or prettier shell than ordinary, while the great ocean of truth lay all undiscovered before me.

VII. Talking point

Discuss these questions in pairs or small groups.

1. What would you ask Newton if you could meet him?

2. If Newton were alive today, what do you think he would be working on?

3. Family relationships had a strong effect on Newton's life, both positive and negative. Explain why and talk about other people whose lives have been strongly affected by their families.

4. On several occasions in his life, Newton had to work independently. Why did he do this? What do you think are the advantages and disadvantages of this way of working?

Which of these Newton quotes do you like best and why? What do these quotes tell us about his personality?

criticism / influence / intellectual / observation / opposition / reputation / transform / wealth

VIII. Extension

Read the information about alchemy and complete the sentences with words from the box. You have already encountered these items during this lesson.

Today, alchemy has a bad reputation [1], seen as more like magic than science, so it's perhaps surprising that Isaac Newton became so interested in it as he grew older. However, the main goals of alchemy: wealth [2], health and possibly even immortality (living forever) are shared by many

observation

branches of modern science. The difference is that alchemists believe that [3] of the stars and planets will show that they have a direct [4] on processes on earth.

influence

transform

Alchemists tried to [5] metals like mercury and copper into silver or gold through a complicated process of heating and mixing with other elements like sulphur. They also looked for ways to cure diseases and extend life. These ideas first became important in Europe during the Middle Ages, but there have been similar intellectual [6] projects in Chinese, Indian and Arabic cultures. It's unlikely that Newton faced criticism [7] for his alchemy experiments during his lifetime, although modern alchemists would certainly face strong [8] from scientists.

opposition

Harry Potter fans will recognise some elements of alchemy – for example, the search for the Philosopher's Stone, which was thought to be the key to achieving all three goals of alchemy.

1. **Do you think we will ever be able to achieve the three goals of alchemy? How could we do this?**
2. **Do you think it would be a good idea for us to achieve these goals? Why/why not?**