Roamer Activity

Forces Unplugged

Helps children understand the idea of force through their personal, everyday experiences.

Subjects	Age	Roamer Expertise	Student Grouping	Lesson Time	Availability
Science	9 10 11				

Activity

Description

This set of unplugged[1] tasks will help your students understand the idea of forces.

Task 1: The Wall - In the gym half the class line up linking arms, pretending to be a wall. The other half push on them the other half try and push them over – without being too aggressive! Then reverse the roles.

Task 2: Discuss their experience of being a wall – do they push back.

Task 3: Making a Ball Move - In the gym pair the students up. Get each pair to pass a football to each other. Move the pairs further apart and repeat the process.

Task 4: Discuss what they had to do to make the football move and reach the other group.

Objectives

Students have the chance to:

1. Understand what a force is.
2. If you push something, it pushes back.
3. You need to use a force to make something move.
4. The more force you apply the faster it will move.

Sustainable Learning Objectives

Students have the chance to:

1. Develop their narrative thinking (Cognitive: Thinking – Types of Thinking)[2].
2. Engage in enactive thinking (Cognitive: Thinking – Types of Thinking).
3. Taking part in a debate and express their ideas (Social: Giving – Group Contribution).

[1] This refers to tasks which teach Computer Science without a computer. Playing Turtle is a forerunner to this idea. We use Unplugged to mean stand-alone tasks which don't involve Roamer but form part of a Roamer project.

[2] The bracketed text refers to the Sustainable Learning Principles taken from (Catlin & Blamires, 2010). How students work with Roamer provides a learning environment where students can unconsciously develop these skills.

Related Activities

A list of Roamer RoboCup Activities will appear here when we finish the project.

Lesson Plan

The lesson plan is for guidance only. Feel free to vary it to suit your circumstances.

Preparation

Layout the Hall

Make sure you can use the school hall (5 minutes).

1. Task 1: Layout crash mats to protect students if they fall.
2. Task 2: Remove crash mats and provide footballs for students.
3. Set up a flip chart to write down student's statements.

Activity

Task 1: The Wall.

1. Split the class into two groups.
2. Have one group line up in front of the crash mats and link arms.
    a. Tell them they're a human wall.
3. The other group should line up opposite them and try and break the wall.
    a. Make sure children of equal size and strength face each other.
    b. Make sure it doesn't get too boisterous.
4. Swap the group roles and repeat the task.

Task 2: Get the student's to explain their experience.

1. Sit the students in a circle.
2. What was it like to be the wall?
    a. How did they prevent themselves from falling over?
    b. If someone pushed harder what did they do?
    c. If they fell over or broke links why?
3. Help them understand if they push the human wall, the human wall pushes back.
    a. Do they think the gym wall pushes back?
4. Show them the picture in student materials.
    a. Ask them to explain what's happening.

Task 3: Passing the Football

1. Split the class into pairs.
2. Place each person facing their partner 5 paces apart.
3. Give each pair a football.
4. Get students to pass the ball from to and fro between their partners.
    a. They should kick the ball hard enough so it just reaches their partner – no further.
5. Now move the pairs further apart (10 paces or more).
6. Get them to repeat the ball passing.

Task 4: Get the student to explain their experience.

1. What did you do to make the ball move?
    a. Is kicking a force?
    b. Why is it?
2. What did you do to pass the ball a longer distance?
    a. When you kick it harder do you use more or less force?

Assessment

Listen to students to the student discussions.

Make notes:

1. Did students express and understand the concepts?
2. How much did you need to guide them?

What did you learn?

Setting Learning Intentions and success criteria.

1. What did you think you've learnt?
    a. Write down the best definitions on the flip chart.
2. Did you understand it?
    a. Run a thumbs up straw poll.
    b. Find out what student's don't understand.
        i. Deal with the problem.
        ii. Make a note to address issues.

Teacher's Notes

Subject Comments

Science is a story we tell to explain the world we live in. In 1687 English scientist Sir Isaac Newton wrote a story nobody had heard before. His story told us how the world worked: how stars move around galaxies, how apples fall to Earth and what happens when we kick footballs. You see before 1687 people had stories which told them how the world worked. But Newton told a radically different, a more exciting tale which revolutionised the way we think about the world. And, Newton's narrative made more sense explaining the scientific evidence.

People try to make sense of their world. And children, constantly bumping into new experiences, work overtime at this endeavour. I remember, driving passed the police doing a stop-and-search which prompted my young daughter's explanation that they were helping the man find his Barbie Doll. Parenting and teaching involve telling our children better stories based on our richer experience, but balanced by the essential need for us to help them become storytellers.

The formal way we tell Newton's story may appear daunting compared with acceptable children's explanations of their experience:

1. Newton: A body stays at rest or continues its motion in a straight line unless acted on by a force. Child: You have to push or pull something to make it move.
2. Newton: Force is equal to the rate of change of momentum. Child: The harder I push the faster it will go.
3. Newton: To every force, there is an equal and opposite force. Child: If I push you, you push back.

Students may express what they think about their experiences in different ways. This set of tasks aims to get students experiencing and talking about those experiences. Guide them, but let them rewrite Newton's story in their own words.

Prior Knowledge

No prior knowledge needed.

Classroom Tips

As an experienced teacher, you'll know the wall task provides the chance for some energetic behaviour. Your common sense will tell you to stop students being too excited and you don't want big kids pushing on little kids.

Training Links

- Effective questioning
- Roamer Unplugged
- Learning Intentions – When Should I Set Up a Learning Intention?
- Feedback – Thumbs Up Straw Poll

Science of Learning

"The foundations of any subject may be taught to anybody at any age in some form (Bruner, 1960, p. 12)*."*

Bruner[3] also said, "*I respect a teacher who can ask interesting questions and has the patience to watch someone attempt to discover an answer to them* (Bodie, 2008)".

According to Bruner good teaching (instruction) has four features (Bruner J. S., 1966, pp. 40-42). We should

1. Provide experiences which makes the student want to learn.
2. Organise knowledge into bits which students can grasp.
3. Sequence these bits into a pathway which lead to a deeper understanding of the ideas.
4. Know how to encourage students.

These ideas lead to Bruner's famous spiral curriculum where students grow their understanding every time they return to a topic. Our approach here is an example of Bruner's discovery learning (Bruner J. S., 1961).

Bruner described two ways of thinking:

"*… we organize our experience and our memory of human happenings mainly in the form of narrative — stories, excuses, myths, reasons for doing and not doing, and so on. Narrative is a conventional form, transmitted culturally... Unlike the constructions generated by logical and scientific procedures that can be weeded out by falsification, narrative constructions can only achieve 'verisimilitude'. Narratives, then, are a version of reality whose acceptability is governed by convention and "narrative necessity" rather than by empirical verification and logical requiredness* (Bruner, Autumn 1991, p. 4)."

However, science does have a narrative. For example, we use the familiar planetary portrayal (a nucleus orbited by electrons) to explain atomic structures. The atom isn't like that, but it's a story that aids our understanding at a basic level. Scientists argue over narratives that explain thee evidence. Famously, Albert Einstein and Danish Physicist Niels Bohr debated over the results of quantum experiments with Bohr's Copenhagen Interpretation winning.

[3] Jerome Seymour Bruner (1915 – 2016) was an American psychologist who made significant contributions to human cognitive psychology and cognitive learning theory in educational psychology.

As educators, we've got a duty to ensure students know the accepted story, but we also need to allow and encourage the student voice and imagination. Saud Nasir and colleagues presented an interesting example which showed how a student's ethnic and home environment made a difference (Suad Nasir, Rosebery, Warren, & Lee, 2006). They compare the way elementary school children from two different social environments responded to the question, "Do plants grow every day?" The child from a highly-educated middle-class family explained how you could measure the size of a plant and chart its growth. A Hispanic child from an immigrant working class family described the growth by, "*…imagining how her own growth through 'the crinkly feeling' she got when her feet outgrew her socks."* Often we devalue the second approach. But then we read Einstein' thought experiments and we understand the role stories play in science.

The Zytglogge Clock Tower, Berne, Switzerland

Einstein worked in the Swiss patent office in Berne. While travelling on the tram away from the clock he suddenly thought, "What would happen if the tram travelled at the speed of light?" He would see the clock hands frozen in the same position, but for his pocket watch would show a time change. This led him to understand time wasn't constant[4] and the theory of relativity.

References

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Bruner, J. S. (1966). *Toward a Theory of Instruction.* New York: W.W. Norton & Company Inc.

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Suad Nasir, N., Rosebery, A. S., Warren, B., & Lee, C. D. (2006). Learning as a Cultural Process. In R. K. Sawyer (Ed.), *The Cambridge Handbook of the Learning Sciences* (pp. 489-504). Cambridge University Press.

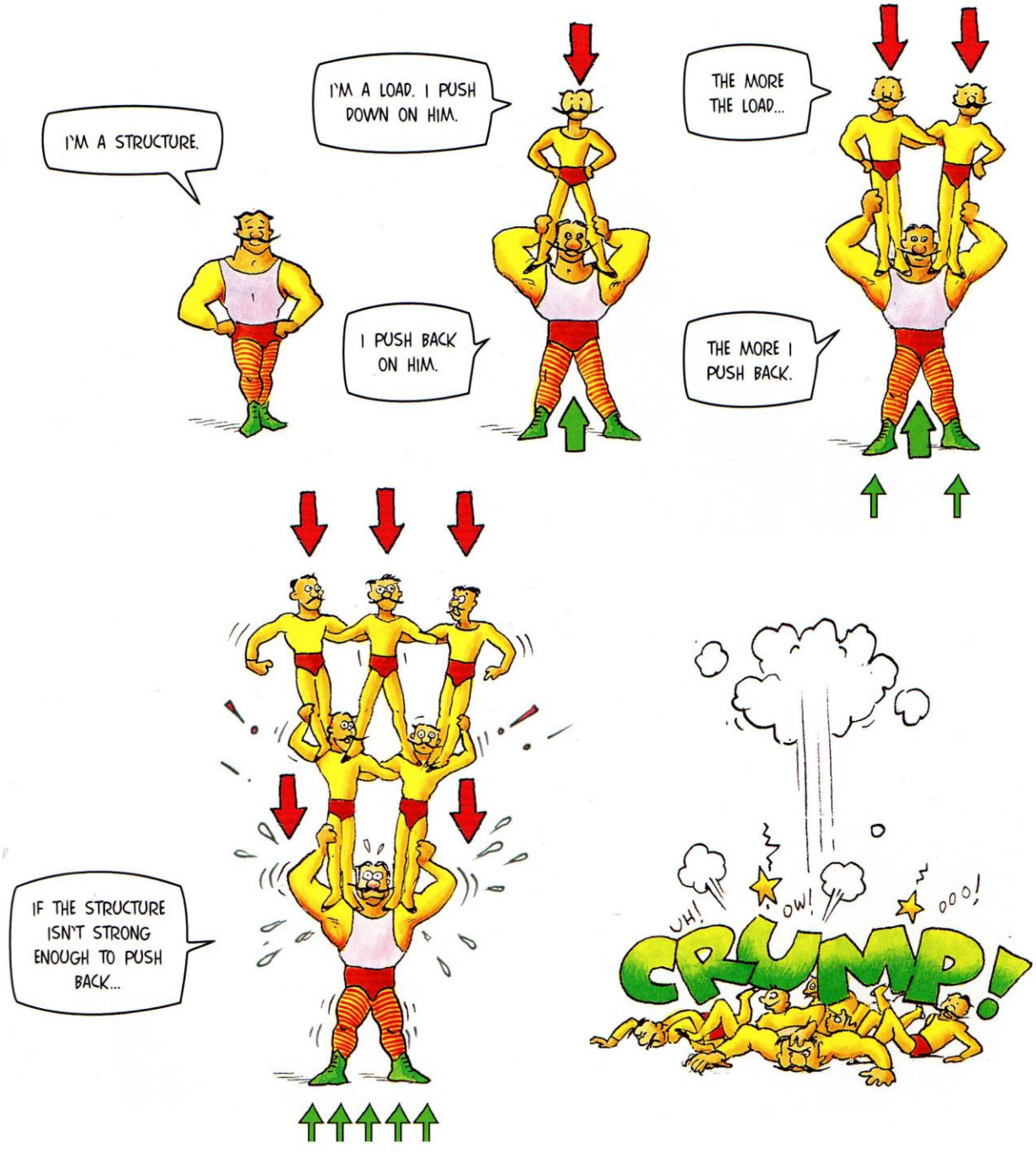
Resources

Other Resources

1. Crash Mats (4 -6)
2. Footballs – one per pair of students (15)

[4] Newton's Laws assume it is – which for most practical purposes it is.

Student Materials



Curriculum Links

These links refer to the English National Curriculum for Key Stage 2 (8 to 11 year-old) students. However, while the wording and organisation for different countries may vary, the substance is the same.

England[5]

Years 3 and 4

"[The principal focus] …to enable pupils to broaden their scientific view of the world around them. They should do this through exploring, talking about, testing and developing ideas about everyday phenomena."

"…and by beginning to develop their ideas about functions, relationships and interactions. They should ask their own questions about what they observe… They should draw simple conclusions and use some scientific language, first, to talk about and, later, to write about what they have found out."

Working Scientifically

"…asking relevant questions and using different types of scientific enquiries to answer them."

"…making systematic and careful observations…"

"…reporting on findings from enquiries, including oral and written explanations…"

"…using straightforward scientific evidence to answer questions or to support their findings."

Yeas 5 and 6

"The principal focus of science teaching in upper key stage 2 is to enable pupils to develop a deeper understanding of a wide range of scientific ideas. They should do this through exploring and talking about their ideas; asking their own questions about scientific phenomena; and analysing functions, relationships and interactions more systematically."

"…should encounter more abstract ideas and begin to recognise how these ideas help them to understand and predict how the world operates."

"Pupils should draw conclusions based on their data and observations, use evidence to justify their ideas, and use their scientific knowledge and understanding to explain their findings."

Working Scientifically

"…reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and a degree of trust in results, in oral and written forms such as displays and other presentations."

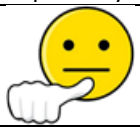
[5] The community can add details of the links with other curriculum to the online Activity Library and we'll add them to the activity.

Lesson Evaluation

Here you can record the assessment results and note the actions needed to help your students further their knowledge[6]. If you do this online your results will contribute to the e-Robot Research Project.

Learning Intentions

Note up to three learning intention statements made by the students.

Forces Unplugged – Thumbs Up Survey			
			
Number of Students			

Outstanding Questions:

Action:

[6] This meets the requirements of the TACTICS Framework.