



## Seed Cities for Science

A COMMUNITY APPROACH FOR A SUSTAINABLE GROWTH  
OF SCIENCE EDUCATION IN EUROPE

# Cross-curricular Hands-on Primary Science Sport and Science



Autumn 2008



# Cross-curricular Hands-on Primary Science Introduction

Leicester is one of 12 'seed' cities in 12 European countries: UK, France, Spain, Italy, Portugal, Estonia, Hungary, Sweden, Belgium, Germany, Netherlands and Slovenia. The European Commission has provided funding to support European schools to raise standards in investigative primary science. Over the past 2 years twenty-two Leicester city schools and sixty-eight teachers have been participating in this 3 year project. Each year teachers are given 2 days and 3 twilight in-service sessions.

During 2008 two in-service sessions focused on making links between physical education and science. Each teacher tried out and extended at least one of the ideas covered during the in-service in their class. Some of the Pollen schools also participated in a Science Challenge focused on Science and Sport during June and July. This included carrying out investigations involving people or businesses from the wider Leicester City Community in some way. This pamphlet gives a taste of some of the school-based activities that developed concepts relating to:

- ◆ Forces
- ◆ Materials
- ◆ Human biology

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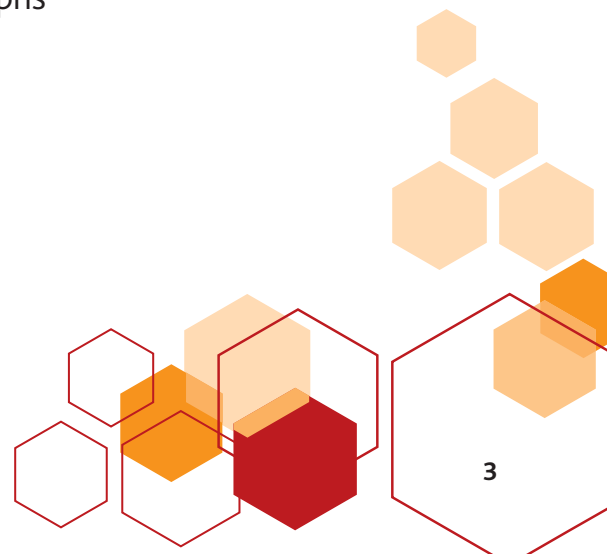
# Cross-curricular Hands-on Primary Science Science and Creativity

The project sets out to promote creative practical investigative work using realistic cross-curricular links so that pupils see that science is exciting and relevant to their everyday lives. Teachers have provided a wide range of interesting contexts to start investigations such as:

- Letter from a football manager
- Email from a tennis coach asking for advice
- Visitors including a tri-athlete
- Fictional stories, nursery rhymes and cartoons
- Displays of sports clothes and equipment
- Sports days and mini-Olympics

Creativity has also been promoted through the variety of ways used by pupils to communicate their science ideas such as:

- Paired work
- Role-play of shop keepers giving science advice
- Oral presentations using storyboards and PowerPoint
- Annotated pictures, photographs and videos
- Science dictionary illustrated with photographs
- Explanatory posters and pamphlets
- Training diaries
- Paintings, poems and a rap





# Forces and Physical Education in the Early Years



## Identifying pushes and pulls

Early years pupils in a number of classes explored forces. One Year 1 class started by looking at pictures of athletes and talked about pushes and pulls. They then worked in three groups to complete an obstacle course; to throw beanbags into baskets as well as to throw and catch a ball. The children took turns to be athletes and observers. The observers were asked to watch and use provided words such as push, pull, fast, slow, stop, up, down, back, forwards and force. It was noticeable that both observers and athletes were thinking carefully about their movements.

Another early years class also started by identifying pushes and pulls. This was extended by asking the pupils to create sequences such as using two pushes and a pull. Pairs were chosen to demonstrate good practice and the rest of the class acted as an audience of 'critical friends'.



## Identifying forces on balls

Other classes used large inflated balls that were subjected to various forces as they were pushed, pulled, accelerated, slowed down and stopped. Pairs of pupils in a Year 2 class explored sports that involved pushing or pulling forces on a ball. They considered how we use balls in them: kicking, throwing, hitting etc. Each child did a quick individual drawing of a sport with a ball and talked about pushes and pulls in the picture with a partner. In the hall, pairs performed a series of manoeuvres: squashing the ball as well as throwing and rolling it to their partner. The teacher continually challenged the children's thinking and elicited a lot of language that kept the science in focus: pull/push, faster/slower, harder/softer, further/nearer and so on. Back in the classroom, the children drew three pictures of themselves rolling, kicking and throwing the ball, which they annotated with the pushes and pulls involved.



## Making a forces dictionary

In the playground, Year 1 & 2 children were given words, one at a time: push, pull, spin, fast, slow, stretch, etc. The children worked singly or with a partner. After discussion, the children acted out each word while the teacher took still photos that were used to make a forces dictionary.

## Friction and the best shoe for running

A Year 2 class was told that 'Mrs Sangheera' wanted to take up running and needed advice on what to buy. The pupils observed and described the key features of three different shoes: trainer, boot and high heels. They predicted that the trainer was best for running (grip, flexibility and lightness) but needed to prove this. One group tested the shoes on a ramp to see which had the best grip. Another group tested for grip by pushing them along a slippery floor. While the boot had equally good non-slip properties as the trainer, the pupils recognised that it was heavy and restricting, so it would slow Mrs Sangheera down. They agreed that the high heels were poor on friction, stability as well as ankle and toe protection. The plenary took place in a 'shop' where Mrs Sangheera came to buy her shoes. Each group took turns as shopkeepers to advise her on which shoes to have, giving their reasons and conclusions from the investigations. This simulation allowed the adult playing Mrs Sangheera to prompt with science-related questions within a real-life context.

## Investigating stable and unstable shapes

After sharing a cartoon story about Fluffy the Kitten, who lost his balance and fell over, a class of Year 1 pupils investigated stable and unstable shapes in PE using their bodies. They found that it was easier to balance on shapes with a big base. They also investigated whether keeping your eyes open helped you to balance and concluded that it did.

Given this introduction, the pupils investigated stable and unstable objects in the classroom. They placed the objects on a tray and gently shook the tray to find out which fell over easily. This confirmed that the larger the base the more stable the object. The pupils also played a game in which a plastic chef balanced a large pizza on his finger and ingredients had to be placed on it without making him overbalance. They found out that the objects had to be evenly placed to keep the chef upright. They then made Humpty Dumpty's using polystyrene eggs and stick legs. They were asked to find a way to help them stay on the wall by using home-made plasticine boots of different shapes and sizes to balance them. Finally they were asked to use all their experiences to explain the reasons for their Humpty Dumpty's' success or failure to stay on the narrow wall.





# Identifying, illustrating and investigating forces in Key Stage 2

## Forces in balance

Pupils tried out pushing and pulling in pairs. They could feel that two people could pull equally hard, or push, but be still. However, when one pull, or push, was bigger than the other there would be movement.



## Photographs and models

A Year 3 class was given pictures of sporting action, such as a rower and asked to annotate them showing the forces involved in the action. Then the pupils took photographs of themselves in action poses. They then had to open a Word document, import three of their photos and write about the forces that were evident during the session. This was completed on laptops and shown to the class during a plenary. Some pupils also created a model of an athlete in an action pose out of modelling clay.



## Science videos

A Year 6 class made a science video for younger pupils in the school. They practised video techniques and critically evaluated prototypes. Groups of pupils then videoed each other skipping, running and doing football moves in the school hall. At a certain point, one of the children would shout 'freeze'. A brief commentary was then recorded onto camera by a narrator who commented on what was happening both to individual muscles and muscle groups. This was done several times covering different scientific concepts each time e.g. the physical effects of exercise, forces, friction, air resistance and gravity etc. Along the way, misconceptions and mistakes were challenged by both the teacher and other children who acted as critical viewers.

## Investigating resistance training

A group of Year 6 pupils received a letter from a Leicester football manager asking them for advice on the best training method to give his players a crucial extra burst of speed on the pitch. They decided that resistance training would be most effective. They timed a runner's performance over a 50-metre grass track to give base-line data. They then set up a training experience using a parachute that was released at the moment the timed section started. Giving plenty of time for recovery, the runner repeated the procedure over the same ground, but without the drag of the parachute. The group had predicted that the runner would do a better time, having fought against the parachute. They analysed the results of several runs and presented them in a bar graph. It showed that the parachute brake did indeed improve the times over the 50 metre distance by an average of about half a second. They considered alternative resistance training techniques such as towing a wheeled trolley loaded with weights, but they found the parachute more manageable and less likely to cause injury. They set out their findings in a letter of recommendation to the football manager.



### Friction and mini-golf

A Year 4 class were asked to investigate how the surface would affect how a small light plastic ball rolls. They had 3 different surfaces: rubber mat, varnished wood and carpet. It was decided that each child would try to give the same 'push'. While the class carried out the investigation, they were encouraged to develop a set of agreed generalised statements e.g. 'The smoother the surface the further and faster the ball goes.' Finally, the children were shown a real golf ball and asked to predict how using this would affect their results and/or their conclusions before testing it.



### The importance of friction in bicycles through the ages

A Year 5 class carried out independent research on the design of bicycles and the importance of friction. They compared different types of modern bicycles: tricycles, tandems, racing, mountain bicycles etc. as well as the penny-farthing and boneshaker that were used in the past. The pupils found out about different types of pedals and brakes in order to explain scientifically to Year 2 pupils why it was better to use the back brake before the front one and how pedals worked. They also discovered that in some cases it was important to maximise friction as in the case of brakes. However sometimes friction needed to be minimised such as on the chain, while the tyre-grip on sports' bicycles needed to vary depending on the different road surfaces.



## Clothing for sports activities

Several children in a Year 3 class brought in outfits that they wore during after-school sports activities. Pupils discussed how the design and choice of materials suited the sport they were used for. They were then shown pictures of surfing, swimming and running outfits and asked to suggest the sport they were used for with reasons. This was followed by pictures of a spacesuit and a fur coat. The pupils had to say why the spacesuit was not suitable for climbing and why the coat was not suitable for swimming. Finally, using an outline of an athlete, pupils designed a suitable outfit for a sport of their choice. They labelled the diagrams with scientific reasons for their choice of material and design.

Another class of Year 3 pupils was also asked to consider the properties of materials used in sports clothes. They felt that an important factor was stretchiness to allow movement and to keep the body streamlined. They tested fabrics to find the stretchiest.

In a Year 4 class a kick-boxing helmet was used as a basis for discussion about the important protective properties of its materials. A Year 5 class examined cycle helmets in a similar way. They carried out a survey throughout the whole school and were shocked to discover that very few pupils wore cycle helmets. Consequently they produced explanatory posters to encourage their use, which were displayed in the school entrance hall.

## Materials used in bicycles

A class of 10 year-olds was visited by a tri-athlete and her son. The pupils compared the tri-athlete's racing bicycle and her clothes with their own bikes in terms of properties of materials and their use. In addition, two pupils visited a local bicycle shop to interview the manager there. Their findings were presented as a rap.





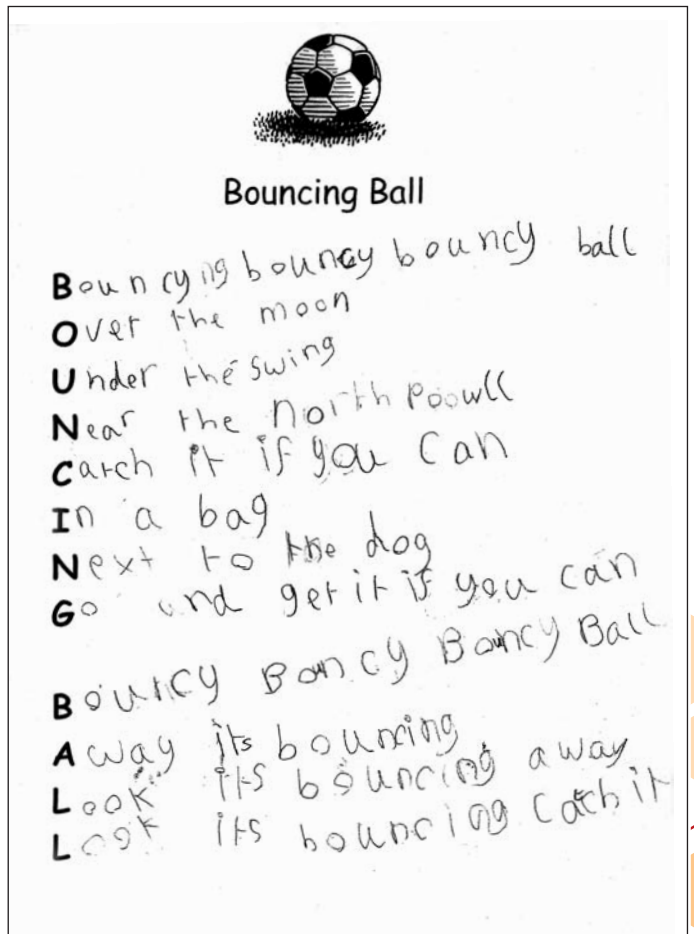


## Investigating balls

The teacher began by reading a story about 'Worried Arthur' who was no good at ball games. The problem for the class was: how could they help Arthur? The children responded with ideas for a softer, lighter ball, a small ball and a bigger ball - all with reasons why it would help. They finally agreed that a bouncier ball was what he needed. They observed six different balls and predicted which ball would be the bounciest and entered their choice on a chart. They decided on a fair test, which was carried out in groups. They counted the number of bounces as each ball was dropped. They recorded their results separate charts. Bouncing the balls in a hoop meant that the balls were not easily lost and confused with those of other groups.

Two other Year 2 classes observed different types of balls used in various sports. An electronic microscope was used to look at the materials of different balls at close quarters. One group took two photos for each ball, each of differing magnification. These were printed, laminated and displayed. The other pupils had to guess which balls the photos went with. Now they were familiar with the materials of manufactured balls, the pupils were given a variety of materials to make their own ball: sugar paper, cellophane, sponge cloths, cotton wool, elasticated silver string, sticky tape, fabric etc. The children made a great range of balls and spontaneously tested them against a commercially produced ball. They also investigated whether the surface the ball was bounced on made a difference to the height of the bounce. They used sand, carpet and a table top for the tests. As part of their communications linked to the topic, the children bounced and rolled balls of differing shapes and materials through paint and then onto paper to produce images. They also wrote acrostic poems, using the words 'bouncing ball'.

A different context for investigating the bounce of balls was given to a Year 5 class. Compared to the early years pupils, these junior aged pupils were expected to be independent; use more accurate measuring approaches; repeat measurements and be prepared to self-evaluate. The class received an email from a tennis coach who was planning to resurface courts at an indoor tennis centre. His question was: what materials should he use? The class thought he should go for one that allowed the balls to bounce high and straight and started planning systematically to investigate 6 or 7 options. How to measure the bounce of the ball and how to keep the tests fair were considered carefully. Most groups used metre-sticks and caught the ball at the height of its bounce and always tried 2 or 3 times to check their results. Despite this safeguard, many children said this was not a very accurate way of measuring. Most concluded, however, that concrete or tiles would be the best choice of material because they were both hard and smooth. They suggested other surfaces to try, including tarmac and AstroTurf. They finally emailed the tennis coach with their conclusions and advice.





## Observing how bodies change with exercise

A number of teachers asked pupils to work in pairs to observe what happens to the body before and after exercise.

A Foundation Stage teacher created the 'Mother Goose Olympics' for her F2 class in which they played a variety of games related to nursery rhymes. Between games the children were asked how they felt (hot, sweaty, heart beating faster etc) and were asked why. The children offered some imaginative explanations for the physical effect and the teacher then explained the reasons for these changes at an appropriate level for the children. Their discussions included why they felt thirsty and needed to drink whilst exercising.

Older pupils in other classes took more detailed measurements before and after activity, including using forehead thermometers as well as pulse rate. Some classes recorded their information on interactive whiteboards so that they could all see and discuss changes. Some investigations included finding out how different types of exercise, such as walking, jogging and skipping, affected pulse rate and whether length of exercise increased it.



## Training diaries

Another school ran a 'Mini-Olympics' for Year 2 pupils. In this case the younger pupils' Year 6 reading buddies acted as their trainers. At the beginning of the event, the pupils found their pulse and the Year 6 children learned how to calculate pulse rate. They predicted which of the activities would raise pulse rate most. While the younger pupils competed in games such as SAQ ladders, egg and spoon, bean bag throwing, skipping and ball bouncing, their older 'trainers' monitored them. All Year 6 children had a training diary for their 'Year 2 athlete' which they completed after each timed activity. They also made sure their athlete drank enough water and rested appropriately.



## Group presentation on body changes

During their sessions with a specialist PE teacher, a Year 5 class took a sequence of four still photos, showing the movement of the body as it prepared to run, during running, as it slowed down and finally in a resting position. They talked about the physical effects of exercise on the body including the functions of the heart, and voluntary and involuntary muscle action in PE and in class. Groups of pupils were finally asked to use the photos to create a storyboard for a class presentation based on the actions of the muscles during exercise.

## Diets for people doing sport

The teacher of a Year 3 class extended their work on healthy eating to consider the specific needs of people doing sports. They had already learned about food groups and a balanced diet. The children were asked to jog on the spot for two minutes and discuss body changes: faster pulse and heart rate. The next questions were 'What did athletes need to help them keep training for long periods? How did they get energy from food and why did they need to drink?' After a general discussion pairs studied daily diet information about a professional skater and footballers.



## Investigating factors that help sporting success

During World Book Day, a Year 4 class was having instalments of the Aladdin story throughout the day. When they reached the point in the story where Aladdin and the Moor were racing to get the lamp, the teacher asked who would get to the lamp first and why? Many thought it would be Aladdin as he was younger. Others thought the Moor would as he had longer legs. The teacher then showed them close-ups of their feet and invited the children to have a careful look before making another prediction. A discussion followed about bigger/smaller feet, pointy green nails, harder/stronger feet.

The teacher then focused the discussion on the big and second toes of each character. Aladdin's big toe was longest, but the Moor's second toe beat Aladdin's on length. Would this affect the outcome? The children were not sure. It was time for an investigation. First, the children measured their own big and second toes and recorded the results on a chart. Then in the playground as a class they observed a series of races until the eight fastest runners emerged. The teacher then explained that a longer big toe gives a natural advantage in sprinting and asked children to think how this could be explained in terms of forces. The teacher drew diagrams to explain, and finally she asked who would get to the lamp first, before the next instalment...

After studying the history of the Olympics and looking at the different events, groups of Year 6 pupils decided to investigate:

- Do people with longer legs run faster?
- Do taller people run faster?
- Do people with longer arms hit a target more often?

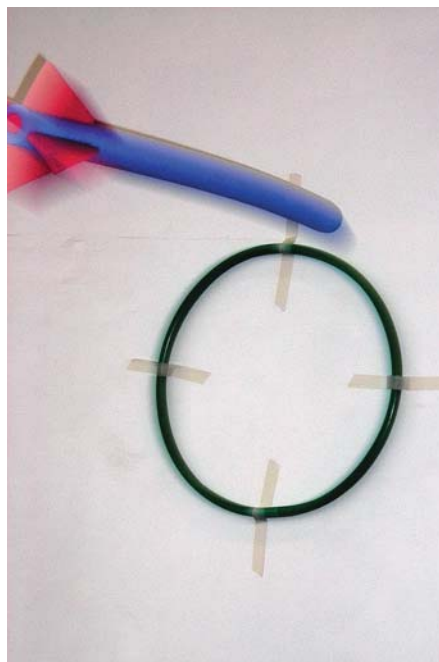
They carried out the running investigations over a fixed distance and timed them. An average of 3 attempts was calculated. In the throwing investigation, the children threw bean bags into hoops from a fixed distance. They did this 3 times and the accuracy was recorded i.e. the number of throws that hit the target. There were trials prior to the investigations to allow them to decide how far away the target should be in order to make a reasonable challenge. All the groups presented their results as bar charts and graphs in PowerPoint presentations.

### Investigating whether two eyes are better than one for sports

The teacher started the investigation by telling his Year 6 class about modern sports personalities (Colin Milburn & Gordon Banks) who had to give up professional sport after accidents affecting their eyes. He challenged the pupils to find out whether it was better to use one eye or two for activities that involved aiming at a target. They were given three activities to consider:

- 🟡 Javelins thrown at a hoop on wall
- 🟡 Beans bags thrown into a box
- 🟡 Plastic pucks slid to a target.

After an initial practice at all 3 tasks, some of the children predicted that using one eye would be best for certain games and sports e.g. darts, archery, shooting. The groups then did all 3 activities: first with one eye, then with two. The results were recorded on a sheet as ✓ or X for hit or miss. They tried each activity 10 times to get more secure data. They also discussed the problems of isolating the key variable (one eye or two). For example, they wondered whether the children watching were learning better techniques from the more successful children and whether continued practice made them more successful.



Result		Result	
Two Eyes	One Eye	Two Eyes	One Eye
1 ✓	10 ✓	1 X	10 ✓
2 ✓		2 X	
3 ✓		3 X	
4 ✓		4 X	
5 ✓		5 X	
6 ✓		6 ✓	
7 ✓		7 X	
8 ✓		8 X	
9 ✓		9 X	
10 ✓		10 ✓	
		11 ✓	
		12 ✓	
		13 X	
		14 X	
		15 X	
		16 X	
		17 ✓	
		18 ✓	
		19 ✓	
		20 ✓	
		21 ✓	
		22 X	
		23 X	
		24 ✓	
		25 ✓	
		26 ✓	
		27 ✓	
		28 ✓	
		29 ✓	
		30 ✓	

Bean Bag Aim

Javelin Throw

Target Slide

## Schools in the Project Spring & Summer 2008

- ◆ Catherine Infant School
- ◆ Coleman Primary School
- ◆ Dovelands Primary School
- ◆ Forest Lodge Primary School
- ◆ Heatherbrook Primary School
- ◆ Herrick Primary School
- ◆ Holy Cross Catholic Primary School
- ◆ Humberstone Infant School
- ◆ Linden Primary School
- ◆ Mayflower Primary School
- ◆ Mellor Community Primary School
- ◆ Northfield House Primary School
- ◆ Rushey Mead Primary School
- ◆ St John the Baptist C E Primary School
- ◆ St Joseph's Catholic Primary School
- ◆ St Thomas More Catholic Primary School
- ◆ Sandfield Close Primary School
- ◆ Scraftoft Valley Primary School
- ◆ Shenton Primary School
- ◆ Wolsey House Primary School



'Great hands-on activities.  
Practical ideas that really work!'

'The Pollen project has been an exciting, interactive and inspiring project allowing us to network, ask questions and learn from each other.'

Teachers' comments

**Further information:**  
[www.pollen-europa.net](http://www.pollen-europa.net)

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