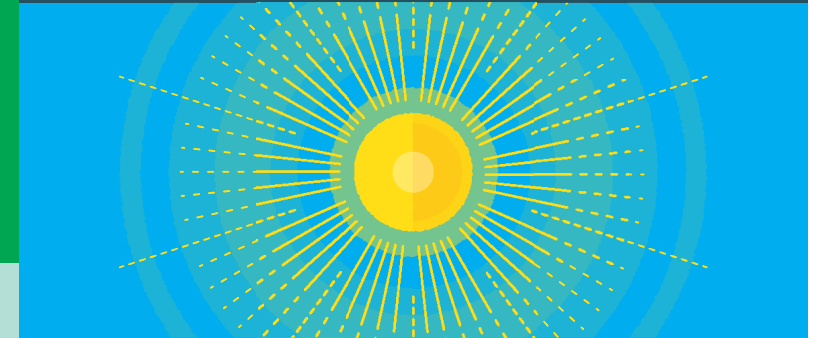
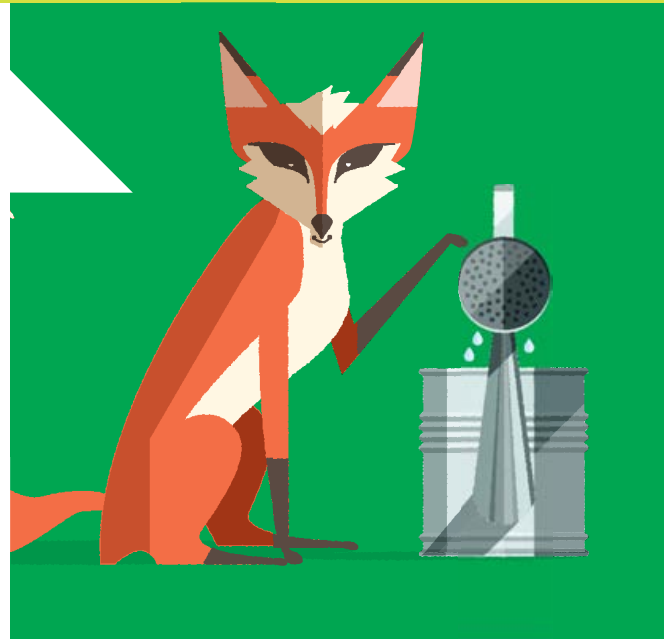


# LIGHT AND GROWING

## SCIENCE

### Learning objectives

- ◆ Observe and describe how seeds and bulbs grow into mature plants
- ◆ Find out and describe how plants need water, light and a suitable temperature to grow and stay healthy
- ◆ Set up simple practical enquiries, comparative and fair tests.
- ◆ Identify differences, similarities or changes related to simple scientific ideas and processes



## LIGHT AND GROWING

### Discover 73

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### Resources

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Activity sheet 3: Grow into the light 89

## LIGHT AND GROWING DISCOVER



Activity 1 duration: 45 mins

Activity 2 duration: 45 mins

Activity 3 duration: 45 mins

### Setting the scene

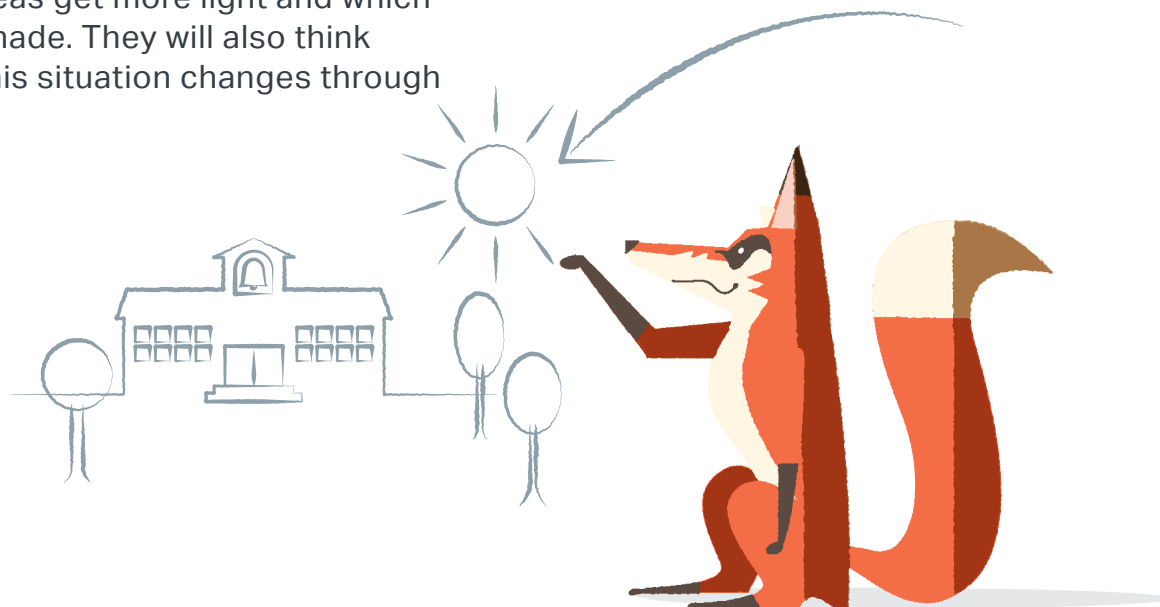
Explain to pupils that, in this topic, they will be exploring urban growing, by looking at examples of urban farms in London and by conducting experiments to learn how things grow in their surrounding communities.

There are three Discover activities to choose from in this topic; they follow on from each other but you don't have to do all activities.

Explain that designers of school grounds need to carefully consider the light and shade of their patch of ground. It is useful to know which parts get the most or the least light. This is especially true in cities, where plots can be shaded by tall buildings. If sun-loving plants are positioned in areas that are usually in shadow, the plants will not grow well.

Sometimes there can be too much light. Playgrounds for small children often have an area which is shaded by a canopy so that they can shelter from hot sun in the summer time.

In the first activity, pupils will survey the school buildings and grounds to work out which areas get more light and which have more shade. They will also think about how this situation changes through the day.



## LIGHT AND GROWING DISCOVER

### Activity 1: Thinking about shadows

Share Activity sheet 1: Map of Lumiere Primary School (page 86) with the pupils, and get out the colouring pencils. Blue can be used to show areas in shadow, yellow can be for places where the sunshine is hitting full-on.

If you are working in Years 3/4, you could ask the class to predict areas of light by colouring areas in blue if they predict that they will be in shadow, and colour areas in yellow if they think that they will be in sunlight.

If you are working in Years 5/6, you might like to ask half the class to shade their map to show where the shadows will be in the morning (when the sun shines from the East) and the other half can use their colours to show the situation in the afternoon (when the sun shines from the West).

Pupils should pay attention to the heights of the different buildings. Will some cast longer shadows than others?

Let pupils compare their map with someone from the opposite group. Do they agree with each other's work?

The trees should also be considered: will some of them get less light than the rest?

Is the car park in a sensible place? Does it need full sunlight?

### Extension Activity

Pupils can discuss the colouring these maps will need in the summer when the Sun is at its zenith. At what time will this be, allowing for British Summer Time?

Why do we not notice many shadows outside when it is a very cloudy day? The sun must still be there, even though we cannot see it. (We are all under the massive shadow of whichever cloud is in the way.)



## LIGHT AND GROWING DISCOVER



### Activity 2: Looking for shadows

Take playground chalks (of any colour) outside around the school grounds to mark the extent of shadows at different times of the day. The chalks can be used to show the outline of shadows on the playground and any other places where appropriate.

This can either be done by all the pupils at both times, or there can be half the class in a 'Morning Team' to mark shadows at say 10am and the other half of the class can be in the 'Afternoon Team' at say 2.30pm.

It must be a relatively sunny day, but if the morning starts out bright and then it suddenly rains in the afternoon, the Afternoon Team will have to wait for a better day.

**WARNING:** remind pupils that they are looking at shadows and they should never look directly at the sun. If they want to find the position of the Sun, they can face their own shadows and know that the Sun is behind them.

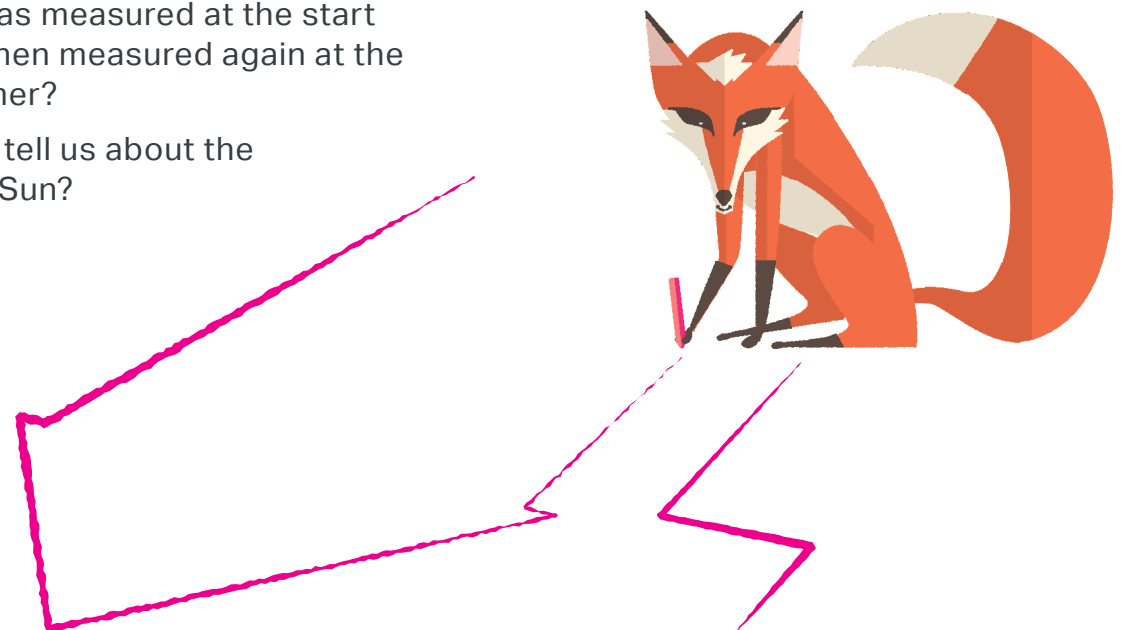
### Extension Activity

More confident pupils can consider seasonal variations while conducting this survey.

How would the length of shadows be different at another time of year? To make this fair they would need to be observed at the same time of day on each occasion.

Would the midday shadow of an object be the same if it was measured at the start of Spring and then measured again at the height of Summer?

What does this tell us about the position of the Sun?



## LIGHT AND GROWING DISCOVER



### Activity 3: Mapping the Shadows

Ask pupils to draw a simple map of their school grounds showing the main buildings and other areas. It does not have to be perfectly to scale, although they may benefit from doing a rough version first, to make sure they fit the main parts on.

This can be done individually or in small groups on A4 or A3 paper. Alternatively, you might like to draw an outline of the school grounds and distribute that to the class.

They may find it useful to look at a Google Earth image of the school and a large-scale local map before you begin.

Can they shade their map to show which parts will be sunny or shady at a particular time of day? They should use a compass to find East for the Sun's position in the morning.

If the school wanted to turn some of the grounds into plots for growing fruit and vegetables, which areas could be used? Would any rooftops be suitable?

How about light and shade inside the school? When the lights are turned off in the classrooms and in the hall, how far inside does direct sunlight fall? Does one side of a particular school building get more sunlight in the morning?



## LIGHT AND GROWING EXPLORE

### Explore activities: Growing in London

Before going on your trip, share Fact sheet 1: Growing in London (page 84) with the pupils. This will give them a unique example of urban growing in London, and should stimulate their interest for their trip.

If you have a small gardening area in your school grounds, you might like to use that for a lesson learning outside the classroom. Alternatively, you might like to take the pupils to a local allotment. Contact your local allotment association first, to gain permission and access. Or you could visit a local crop growing area to explore another example of urban growing.

Some good examples of these include:

### Hackney City Farms

**1a Goldsmiths Row, London E2 8QA**  
**020 7729 6381**  
**[education@hackneycityfarm.co.uk](mailto:education@hackneycityfarm.co.uk)**

This site was used by farmers and market gardeners as far back as the early 1800s. It was established in its current form in 1984 and is home to many animals. School groups can visit free of charge if teachers organise their own activities, but you must book in advance.

Various workshops run by the staff are available, including one on Growing Food.

It is also interesting to note the Projects section of their website, especially the Haggerstone Orchard Project which turned an underused area of a park into a food forest for the local community to enjoy picking and eating fresh fruit.

**[www.hackneycityfarm.co.uk/projects/haggerston-orchard](http://www.hackneycityfarm.co.uk/projects/haggerston-orchard)**



HACKNEY CITY FARM  
© Yukino Miyazawa



## LIGHT AND GROWING EXPLORE

### Stepney City Farm

**Stepney Way, London E1 3DG**  
**020 7790 8204**  
**info@stepneycityfarm.org**

A working farm in the East End, this is also a Rural Arts Centre and a community meeting place. There are three workshops with large glass fronts so the artists can be viewed at work, keeping alive traditional trades, crafts and arts.

30 pupils is the maximum that can be accommodated but teachers can conduct self-guided tours, or take up one of the many workshops on offer. Reading the list of ideas is like viewing a cornucopia of delights, with many aspects of food growth covered, also pollination and even waste management.

**www.stepneycityfarm.org/learning-and-courses/workshops**

It is very helpful that the education team here also put forward lots of ideas for post visit work, including suggestions for literacy,

### Chelsea Physic Garden

**66 Royal Hospital Road**  
**Chelsea**  
**SW3 4HS**

**<http://chelseaphysicgarden.co.uk/learning/school-visits/>**

Tucked away beside the Thames, Chelsea Physic Garden is the oldest botanic garden in London. Its walls shelter a unique living collection of around 5,000 different edible, useful, medicinal and historical plants. The Garden offers a wide range of educational experiences for school groups, which can be suited to cover many garden-related topics. They also offer outreach to schools. To learn more about their offers, visit their website or email

**education@chelseaphysicgarden.co.uk.**



STEPNEY CITY FARM

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CHELSEA PHYSIC GARDEN

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## LIGHT AND GROWING EXPLORE

### GrowUp Farms

**box@growup.org.uk**

**www.growup.org.uk**

This very interesting project uses aquaponics. The main growing area, Unit 84, is a working farm and not open to the public apart from its visitor centre.

However the GrowUp Box is set up as an example of what communities can achieve themselves. This is on the roof of a large car park in Stratford (E15) and school visits can be arranged by email.

It is also possible to organise outreach visits, with talks about their project and growing activities, including tasting of their produce.

For interesting pictures about growing methods to share with pupils, check out the videos and photos on:

**www.growup.org.uk/growup-box**

### Vauxhall City Farm

**165 Tyers Street, London SE11 5HS**

**020 7582 4204**

**www.vauxhallcityfarm.org**

A little piece of the countryside in central London, this place has lots of educational experiences on offer. Established in 1976 this farm specialises in educational, therapeutic and recreational services.

There are intriguing offers such as the Mobile Farm (so the animals can come to your school) and Incubation (so you can hatch chicks in your classroom).

**www.vauxhallcityfarm.org/schools**

More plant-centred pleasures include the Ecology Garden. There is also the possibility to Get Growing, whereby the farm staff can create a whole project with teachers to help a school set up its own food-growing space or wildlife haven.



GROWUP FARMS

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VAUXHALL CITY FARM

© 2016 The Growing City

## LIGHT AND GROWING

### EXPLORE

#### The King's Cross Skip Garden

**Tapper Walk, King's Cross, N1C 4AQ**  
**020 7790 8204**

**[generate@globalgeneration.org.uk](mailto:generate@globalgeneration.org.uk)**

The garden offers tours of their site, where a guide will explain how they grow the variety of crops and give you information about the materials used to build the garden. You might like to visit their skip garden café for lunch to try some of the garden's tasty produce.

The garden is open Tuesday – Saturday 10am – 4pm. You can contact them to arrange a visit via email.

**[www.kingscross.co.uk/skip-garden](http://www.kingscross.co.uk/skip-garden)**



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## LIGHT AND GROWING CONNECT



### Light and Dark in Growing – Two controlled experiments

Duration: 45 minutes introductory activity, 30 minutes follow up lessons

#### Setting the scene

Explain to pupils that they will be conducting two experiments to observe plant growth. They will monitor seeds and control the environments for their plants, in a similar way to the farmers in the Growing Underground company.

Ask pupils to consider which parts of a plant need light the most: seeds and roots or (green) stems and leaves? And which parts need to take in water?

### Activity 1: Dark Germination

The purpose of this activity is to observe germination and measure the quantity of water required by dried seeds.

Dried Runner bean seeds are recommended. They are large enough to handle and often have striking pink/ purple/ black patterns so they are more interesting for observational drawings. Broad (Fava) bean or Butter bean seeds will also do, but they must start out dried. Results will be better if packets of seeds for gardening are used, rather than culinary seeds.

Do not allow pupils to weigh individual seeds. It is quicker and far more accurate to use a large number of seeds (say a total of 40 per class), weigh them altogether and then divide the result by the total number for the mean.

Electronic weighing scales are preferable. When the seeds are germinating in the tray, some air is needed. If the cupboard where they are kept is airtight, leave the door ajar.

Share Activity sheet 2: Dark germination (page 87) with the pupils. Run through the sheet together, and demonstrate how to measure the length, breadth and thickness of the seeds. Take measurements and record observations as detailed on the activity sheet.

Let pupils know that they will not each be allocated a particular seed. It does not matter if a pupil draws and measures one seed for the first section and then a completely different seed for the second section etc. This is because all the data will be pooled for the whole class.

## LIGHT AND GROWING

### CONNECT



It is enough to know that when soaked, the seed sizes increase generally. But if you wish, all the dried seed lengths could be totalled and all the soaked seed lengths could also be totalled. Then average seed length could be calculated and the average increase in size.

#### Extension

Average seed weight and water uptake per seedling can be calculated. Some of the seeds might turn out to be duds. If say three of them do not appear to have expanded much after the soaking, then those can be discarded – but remember to divide by the reduced number of (say) 37 when finding the new average weight. Likewise with the germination stage.

If pupils were running a business and wished to grow 10,000 seedlings, what volume of water would they need?

#### Activity 2: Grow into the Light

It would be nice if delicate plants grown in classroom environments had high survival rates. But failure is often caused by unsuitable room temperatures, fungus, inappropriate watering and pests. For expediency, it is recommended that ready – grown pots of herbs are used for this experiment. Basil plants can be cheaply purchased from supermarkets. These do not contain a single plant but many seedlings and they will do for this test.

Pupils should do a light survey of the classroom. Switch off any electric lights and use a light meter to determine light levels at different parts of the classroom, including inside a cupboard.

How different are the results with the electric lights back on?

Can results be displayed in a chart?

Will afternoon readings be different from those taken in the morning for the same places?

Set up the experiment by placing the four plants in different conditions:

- ◆ Plant A, by window in full sunlight
- ◆ Plant B, back of classroom away from windows
- ◆ Plant C in a dark cupboard
- ◆ Plant D, away from windows but illuminated by a bright lamp to one side

Share Activity sheet 3: Grow into the light (page 89) with pupils. Encourage pupils to make predictions about how well the four plants will grow. Pupils to inspect the plants every 2–3 days. Review their predictions at the end of the experiment.



## THE SUN AND OUR SOLAR SYSTEM

### CONNECT



#### Data logging opportunity

During the experiment, over a couple of weeks, readings for light levels and temperature can be logged if you have the equipment.

Quantity of water is an issue: the class needs to decide if all the plants should be watered with identical quantities. Or should they aim to keep all four pots at a similar moisture level? The plants in more shady conditions will need less water to maintain the same level of soil moisture, provided they are not right beside a radiator.

Whatever is decided, different groups of pupils can take turns to gather the data each day.

Results for Plant C might be surprising at first. When deprived of light, plants often become 'leggy' in an attempt to shoot up and 'find the light'. But in the end Plant C will be sickly-looking.

Stems of Plant B should be bending towards the window, whereas Plant A should be more upright if it is positioned in the best light.

Plant D may bend towards the window, but if the lamp light beside it is strong enough, stems may bend towards the lamp instead. Any other classroom lights should be switched off whenever possible (at lunchtimes and home-time) so that natural light conditions prevail.



## FACT SHEET 1: GROWING IN LONDON



Growing a variety of plants in an urban city like London is often a challenge. We live in a densely populated city, so a lot of our land is used for housing. We don't have much space to use for agriculture in the city centre.

However, London is home to some very interesting and exciting examples of growing, using the small amount of land that is available. One of these is the 'Growing Underground' project which ingeniously uses old world war two air raid bunkers as a place to grow salad leaves and other edible plants.

### Growing Underground

Growing Underground is situated 33 metres below the busy streets of Clapham in South London. Their crops include a wide variety of micro-greens and salad leaves, which can be grown all year round in the pesticide-free environment that the tunnels provide.

Can you think of any problems with growing crops underground?

Two vital ingredients are needed to grow plants – water and light. Since neither of those are present naturally in the underground tube tunnels, the farmers at Growing Underground had to think out of the box to make their plants grow.



GROWUP FARMS

© 2014 GrowUp Urban Farms Ltd



## FACT SHEET 1: GROWING IN LONDON



To provide enough water, they use hydroponic systems, which need 70% less water than traditional open-field farming. Since the farmers control exactly how much irrigation each plant gets, they don't waste any of this valuable resource.

Providing the plants with the best quality light was more tricky – it wasn't possible to capture the sun's rays and transfer them straight to the plants underground. The farmers had to build their own artificial light system in the tunnel and for that they used LED (Light Emitting Diode) technology. This allows the farmers to control the intensity of light that each plant gets.

The farmers can control everything that the plants are exposed to. They have adjusted the environment to produce what they think results in the tastiest crops. Their greens aren't affected by the weather or seasonal changes

### King's Cross skip garden

This garden is in zone one, in an old bus depot, right next to King's Cross station. It is a charming oasis growing wild flowers, vegetables and herbs. Beehives, chicken coops and yurts are dotted about in the space.

Everything has been built from upcycled materials, which were mostly found in the building site when King's cross station was being redeveloped. Lots of local young people

(named 'Generators') were involved in creating the garden and many still help with maintaining the garden today. Some even work in the on-site café, turning their lovingly grown crops into delicious lunches. As well as growing food, tending beehives, creating furniture and making jams, the Generators learn how to market and sell their produce.

The skip garden is open to the elements, so the amount of light and water that the plants get cannot be controlled in the same way as in the 'Growing Underground' project.

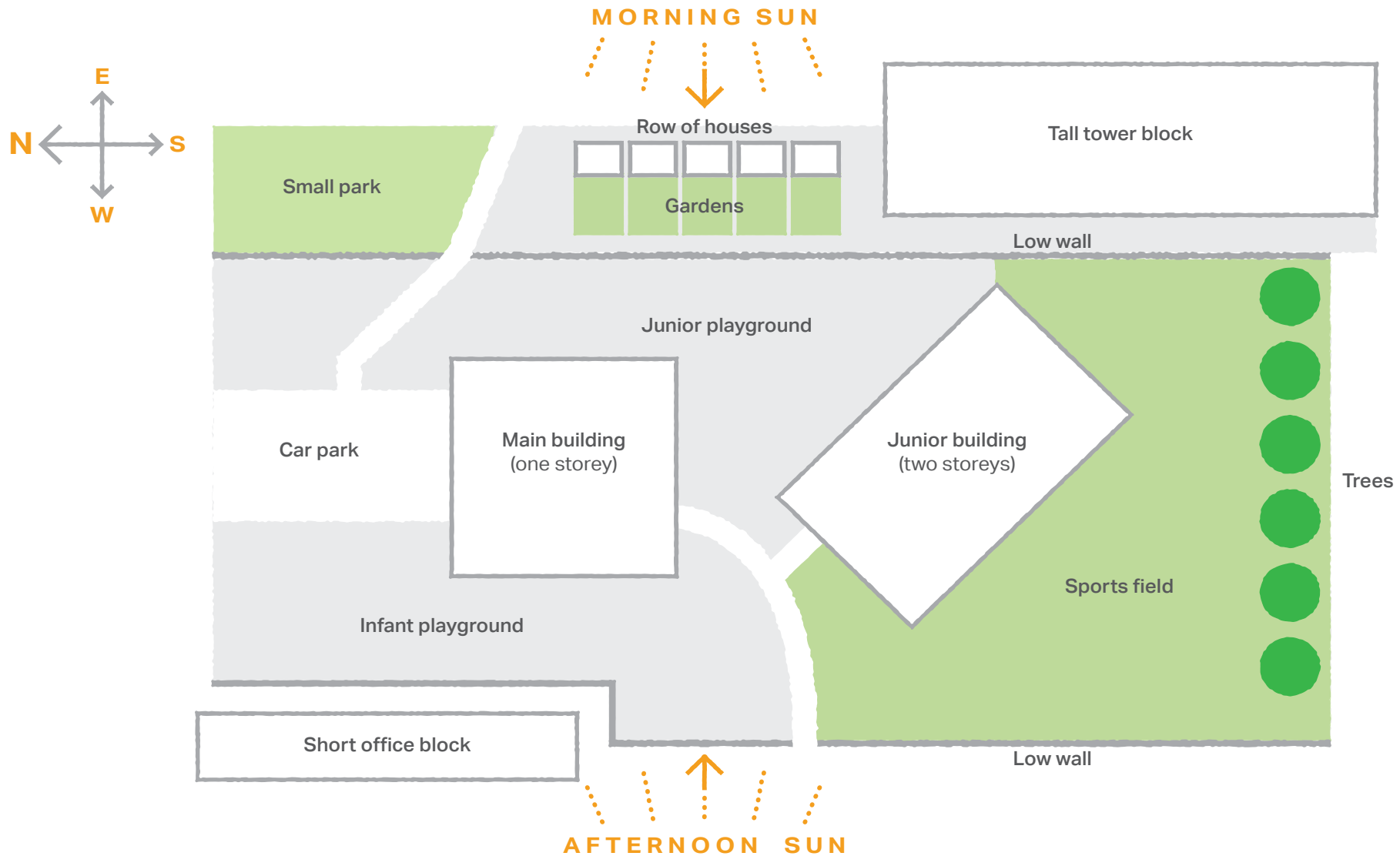
[www.globalgeneration.org.uk/about-the-skip-garden](http://www.globalgeneration.org.uk/about-the-skip-garden)



KING'S CROSS SKIP GARDEN

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## ACTIVITY SHEET 1: MAP OF LUMIERE PRIMARY SCHOOL



## ACTIVITY SHEET 2: DARK GERMINATION



Seeds may be small but they are amazing.

Inside each seed is a tiny new plant, along with its own food supply to get it started. It is as though the tiny plant has its packed lunch in with it!

But the food is often dry. This means that the seed can last for months without going rotten. So before the tiny plant can use its food and start to grow, that food must be hydrated.

*Question:*

Remember one gramme of water is one millilitre of water. How could you work out the volume of water taken up by all the germinating seeds?



### Stage 1

Date:

Observational drawing of a dry seed

---

### Measurements of dry seed

Length:                      Breadth:                      Thickness:

Estimated total weight of all seeds:

Actual total weight of all seeds:

## ACTIVITY SHEET 2: DARK GERMINATION



### Stage 2 instructions

Put all the seeds in a jug of water to soak, in a cupboard. One to two days is plenty, if they are at room temperature. Afterwards, take them out of the jug of water and gently pat them dry with a paper towel before the next stage.

### Stage 3 instructions

Place each soaked seed on its side, on top of several layers of very wet paper towel in a large tray. Then put them all back in the cupboard. After a few days, place each seedling on a dry paper towel for drawing. Then hand it in for weighing altogether with the other seedlings.

#### Stage 2

Date:

Observational drawing of a soaked seed

#### Measurements of dry seed

Length:                      Breadth:                      Thickness:

Estimated total weight of soaked seeds:

Actual total weight of soaked seeds:

#### Stage 3

Date:

Observational drawing of a seedling

#### Measurements of seedling

Length (top of shoot to root):

Estimated total weight of all seedlings:

Actual total weight of all seedlings:

## ACTIVITY SHEET 3: GROW INTO THE LIGHT



Different kinds of plants are adapted to live in different situations. Ferns grow well in shade and damp. Cactus plants can cope with harsh sunlight and dry conditions.

But whatever they are adapted for, if plants are placed in an unsuitable environment, they will not do well. Predict what might happen in these different situations below.

Label each pot A, B, C or D on one side only. The label stickers indicate the front of each pot.

<p>Plant A – <b>By window in full sunlight</b></p> <p>My prediction:</p>	<p>Plant B – <b>Back of classroom away from windows</b></p> <p>My prediction:</p>
<p>Plant C – <b>In a dark cupboard</b></p> <p>My prediction:</p>	<p>Plant D – <b>Away from windows but illuminated by a bright lamp to one side</b></p> <p>My prediction:</p>

## ACTIVITY SHEET 3: GROW INTO THE LIGHT



*Questions for class discussion:*

1. If this experiment is to be a fair test, which of these factors must be kept the same for all four plants?
  - ◆ Amount of light?
  - ◆ Quantity of water given? Or moisture level of the soil?
  - ◆ Temperature? If temperature drops at night-time, do all four plants get the same drop?
2. In your classroom, are there skylights in the ceiling? Are there electric lights which are switched on all day?

If so, plants B and D should have something placed above them to shade them from the overhead light.

3. How will you record the progress of the different plants?

Do the leaves seem to point in different directions on different plants?

Daily photography might be quicker than lots of drawings. But whichever way, make sure the plants are put back the same way around as before, with their label A, B, C or D facing the front.

4. If some of the stems start to lean to one side, would it be possible to get them to grow straight up again?

