



# Science in Cycles

All taking requires giving back

Seasonal Cycles



Within systems, certain configurations of relationship appear again and again in patterns such as cycles and feedback loops. Understanding how a pattern works in one natural or social system helps us to understand other systems that manifest the same pattern.

Members of an ecological community depend on the exchange of resources in continual cycles. Cycles within an ecosystem intersect with larger regional and global cycles.



The passing of a year can bring a marked change in the weather and the surrounding environment. The four seasons — winter, spring, summer, autumn — can vary significantly in characteristics, and can prompt changes in the world around them. This annual seasonal cycle can be observed and experienced on any number of levels, from the global to the microscopic, and from the purely scientific and physical to the cultural and emotional.

Frame	Understanding	Transferability	Experience	Empowerment	Values
Is there a frame providing a story?	Are scientific concepts of life involved?	Are different areas of life included?	Do learners get in touch with outdoor settings?	Are learners empowered to shape a sustainable future?	Are self-transcending values promoted?
<b>YES.</b> The idea that <i>'all taking requires giving back'</i> sets a strong frame for this project. This frame connects the values (see final column) to the other areas of the model. If embedded into thinking patterns through the learning, this frame provides a strong basis for sustainable thought process applied to other situations, topics or life events.	<b>YES.</b> The concept of cycles, which is key to most systems, is at the heart of this project. By exploring the pieces of science and the processes behind them, the patterns of the seasons can be used to give these context and meaning in the bigger picture of life on the planet.	<b>YES.</b> Seasonal cycles are experienced on every level, from the purely physical to the emotional and from the global to the personal. Activities in this session will draw on areas from across these spectrums, allowing active transfer of the understanding, experience, values, empowerment and frame to other areas of life.	<b>YES.</b> The activities will connect the learners with the outdoor setting of the woodland, and the wider picture of the world and universe in which the woodland is set. Seasons are not just something we observe, they are also deeply engrained in our culture and daily lives. Learners will be able to explore these facets of the seasonal cycles with head, heart and hand.	<b>YES.</b> The learners will work closely together in their exploration of the seasonal cycles in the woodland and beyond. This will allow them to collaborate, sharing feelings and experiences, recognise their connectivity to the world around them and to take ownership of their own learning.	<b>YES.</b> The values around respecting and caring for nature and our shared planet will underpin this session. Through direct and close contact with the natural environment, and through recognising our deep connectedness and interdependence to all things these values will be strongly promoted.



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	Description	Resource
<p><b>Raising Curiosity</b></p> <p>(group names: Spring seedlings, Summer Growers, Autumn Bounty)</p> <p>10.00 – 10.40</p>	<p><b>Meet and greet:</b> Offer four fruits, three seasonal and one out of season....where is it from? How has it been grown?</p> <p><b>Seasonal image hunt:</b> To scatter image and facilitate collection and placing into brush quartered circle.</p> <p><b>The seasonal grottos.....</b></p> <p><b>Harvest festival:</b> Ask everyone to bring something from their gardens.</p> <p><b>Taste the seasons:</b> Marrow chutney, blackberry jam, green bean chutney, pickled spring onions, mince meat, bread.</p> <p><b>What do you love about the seasons?:</b> Write what you love about... (tie on/pin up) Spring (bud) Summer (flower) Autumn (leaf) Winter (snowflake)</p>	<p>Tray, 4 x bowls, 4 x fruits/seasonal edibles.</p> <p>Jigsaw</p> <p>Set up structures on previous day.</p> <p>Produce, grotto decorations.</p> <p>Bread, chutneys, cutlery.</p> <p>Card, paper, pens, poems, pictures, natural paints (blackberries, mud etc). Grotto decorations and titles.</p>

<p><b>Transferability</b></p> <p>10.40 – 12.00</p>	<p><b>KS3 - (Autumn bounty)</b></p> <p><b>Us –</b> Our connections to the seasons, what do they mean for us? Develop thinking and sharing around the seasonal grottos. Developing openness and sharing of thoughts and feelings with others. Learners take each other round the grottos sharing their experiences of the different seasons.</p> <p><b>The Woodland –</b> Tree rings and other connected cyclical events. Investigating tree rings on felled stumps in the woodland, connecting these to the science of climatic variations on seasonal, annual and longer timescales.</p> <ul style="list-style-type: none"> <li>- Give pairs a tree round. What does this tell you about seasonal cycles? Discuss in pairs then share a summary with the group to explore current knowledge.</li> <li>- Short discussion about holistic science. How does this relate to what we have done in previous sessions, how can we use it to help us think in a broader more connected way? Pieces, patterns and process.</li> <li>- What are the pieces of the science involved in tree rings? What patterns are there we could explore? Which processes might</li> </ul>	<p>Grottos, paper, pens.</p> <p>Tree cross sections.</p> <p>Three different coloured</p>
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	<p>we explore that relate to this aspect of seasonal cycles?</p> <ul style="list-style-type: none"> <li>- Explore the celestial cycles of seasons wherever appropriate in this discussion (be open to the outcome).</li> <li>- In pairs use paper and pencils to mark off the tree rings from the log round. Identify rapid growth years and stunted growth years. What might the processes be that have caused this, and where do they fit with the patterns?</li> <li>- Introduce climate graphs and what they show. Which are most relevant?</li> <li>- Is it possible to date the tree rings using the graphs? Correlate dates to the paper tree ring mapping.</li> <li>- Can we relate these dates back to your experiences and memories of particular years and seasons that hold significance for you? What else was happening at that time? How did the patterns and process that had an impact on this piece (the tree) affect other areas of life? Floods....draughts.....high price of wheat....poor holiday season for the Welsh coast....?</li> </ul> <p><b>The Planet</b> – The celestial drivers of the seasons, and variation in variation for others across the planet. Recreate in miniature the celestial movements of Earth and Sun, trying to fathom their size relation and relationship in the universe.</p> <ul style="list-style-type: none"> <li>- Give learners marbles to represent the Earth. Use a ruler and tape measure to then work out relative sizes and distances of other bodies (sun and moon). Recreate these if time and space allowa.</li> <li>- Earth= 4x diameter of moon. Moon = 30x Earth’s diameter away from Earth.</li> <li>- Sun = ~100x diameter of Earth (400x diameter of moon), it is also 400x further away from the Earth than the moon (therefore the perfect total eclipse!).</li> <li>- Introduce the 23.5degree tilt of the Earth, and it’s almost circular orbit of the sun in 365.25 days. Add in the one rotation of Earth per 24hrs.</li> <li>- Use a torch to represent the sun, spinning an apple on a skewer to represent the Earth on its tilted axis. Orbit the apple around the sun (torch) to explore the seasonal variation in insolation. Elicit the impacts this would have on the climate at different points on the globe.</li> <li>- Repeat this orbit having given learners new places to live on the planet. Get them to shout out what season they are experiencing as the Earth orbits the sun over the course of a year.</li> </ul>	<p>paper/card. Pens.</p> <p>Pencil and paper.</p> <p>Climate graphs (rain and temp from local weather station)</p> <p>Palates ball (sun), marbles (Earth), pebble (moon). Ruler, tape measure, calculator.</p>
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10.40am – 11.15:  
Small picture to big picture.

**KS2** – (Summer growers)

**“the Rhythms of the Seasons”** – (*EXPERIENCE*)  
 Seasonal areas marked out. Start with Winter, give a verbal guide to the season e.g. “In the old days this was the beginning of the year, the harvest had been brought in, the leaves fallen, some birds flown, some animals hibernating... less daylight, more cold, time to light fires, tell stories, snuggle down and keep warm...” –then divide the group into 4 and give them 3 minutes to each come up with a movement and sound that represents winter to them. Bring the 4 groups together and each ‘performs’ their sound/action to the others. Encourage positive feedback for each one - ‘what did we like about it?’ Then Cath in middle as ‘conductor’, cueing sounds as if in an orchestra....Bring it out loud, let it fade away, start and stop abruptly, one at a time or all together... – have some fun with the sounds and feel that winter rhythm!!!  
 Repeat for spring, summer and autumn. (5 minutes each). If time, get the seasonal sounds all together and conduct “The 4 seasons!”

Pictures of seasons on trees to mark out areas

11.15 – 11.40

– Split into 3 groups for more seasonal explorations and experimentations:

- **A Journey into Space to discover why we have seasons** (*UNDERSTANDING, TRANSFERABILITY*)

**Activity**

We’re taking a journey into space to see why we have seasons ...

1. Elicit what group know about earth sun (and moon?); day & night
2. Are we in Wales nearer or further from the sun in summer and in winter?

What about in spring/autumn equinox (=now)?

3. Set up sun – & show path for elliptical orbit from diagram. Have fun walking the path and turning – pretend you are the earth!

Ask question – winter and summer are the same distance, but we said we must be closer in summer and further away in winter, so what have we missed?

4. Earth tilts @ 23.5 degrees, so get them to space

Something to represent the sun, earth, moon.

An area marked out on the ground that represents the earth's path round the sun - large enough for people to pass 'the earth' round and also circle round themselves.

A bright torch.

Diagram of Earth’s rotation through seasons



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themselves out along elliptical orbit and pass the globe around – **keeping it at the same tilt**

5. Keep passing it around, and stop it at summer and winter points to examine the difference in sunlight in Wales – call everyone over to look at these stopped points

6. Look at how the tilt affects sunlight at the equator, and ask the question, are there still four seasons at the equator?

7. If time, look at southern hemisphere, and vernal and autumnal equinoxes

- **Tree Survival!** (*UNDERSTANDING, TRANSFERABILITY*)

### Activity

How do trees survive through the harshness of winter?

*elicit dropping leaves etc*

How do they know to drop their leaves, how do they know it's autumn? (Yesterday was the autumnal equinox, in the Northern hemisphere. What's happening at the equinoxes?)

*ensure understanding of shortening, then lengthening days as triggers – light warmth etc*

*Show Field Studies Council photohours chart , discuss effects*

From now until winter solstice there will be less light ...fewer photohours per day, less energy for photosynthesis. So in order to survive the winter, what processes, what strategies could a tree use now?

*ensure understanding that deciduous /broadleaf tree drops leaves, conserving energy used to circulate water and nutrients to/from leaves ... dormant phase*

*(evergreen /coniferous originated in harsher climates, developed strategies to photosynthesise all year long - tough, tiny water-retentive leaves (needles), shed regularly)*

Photo-hours chart

Leaf Spectrum charts (with double sided tape)

for extension activity, pencils, crayons



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What happens to the leaf before it falls off the tree?

*dies / changes colour/ goes brown*

Introduce leaf spectrum chart, explore vocabulary / names of different carotenoids etc, ask children to find as many different coloured leaves as possible in 5 minutes (*take off double sided tape so they can stick leaves on*)

Call them back, explore findings, explain that these colours are mostly in the leaf all the time, but we don't see them because the green chlorophyll is what there's most of .

As the days shorten and the photo hours – the hours of daylight – decrease, less chlorophyll is produced, so the green colour fades away and the other colours are revealed.

In autumn, when the leaf is getting ready to drop off, the sugars that are trapped in the leaves help produce lots of anthocyanin that gives deep reds and purple colours to the leaves, that we see clearly once the remaining chlorophyll decomposes and fades away.

Discuss colours in other parts of plants, too. Where do you think we might find them?

*fruits, veg – different colours of veg tend to have diff types of vitamins and minerals, which is why it's important for us to eat food that's all colours of the rainbow*

## Extension activities

a) draw a fruit or vegetable that contains this compound beside the name on spectrum chart

### b) Exploring leaf-drop

We know that the leaves fall off the trees... but how do the trees drop their leaves?

Pick up a leaf and take a look at the end where it came off the tree. What do you notice?

*observations ... bumpy nodule at end of leaf*

Introduce abscission layer ... cells that the tree produces



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	<p>that form a seal, a cork-like substance that seals off the leaf, cuts off supply of water from the tree. As abscission layer dries, it contracts, breaks and the leaf falls away.</p> <p>show diagram</p> <ul style="list-style-type: none"> <li>• <b>What's the point of seasons?</b> (TRANSFERABILITY, EMPOWERMENT)– Using big paper and pens, elicit ideas for ‘what’s the point of /Spring/Summer /Autumn/ Winter?’ – divide each page into 3 groups - humans, plants(flora), animals (fauna) and note what each group does (‘gets out of’) each season. The get a 4/4 clap/click rhythm going and create a ditty using these ideas e.g. <i>(beat – clap/click)      everyone chants:</i> 1-2-3-4      “what’s the point of Summer 1-2-3-4      what’s the point of Summer 1-2-3-4      what’s the point of Summer 1-2-3-4      Tell me now! 1-2-3-4      Sally – 1-2-3-4      <i>(Sally chants an idea)</i> 1-2-3-4      Tommy- 1-2-3-4      <i>(Tommy chants an idea)..... etc</i></li> </ul> <p>During lunch – set 4 challenges in Seasonal areas used for first exercise:</p>	<p>big paper, pens )or whiteboard)</p>
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	<p><b>Foundation Phase (Spring seedlings)</b></p> <ul style="list-style-type: none"> <li>• At the meeting circle we will look at where the sun is in the sky (use a stick to mark our shadows)</li> <li>• Talk about how many autumns we have all seen – one a year since birth</li> <li>• Look for signs of autumn and collect things</li> <li>• Put things we found out on the gold section of the cloth (gold for autumn, silver for winter, light green for spring and dark green for summer)</li> <li>• Talk about what will happen next with the colourful leaves and the nuts – place pictures on the other cloths.</li> <li>• Be scientists and do an investigation – collect lots of colours and lots of shapes of leaf; do different trees go different colours in autumn?</li> <li>• Talk about what the animals in the woods are doing now and what they will be doing next in winter. – dormouse hibernation. Make hibernation nests and test how well they would keep a dormouse warm using fur covered little bottles of warm water and seeing how well they kept their heat in the nests.</li> </ul>	<p>4 cloths,</p> <p>pictures, nests</p> <p>black felt to display coloured leaves</p>
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	<ul style="list-style-type: none"> <li>• Go back to the meeting circle to see if the sun has moved. Explain it is actually the earth that moves – see if we can feel the spin.</li> <li>• Go to the sun in the season grotto. Rotate ourselves to get the idea of day (when we can see the sun) and night (when we can't) Demonstrate that the model sun is staying still and it is us – the earth – that moves. The sun looks different in the morning as it first comes into view and we can see it out of our right eye than when we look at it full on at lunch time...etc. probably far too complex but hey....let's just do it.</li> <li>• Then we – the earths – move around the sun through the seasons while rotating for day and night and trying not to fall over from dizziness.</li> </ul> <p>Start the 'seasons in the wood go round and round' song to the tune of 'wheels on the bus' – just the first couple of verses.</p>	<p>'dormice, flasks with hot water, pictures of dormice nests</p>
12.00– 13.00	Lunch and free-play – <b>Where in the world is your food in season now?</b>	Eat seasonably poster. World map.



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<p><b>Exploring Self-direction</b></p> <p>13.00 – 14.00</p> <p><b>1-1.45pm</b></p>	<p><u>KS3</u></p> <p><i>All taking requires giving back –</i></p> <p>Looking for ways to link the pieces, patterns and processes of the seasonal cycles in the woodland and their connectivity to our own seasonality.</p> <p>Exploration through scientific, literary or artistic means.</p> <p>Facilitate some self-directed learning or expression. Asking questions such as:          What interested you?          What would you like to find out?          How might you go about that?          What might you need to help you do this?          How might you share this with others?</p> <p>Bring together self-directed elements and decide how to share with the rest of the group.</p>	
<p>1.40pm</p>	<p><u>KS2</u></p> <p><b>Development of theme, self-direction. (EMPOWERMENT, GREEN COMPETANCES, VALUES)</b></p> <p>Back to the 4 marked out areas....</p> <p>Brief introduction to idea of climate change – going to have to do some things differently, use our imaginations and skills to stay fed, warm, happy.... One thing we can try and do more of is grow our own food – concept of food miles, fuel use vs seasonal, local veg. So imagine you have a little garden somewhere and are going to grow as much as possible of your own fruit and veg.... But – there are some difficulties with your garden, and they are seasonal....</p> <p>Pre-set 4 challenges, see if the group can together decide on which ones to tackle, how to do it..... AND DO IT!</p> <ol style="list-style-type: none"> <li>1. Winter challenge – hard frosts likely to kill roots of young fruit trees – what to do? (collect leaves to mulch round trees)</li> <li>2. Spring challenge – want to start growing as early as possible – but could be a late frost and kill seedlings – how to keep them warm and safe? (build a ‘polytunnel’ – bender + plastic)</li> <li>3. Summer challenge – not enough rain – and nearest tap is miles away (and rainwater is better than chlorinated water anyway! (build a rain collector – hearken back to first ‘water’ session)</li> <li>4. Autumn challenge – fruit will be ready to pick in a couple of weeks – but get fierce winds, going to blow fruit off the trees..... (build a hurdle-type screen)</li> </ol> <p>As groups are working, get them to start thinking about what they’d like to share with the rest of the group about what they’ve learnt /done today...</p>	<ol style="list-style-type: none"> <li>1. in Winter area - sticks in ground to represent young fruit trees (with pretend fruit on if want!), check there are leaves or other mulchable material nearby. If nec - gloves to collect mulch.</li> <li>2. In spring area -mark out a pretend veg bed, with nearby withy, string, plastic sheeting.</li> <li>3. in summer area - plastic sheeting, thin rope / string, nearby small pebbles (to wrap in corners of sheet, to enable tying it down). Trees available to hang sheet off, large stone for weighing it down, bucket for water collection.</li> <li>4. In autumn area - enough light branches,</li> </ol>



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	<p>Admire what's been done to resolve the challenges then 15 minutes to work on what to share and how to do this.</p>	<p>sticks, string to construct a basic hurdle/windbreak. For all - scissors/knife for cutting string. Secateurs/loppers for cutting small branches /withy.</p>
	<p><b>Foundation Phase</b></p> <ul style="list-style-type: none"> <li>• See how the hibernating dormice are doing</li> <li>• Frederick story (about collecting and storing food for winter but also collecting and storing memories ... i.e autumn as a time of reflection)</li> <li>• Children given corn dolly baskets to fill with things and memories and words and whatever they want</li> <li>• Go and look at where the sun has moved to</li> <li>• Practise song again</li> </ul>	<p>Book</p> <p>Baskets</p>
<p><b>A sharing community</b></p> <p>14.00 – 14.30</p>	<p>Bringing all age groups back together to share their experiences of rocks from throughout the day. Use the large jigsaw as the basis for sharing (in a large crescent of log rounds).</p>	<p>Set up suitable space for sharing.</p>



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Extending the thinking –

- Is climatic change having an impact on the seasons? What will we expect to happen to summer rainfall, or winter temperatures for example? How will this affect plants and animals?
- How do seasons work in the Southern Hemisphere? Are they different to ours?
- What other seasonal cycles are experienced in other parts of the world India or Equatorial Africa for example?
- How are certain animals adapted to deal with seasons in different parts of the world such as in the Arctic Circle where photo-hours vary hugely through the year?

## SOME FOLLOW UP ACTIVITIES

### Life through the seasons

Imagine you are an animal getting ready to hibernate ... what do you need to do? Write or tell someone a story about your preparations, or make yourself a 'to do' list, planning everything you will need to stay comfortable through the winter.

**Spend some time near you favourite deciduous tree** ... once its leaves have dropped away, it will be dormant through winter. Write a poem or a few words imagining its dreams of springtime.

### Autumn colours

Find out more about colours in fruits and vegetables. Explore why it's a good idea to eat a rainbow of fresh foods:

<http://healthyeating.sfgate.com/colors-fruits-vegetables-play-important-role-1660.html>

<http://www.csa.com/discoveryguides/food/review3.php>

**Try a science experiment:** Leaf Chromatography! Find out how to explore the different colours in leaves at <http://www.education.com/science-fair/article/find-color-pigments-hidden-green/>

### Living with the seasons

If we conserve food that we grow locally, we can eat it even when it's not in season, and reduce the costs and emissions caused by transporting foods across the planet. What are some ways that we could do this? Try to think of three ways you could preserve an apple!