THE RAINBOW

Box Art Group Newsletter - Tuesday 28th November 2023

Written by and for the members of Box Art Group (No. 92)

Contents

Music

Music is everywhere, all around us in the air, on land and water.

My charcoal painting was inspired by the music composed by Keith Hyett. Much of his music was inspired by poetry and the countryside around him, the forest, hills and rivers.

For about a year I have been going to Hanover art in Nailsworth. During the Summer we were challenged to do a larger project to last over several weeks. It actually took me about 3 months. I was thinking of Keith Hyett's latest CD Dancing on Strings. I had an idea about notes bouncing off his guitar strings and morphing into birds flying into the distance. It is the first time I have done anything like this and is larger than most of my work, about 32 x32cm. It is now framed and hanging in its new home.

Ann J

Tip of the Month

For those of us who use acrylics, which once applied to the palette tend to dry out rather quickly, you might try asking Santa for a box of Ferrero Rocher chocolates in a square plastic box with lid. Give the contents away, and use the box and lid for your paint. Line the base with a couple of sheets of paper towel, and cover this with a sheet of greaseproof paper. Add water to dampen the paper, pour off any excess, fit the lid and use this as your palette. This will keep the paint workable for at least a week.

Pete

The Music of Visual Patterns

Music comes in waves. The pressure waves caused by backwards/forwards movements of the air striking our ears, and the “pitch” we hear corresponds the fundamental frequency at which the wave oscillate. Any musician, however, will tell you that “pure” tones, such as produced by a tuning fork, are not typical (and in fact are quite boring). Most instruments produce sounds that consist of the fundamental note overlain by higher harmonics (multiples of the fundamental frequency). The characteristic timbre of the instrument we hear is created by a combination of the relative amounts of each harmonic in the mix and the “attack” and “decay” of the note (that is, how it starts and ends). Electronic keyboards can therefore simulate the sounds of a variety of instruments using a computer chip that has been given the recipes for each instrument, and if you are prepared to pay for the right amount of computing power they can be surprisingly convincing.

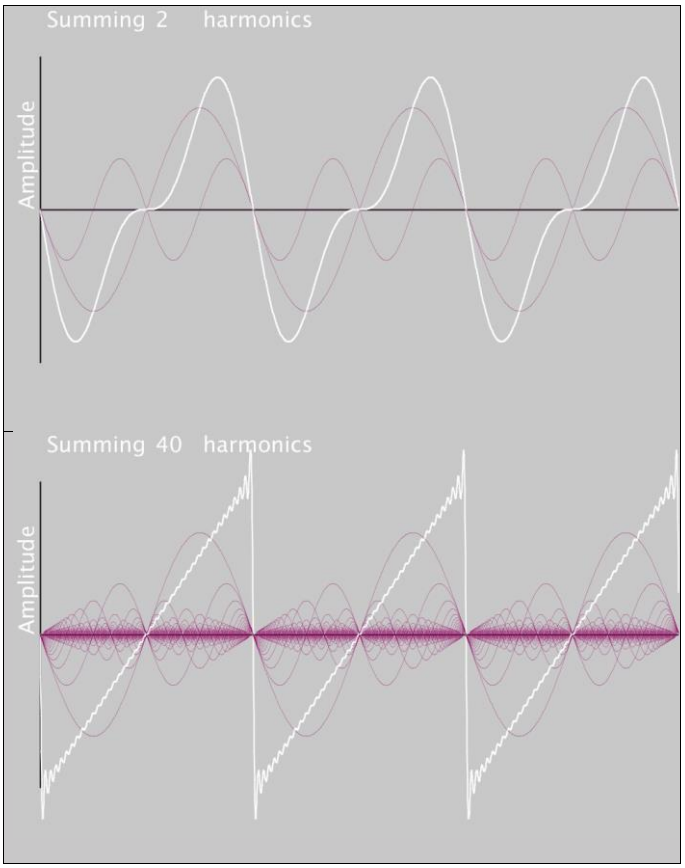


Figure 1: Building waveforms with harmonics.

Mathematics says that you can construct *any* regular wave form (that is one which repeats itself in time in successive cycles) by adding the required number harmonics in the right proportions, and this works even when the wave shape you want to construct has sharp changes of amplitude. Brass instruments, for example, rely on vibrations of the musician’s lips, which keep interrupting the air flow, leading to jagged wave-forms.

Figure 1 shows plots of the variation of pressure (up and down) with time (left to right). The upper graph shows how adding just one overtone, with twice the fundamental frequency, to the smooth wave of the fundamental can change the shape of the wave. The bottom graph shows what happens when we continue to increase the number of overtones up to the 40th harmonic. (We need to add about 200 harmonics before we really sharpen up the edges of the sawtooth to the point where the “ringing” - rapid oscillations as the curve changes direction - is no longer noticeable.)

The take-away point is that any undergraduate engineer, mathematician or physicist knows how to apply well known recipes - so-called Fourier transforms - in order to create waveforms of any desired shape by adding simple harmonics. Professional engineers and scientists need to decompose vibrations into their harmonics all the time for everything from understanding the behaviour of atoms with their orbiting electron, to designing electronics, to working out how wind-induced vibrations might cause bridges to fall down.

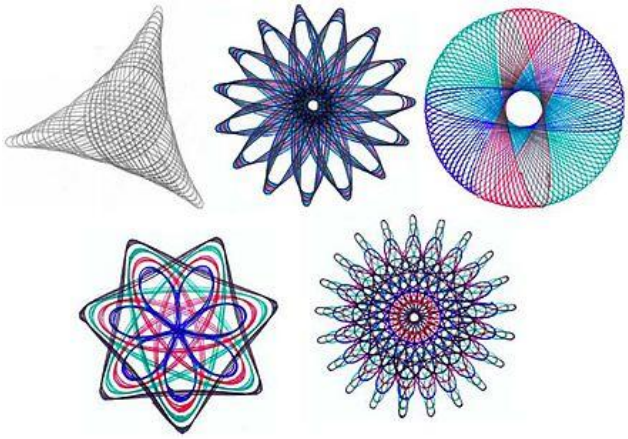
There is, of course, a pattern here: the each of the wave’s cycles is exactly like the one before. In fact, we just need to draw one cycle because the rest of them are all the same. We might as well bend the graphs of Figure 1 around into a circle, where instead of going up and down as we move left-to-right, we go in and out as time takes us round the curve, again and again.

In fact, the same mathematics that allows us to build any shape of waveform (as in Figure 1) tells us that we can produce *any* shape of closed curves (even ones with sharp corners) with a harmonic series of circular motions. (I have an animated demonstration on my website.)

Figure 2: Spirograph (source: Wikipedia).

You may well have played with a "Spirograph" toy as a child, whose rolling gears produce intriguingly patterns (see Figures 2 and 3) are just a mechanical implementation of the same idea. Though you may not have known it, you were playing with complex and highly useful mathematics.

Accept for the moment that for every repeating graph (such as we see in Figure 1) there is an equivalent closed curve. Furthermore, every complex closed curve, as we see in Figure 3, is equivalent to a complicated wave pattern, as for example, in Figure 1, which could be made into a musical sound or a train of waves on the surface of a pond.



So, every musical note has an equivalent closed curve, and every closed curve has an equivalent musical note. See my website if you want to know the gory details and can remember enough GCSE trigonometry. (We just need to know that for each wave shape, however complex, there is a closed curve and vice versa.)

But what does this have to do with art, and particularly with patterns? Fasten seat belts! There are a several jumps to make before we get to the gold at the end of the rainbow.

Let us imagine a pond where we are creating waves from, say three equally spaced locations round the edge meeting and interfering near the centre. From above, it might look something like the image in Figure 4, in which the white areas show the places where the waves add together, going up and down with maximum amplitude - and the dark areas show areas where the wave interfere and cancel - that is the waves from one direction are telling the water to go up while those from another direction tell the water to go down.

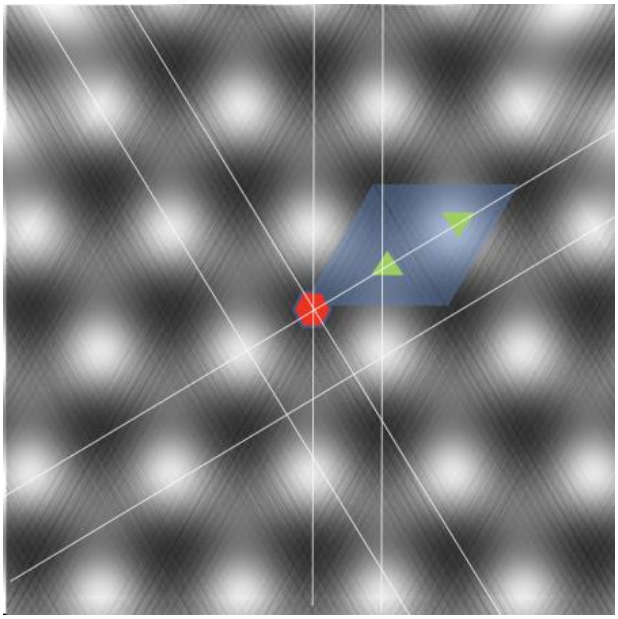


Figure 4: Interfering Waves.

I have overlain some lines showing some wavefront planes, and a "unit-cell" showing the symmetries exhibited by the pattern, for example, a hexagonal rotation axes at all the

points equivalent to the one with the red symbol. (I wrote about this in the July Rainbow in "*The Patterns behind Patterns*".) The pattern across the entire place can be created just by replicating the unit-cell with adjacent tiles. So, we have demonstrated that we can generate a pattern of waves that exhibit 2D symmetry.

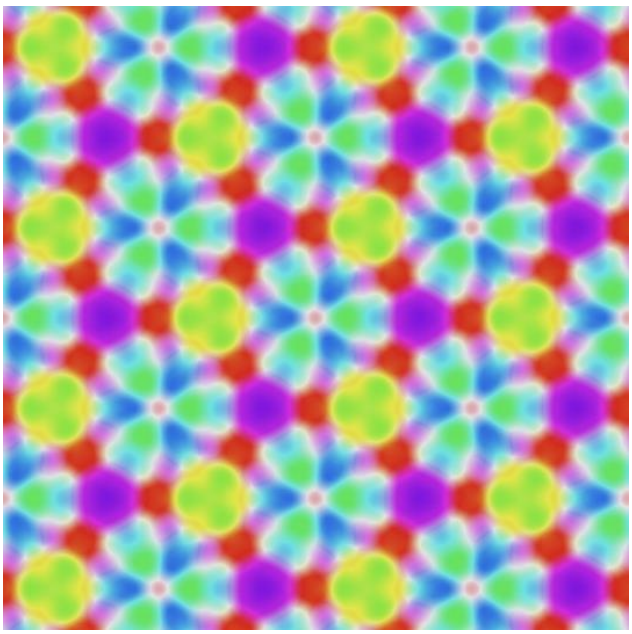


Figure 5

This is a static image, but in fact the surface of the water ought to be animated to go up and down with a regular repeating wave profile which if we mix waves of many different frequencies could have an arbitrarily complicated shape when plotted against time.

Now, as I have explained, for each type of wave vibration (and this includes waves that have been added together, as in the pattern for Figure 1) we have an equivalent closed curve and it turns out that we can associate every point in Figure 4 with a particular closed curve which is the repeating graph of the way the water goes up and down with respect to time. The curves will have a large size in the white areas and be smaller in the dark areas. The shapes will be the same but the sizes will differ. In addition, because waves travel, there are differences in the timing at which the wave at a particular point reaches its maximum amplitude - this is known as its *phase*.

Suppose we now imagine our curve lying over a standard colour wheel. The amplitude is fixing the size of the curve relative to the centre of the wheel, and the phase lets us fix a particular point around the curve. We take the colour from that point in the colour wheel and transfer it to Figure 4 and then we end up with something like Figure 5. In a real sense, Figure 5 is a visual representation of a complex musical note.

I am skipping a few subtleties that would come up if you actually wanted to write a computer program to do this - see my website for the full story. Nevertheless, although it seems like there are several complicated steps, once you have grasped the central idea it is actually easier to code than it is to describe in words.

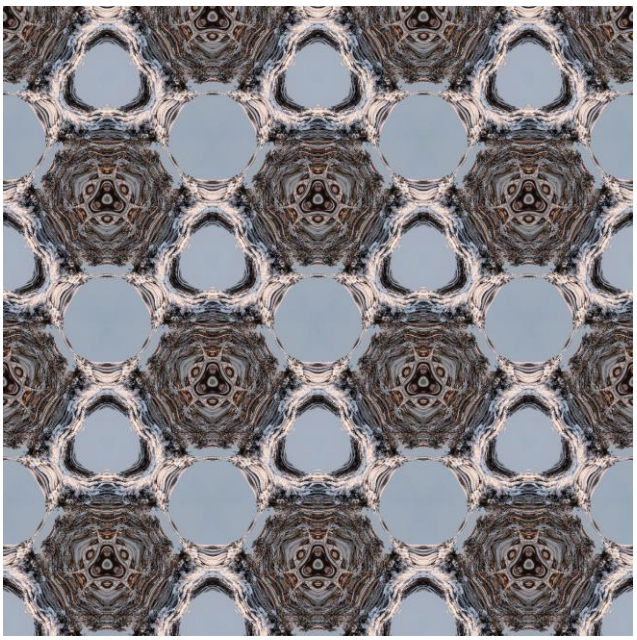


Figure 6

Figure 5 is clearly a pattern - but most people would probably not consider it a particularly interesting example: too simple, too garish. It is useful only as a demonstration of how to make patterns from waves.

We can, however, replace our colour wheel by any other photographic image and now the possibilities become worthy of more investigation. (See Figures 6 and 7.) Note that while I have stayed with hexagonal symmetry in Figure 6, Figure 7 uses the symmetry of a square (my wave trains are

coming in left-right and bottom-top). What we see in Figures 6 and 7 are, in effect, photographs transformed by a musical tone.

So far, we have remained with completely regular patterns: they could be extended infinitely in any direction because our waves trains can repeat out to infinity, keeping the same waveform profile - that is the same mix of harmonics everywhere.

We can now ask what happens if we allow our harmonic mix to vary from place to place (i.e. the quality of the musical tone is varying) which is easy to do with a computer (and very hard without one). The results then become (at least in my view) even more interesting. Figure 8 shows an example where the harmonic amplitudes vary from the centre of the image and decay away completely as we get towards the edge.

Figure 7

With enough computer time, we can even make the patterns dynamic, with harmonic mixes that vary over time. A little while ago a local artist in Stroud had been trying to capture the lighting effect of waves in a shallow lake with a colourful bottom. At her exhibition she told me that she would really like to make it move - and I said “I think I could do that for you.” Using some of her work as a base image we eventually animated an extended series of pattern transformations to newly composed music supplied by a local musician.

Figure 8

For those with the right science background a beautiful book by Frank Farris[1] was produced to support his teaching of first year maths undergraduates, and it inspired a good deal of my own work - though I have added my own algorithmic twists. (Why isn’t all maths teaching this imaginative?)

We are now well into the realm of pattern creation that would be extremely tricky and tedious without the help of computer algorithms.

How difficult is all this? It is of course clearly well outside the normal knowledge scope for most practicing artists, though any maths, physical science or computer science students would find it entirely straightforward. Of course, not everyone needs to write the software themselves or even understand the mathematical detail: once the software works anyone can use it. Few people understand the sophisticated maths that underlies the way Photoshop works its magic, but many artists and photographers use it with virtuosity.

[1] Farris, F.A., 2015. *Creating symmetry: The artful mathematics of wallpaper patterns*. Princeton University Press.

Having myself had a career in mathematical modelling it is all as natural and familiar for me as basic perspective is to visual artists. I can, of course, also write my own software and add my particular unique twists to the pattern generation algorithms, as new ideas occur to me. I am far from being alone in having both artistic and mathematical skills (the aptitudes seem to be entirely independent: you can have one, or both, or neither) and there are increasing job opportunities for artists who are comfortable with the digital world. Every day on TV you are probably seeing more of this type of work than you might think - especially in adverts and program titles. Creative Computing degrees are now offered by many prestigious art colleges, and they feed the UK computer games industry which is now a multi-billion pound enterprise.

I explore a lot of this on my personal website Artful Computing. You can just enjoy the images, but this type of art also turns out to be a good way of learning some basic programming skills (and most of the maths I use can be skipped.)

So, what have we learned?

Waves of any particular shape can also be matched with a closed curve on a plane, which we can choose to lay onto a selected image, and then carry pixel colours from the image to corresponding points in the wave-train. The result may look nothing like the original base image in detail, though it does express its colour palette.

Once we start building patterns inside a computer, we can also free ourselves from the discipline of having to keep our patterns precisely regular. Within certain constraints (such as respecting an underlying base symmetry) is possible to morph continuously between patterns across the plane

of our fabric. We can also do that over time in video.

The only thing really new here is the ease with which computers allow us to explore these ideas. In the heroic age of modern physics, back in the 1920s and 1930s, where ideas of symmetry began to pervade maths and physics, some of the leading people of the time investigated connections between art, music and symmetry, and artists such as Max Bill (later director of the Bauhaus) were strongly influenced by cross disciplinary connections in the small world of the early 20th Century

intellectuals. (I was myself rather surprised to discover that Albert Einstein himself was for a time on the board of directors of the Bauhaus.)

For those who feel that it might be worth learning some coding, creative computing provides one of the gentlest learning curves towards doing something that provides a useful pay-off.

Every year the *Bridges* conference still discusses connections between art, music and mathematics - see https://www.bridgesmathart.org . Every year the world's largest annual gathering of mathematicians is always accompanied by displays of mathematically influenced art. (See links through the Bridges website.)

See my website at https://mcellin.me.uk/artfulcomputing/ if you want to know more and see many more examples my own work.

Michael

Bring and Buy

December 7th will be our last session of the autumn term, so we are planning a bring and buy sale of donated items, so bring and donate your unused art books, paints and items. Also, a mince pie party, or anything else that you fancy, and a bit of quizzing, drawing, painting and socialising if we can fit these in too.

The first session of the spring term is on 11th January, when we will be able to welcome back Beth, and when the 'Lazy Summer Afternoon' competition entries will be critiqued. So don't forget to bring your entries along. The Competition was described in Rainbow 86 dated 31st May 2023.

Extra Unrelated Tip

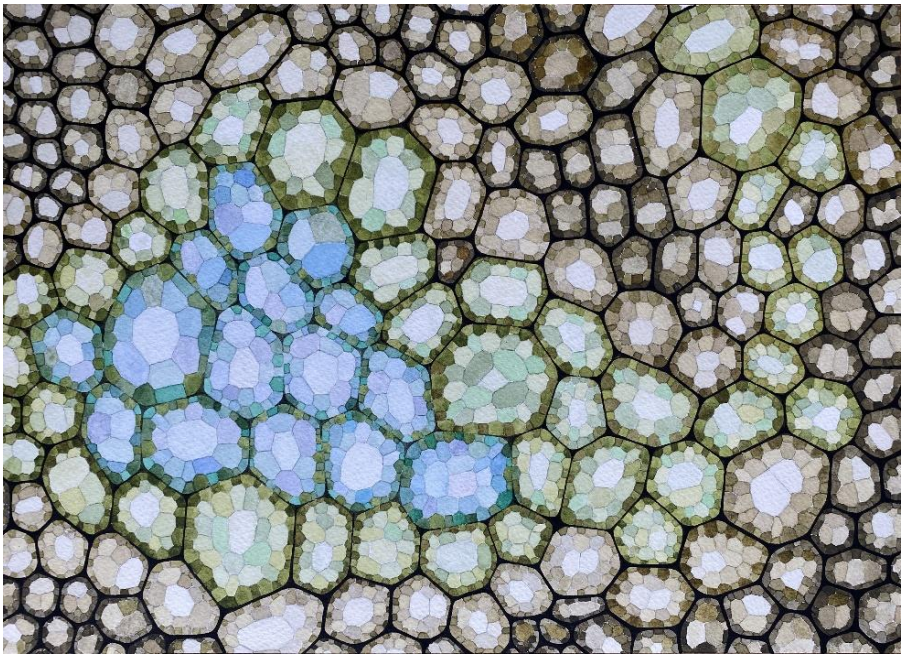
If you have an unheated greenhouse, a means of passive heating is to introduce a container of some sort (I use an old kitchen bin). Fill it with water and drag an empty inside-out compost bag over the container, black side out. This will warm up during the day, and help to maintain the temperature of the greenhouse overnight.

Pete

Scales Abstract

Following on my theme of patterns in nature; pebbles, reptile skin, dragonfly wings etc, I thought I'd relax with an abstract which doesn't need to look like anything! It roughly represents reptile skin but uses the pattern formation of a dragonfly's wing. Now it's complete I find it quite interesting, but it's not exactly attractive! Think I need more work on colour.

Richard (jn watercolour)



Sunset in Turkey

Here is a recent watercolour "Sunset in Turkey", which I have painted to send to relations staying there. The small mount made a great improvement by blocking out side details.

Hilary K

Thanks to Michael for preparing a constitution for the group, to be formalised soon:

BOX ART GROUP

Constitution

November 2023

Purpose of the Group

The Box Art Group ("The Group") exists to facilitate the development of members' artistic skills in a welcoming and inclusive social environment. The Group carries out its purpose by holding regular meetings, mainly based at Box Village Hall, where members can receive professional tuition as well as encouragement and inspiration from other members. The Group may also organise other events, such as visits, "*plein air*" sessions and exhibitions of members' work.

Structure

The Group consists of the members and a Committee, elected annually from the members. The Committee is authorised to arrange meetings and other events, using the funds provided to the Group by the members.

The members consist of ordinary members, who pay subscriptions, and honorary members, appointed by the Committee, who perform services to the Group (e.g. the tutors).

Membership

Membership is open to any adult on application to the Membership Secretary (see below) and on payment of the subscription. Subscriptions become due on 1st September each year. Members may be admitted at a lower subscription part way through the year at a rate agreed by the Committee.

Roles

The following roles need to be supported in order for the Group to carry out its purposes.

Chairman: The Chairman convenes the committee and defines the agenda. The principal responsibility of the Chairman is to see that the Group fulfils its declared purposes by ensuring that the other roles coordinate their activities.

Treasurer: The Treasurer is responsible for the financial health of the Group. He or she holds the Group's funds, receives monies provided to the Group and makes payments on the Group's behalf. The Treasurer will also prepare an annual statement of accounts to explain to the members how their funds have been employed, and to keep them informed of the financial position of the society.

Secretary: The Secretary maintains the records of the Group, including this Constitution, and minutes from Committee meetings which contain formal decisions of the Committee.

Membership Secretary: The Membership Secretary maintains a record of the current membership of the Group and issues membership cards. The Membership Secretary will liaise with the Treasurer to ensure that ordinary membership is granted to those who pay the subscription.

Publicity: promotes the activities of the Group and in particular ensures that potential members are aware of the Groups' existence and the opportunities it offers.

Hall Liaison: the Hall Liaison role negotiates the hire of Box Village Hall for use by the Group.

Refreshments: organises the purchase of tea, coffee biscuits etc. for the tea break and the rota of members making refreshments.

Portrait Group Sitters: a member is required to organise a rota of "sitters" for the portrait group.

The Chairman, Treasurer, Secretary, Membership Secretary, Publicity and Hall Liaison are the formal Committee of the Group.

Income and expenditures

The subscription rate of the Group is proposed by the Committee and agreed by the members at either the Annual General Meeting or else at an Extraordinary General Meeting.

People operating the formal roles defined for the Group are authorised to commit to expenditure on behalf of the Group within the scope of their role. Substantial expenditures - e.g. the rates for tutor fees - will need to be formally agreed by the Committee. Minor expenditures (e.g. for refreshments, sitter fees, sundries for carrying on the business of the Group) do not require prior agreement. Cheques and BACS payments will require dual authorisation. The Treasurer and other Committee members may request minor expenditures from petty cash (e.g. portrait sitter fees or competition prize vouchers), though all such expenditures should be individually itemised in the Group accounts.

Those members currently authorised to sign cheques on behalf of the Group are: Jill Harwood, Hilary Kemmett, Michael McEllin and Peter Smith. Jill Harwood and Michael McEllin have digital access to the Group's bank account and may authorise BACS payments.

Expenditures on behalf of the Group should be receipted and these should be presented to the Treasurer who will then cover the expenses.

Data Protection

Members of the Group who hold personal information regarding the members will hold that information securely, use it only to support the purposes of the Group and delete it from any storage they control when they no longer need to have access to the information.

Constitution

This Constitution will be agreed by the members at either the Annual General Meeting or else at an Extraordinary General Meeting.

Nearby Events in December

Show of Hands - Artists and Makers Winter Exhibition

24th November - 16th December 2023
Open Fridays and Saturdays
12 Kendrick Street (was Halifax) 12 Kendrick St, Stroud GL5 1AA, UK

Lansdown Gallery

SPLASHhh – *a drop in the ocean – mixed media exhibition*

10 – 4pm from 29th Nov to 3rd December

At the Sky's Edge / Bound to Earth

10 – 5pm from 6th to 10th December, and late Friday from 6 – 8pm

The Good, The Bad and The Ugly – DiSect, Crazy Horse and The Fox

10 – 7pm from 14th to 23rd December, launch Friday 15th from 7 – 10pm

The Little Art Exhibition takes place at the Sub Rooms from 10am -4pm from Tuesday 28th Nov to Saturday 2nd December

Museum in the Park

'The Activist Alphabet' by Christine Felce

Saturday 11th November to Sunday 3rd December

Slimbridge WWT

Drawn to Water by Quinten Blake until 1st January, and an **Autumn/Winter Gallery Exhibition** with various artists, on until 13th January.