Hands-on STEM activities for Early Years and Primary – dealing with Covid-19

Version 6.0 - 18th August 2022

This document focusses on practical STEM activity in the classroom. More detail, particularly about wider school issues can be found in the official Scottish Government advice which can be found here (https://www.gov.scot/publications/coronavirus-covid-19-guidance-on-schools-reopening/) and here (https://www.gov.scot/publications/coronavirus-covid-19-early-learning-and-childcare-services/) .

The guidance on physical distancing in Early Years and Primary remains the same as that issued earlier in the Summer, which in turn had not change significantly from that at the beginning of the year.

There are no mandatory, specific mitigations that need to be in place in schools. However, all schools should have a Covid-19 risk assessment. If this risk assessment determined that there are certain measures that should be put in place then this must be done.

Unless your school policy prevents the use of any form of equipment, then all hands on STEM activities tat you might previously had done can still take place in your primary school.

The situation will vary significantly across the country: learner rolls, numbers and location of teaching rooms, their dimensions and arrangements will all differ, not just from Authority to Authority but from school to school. The advice in this document, therefore, is necessarily general in nature but SSERC will be happy to provide specific advice to schools and colleges if needed.

It is important to emphasise that the whole procedure for making arrangements for learners should be led by risk assessment. This risk assessment should directly address any risks associated with coronavirus so that sensible measures can be put in place to minimise those risks for learners, young people and staff.

Any further updates will be via a series of FAQs appended to the end of the document.

Check our website www.sserc.scot , **Twitter** and **Facebook** posts regularly for news of updates.

Versions

Version 1 (June 24th 2020)

At present the guidance is that physical distancing is set at 2 metres. If there are any changes to this then we will change the guidance to reflect it.

Version 2 (August 5th 2020)

Updated to reflect the changes announced by the Scottish Government at the end of July. Significant changes to the section on distancing but the hygiene and experimental sections are largely the same.

Version 3 (14th February 2021)

Minor updates to reflect the situation with regard to the phased reopening, starting with P1-3.

Version 4 (9th September 2021)

Some updates to reflect a number of relevant changes. Areas that have changed (other than minor rephrasing)

Version 5 (7th January 2022)

Some tweaks in phrasing and a new section with more detail on ventilation.

Version 6 (18th August 2022)

No significant changes – just a revision of emphasis on the importance of a risk-assessment-based approach.

Changes from the previous version are in purple

General Guidance

Guidance on important matters including general distancing, movement around the school, arrival and departure is outwith the scope of this document. Useful guidance has been provided by the Scottish government and can be found here (https://www.gov.scot/publications/coronavirus-covid-19-guidance-on-schools-reopening/) and here (https://www.gov.scot/publications/coronavirus-covid-19-early-learning-and-childcare-services/) .

In Early Years and Primary education, there is much overlap between STEM activities and other classroom activities but there are some measures that are more specific to science and technology.

A holistic approach

The measures outlined in this and other documents are none of them exclusive of others: they are part of a whole.

Good hand hygiene in your school does not mean that there is no need to maximise spacing. A reduction in interactions does not mean that you can neglect the cleaning of surfaces.

We all of us need to implement as many of these measures as far as we possibly can. It is the combination of approaches that will help us in our fight to keep the coronavirus under control.

You may have come across relatively recent research showing that the transmission of Covid-19 from surfaces is minimal. That does not, however, mean that we should stop all cleaning and sanitising. Firstly, even it the effect on covid is minimal, every little helps. More importantly, good hand/surface hygiene definitely **does** help stop transmission of other viruses such as flu and norovirus and so will still contribute to reducing the strain on the NHS.

Early Years

The situation regarding STEM in Early Years education is largely covered by current government advice

https://www.gov.scot/publications/coronavirus-covid-19-phase-3-guidance-on-reopening-early-learning-and-childcare-services/pages/groups-and-cohorts/

This gives guidance on:

1. Hygiene and cleaning
2. Limiting children's contacts
3. Use of outdoor spaces and much more

As far as any STEM activities go, advice will be very much in line with that for other Early Years activities.

1. Make use of outdoor learning activities where possible.
2. Wash hands with soap and water after any outdoor activity or after using any sand, water, play dough etc. for STEM activities
3. Where possible try to avoid the sharing of equipment for STEM activities. Discourage children from putting any shared items into their mouths – wash hands correctly after touching any contaminated resources.
4. Follow the manufacturer's instructions and guidance from the Scottish Government and your employer when washing any resources or other equipment used for STEM activities.

Primary Schools

Classroom layout

The change in the distancing requirements mean that you will be able to have your full complement of learners in the classroom. That does not, however, mean that things are completely back to normal.

1. There is no need for any mandatory spacing between learners or between teachers and learners. That said, where distances can be increased without interfering with the teaching and learning process, it can only help.
2. Try to ensure, where possible, in science classes, that learners are not working face to face. If they are working together then it is much preferable if this is done side by side. This may involve some moving of tables/desks.

Ventilation

As the pandemic has developed, it has become clear that the main route of infection, for Covid-19 is by inhalation of particles which can sometimes spread relatively large distances.

The main problem comes from bioaerosols, droplets or particles smaller than 5 micrometers. The particular problem with these is that they can remain suspended in the air for extended periods and move with air currents.

Larger particles are less concerning as they tend to sink to the ground and remain there.

We are being told, quite sensibly, that ventilation is important and that we should open windows or find other ways to increase ventilation.

How do I know if I need to increase the ventilation?

By now, most schools and colleges should have access to some sort of CO_2 monitors. These can act as a proxy for ventilation rate.

In order to get a reasonable figure from your monitor:

- Place it at head height
- Keep it away from windows
- Keep it away from doors
- Keep it away from air supply openings
- Position the monitor over 50cm away from people as their exhaled breath contains CO_2. If your monitor is too close it may give a misleadingly high reading.

CO_2 levels vary within an indoor space so try out several locations to find the most representative position for the monitor in the space.

Levels

A consistent CO_2 value below 800ppm is likely to indicate that an indoor space is well ventilated.

CO_2 levels consistently higher than 1500ppm in an occupied room indicate poor ventilation and you should take action.

CO_2 levels below 800ppm are recommended for areas with continuous talking, singing or high levels of physical activity such as sport or dancing

Remember other factors

Aside from anything else, the opening of windows to reduce build-up of viruses needs to be considered in conjunction with other factors such as room temperature that could be deleterious to health and welfare of students and teachers.

Ventilation

It seems important, therefore, that we should be able to make the most of any ventilation we already have.

Mechanical Ventilation

If you are lucky enough to have mechanical ventilation and if this ventilation is working well, it should be equally effective at removing airborne Covid-19 containing aerosols.

Air conditioning?

If the air conditioning is taking in air from outside there is little problem. If it is a self-contained system that is simply recirculating air within the same room then it does create a marginally higher risk but there will still be a significant level of dilution. For airborne infection proximity seems to be the most important factor.

HSE guidance says that the risk of air conditioning spreading coronavirus (COVID-19) in the workplace is extremely low.

However, they do suggest that *'. . . if you use a centralised ventilations system that removes and circulates air to different rooms it is recommended that you turn off recirculation and use a fresh air supply.'*

So you should check (or get someone else to check) the way the ventilation system works for your laboratories and classrooms – If the air is being drawn in from other rooms that have people in, it should be turned off.

Passive Ventilation

This is the ventilation you get from opening doors and windows. But it is more complicated than you might think.

The HSE suggests various measures:

- Partially opening windows and doors can still provide adequate ventilation
- Make sure trickle vents (small vents usually on the top of a window) or grilles are open and not blocked. Air which flows in from these vents will mix with warm room air as it enters, which helps keep the room a comfortable temperature.
- Open higher-level windows to create fewer draughts (rather than at the level of students)
- If the area is cold, relax dress codes so people can wear extra layers and warmer clothing
- You could set the heating to maintain a comfortable temperature even when windows and doors are open
- Consider providing additional sources of heating if required. Only use fan convector heaters if the area is well ventilated
- You can also regularly air the space in rooms that rely on natural ventilation, by opening windows and doors as fully as possible.

  For example, you can do this when people leave for a break. Even 10 minutes an hour can help reduce the risk from virus in the air, depending on the size of the room.

Purging (airing) rooms

Airing rooms as frequently as you can improves air quality. Opening all the doors and windows maximises ventilation in a room. It is better to do this when the room is unoccupied to avoid discomfort.

Research shows that being in a room with fresh air can reduce your risk of infection from particles by over 70%, as fresh air dilutes the particles[1].

As we spend more time indoors, experts are recommending that people either:

- open windows for short, sharp bursts of 10 to 15 minutes regularly throughout the day
- leave windows open a small amount continuously

"Opening windows for short periods of time (10 minutes every hour or two hour) may be effective at reducing risks without significantly compromising temperature."– Dr Louise Smith, King's IoPPN[2]

Interestingly, in Germany, airing of rooms, including classrooms, has been taken much more seriously.

The practice of *stosslüften*, opening a window in the morning and evening for at least five minutes to allow air circulation is of long standing. Even more effective is *querlüften* or cross-ventilation, which involves opening all windows.[3]

A recent gathering of the ministers of education for Germany's 16 states was dedicated to how to air a classroom. The Experts reinforced the importance of airing a room every 15 to 20 minutes, for five minutes in spring and autumn, and three minutes in winter.[4]

The decision about how often this purging should happen and for how long should be taken by the school or college

Ongoing ventilation

If your school does not have windows that open, this this is going to be problematic, to say the least. But for anyone who does have opening windows, there is a number of questions:

- How long should the windows be open for?

[1] https://www.gov.uk/government/news/new-film-shows-importance-of-ventilation-to-reduce-spread-of-covid-19

[2] https://www.kcl.ac.uk/news/opening-windows-for-short-periods-of-time-could-help-prevent-covid-19-transmission

[3] https://www.theguardian.com/world/2020/sep/30/germans-embrace-fresh-air-to-ward-off-coronavirus

[4] https://www.kmk.org/presse/pressearchiv/mitteilung/kmk-expertengespraech-lueften-in-schulraeumen-richtiges-und-regelmaessiges-lueften-bleibt-a-und-o-bunde.html

- Which windows should be open? Should doors be opened as well?
- How should they be opened?
- What if there is no wind?

How long?

It is clear that ventilation should be maximised. So windows should be open for as long as possible. But we are not talking about the wide open 'purge' ventilation discussed above but rather a constant 'trickle' ventilation. In this case, the level should be set such that the ventilation is as great as possible without causing discomfort to students and teachers.

Which windows?

The best method is having a breeze enter one window and exit directly from another one placed opposite the first (or possibly a door). Don't worry too much about them being precisely opposite, the air will find a way to the open areas even if windows are situated at 90 degrees from the inlet window so as long as they are on different walls, it will help.

Opening doors can be problematic as far as noise goes. It would be a good idea, then, to have the door open only slightly. There will still be significant ventilation through it. Fire doors should not be propped open but while there are people in the laboratory, having them open is not problematic. If the room needs to be evacuated the door will be opened anyway and as long as it is closed after exiting then fire breaking abilities of the door will not be impaired.

How to open them?

Where there are sash windows – or tilting ones that open top and bottom - to getting the best flow of air slide the sashes so the window is open equally at the top and bottom. (Tilting windows do this automatically). The warm air inside the room passes out through the top opening and the cooler air from the outside comes in through the lower opening.

Effect of the wind

Clearly the wind will have an effect on airflow. In general, it is probably preferable to have windows facing the wind open less than the ones on the opposite side. Ventilation will still take place but there will be less of a draft.

When there is no wind, the air change rate will be lower. You can increase it simply by using a fan. (or a fan heater set to cold). Counterintuitively, you should point the fan out of the window, this will drag air out from the room which will be replaced by cleaner air from the opposite window or door. If the fan is blowing

into the room then there is the increased possibility of contaminated air being blown from an infected individual to someone else.

A more complex picture.

Most work has been assuming that air in rooms is fairly evenly mixed. However, a recent study from the Massachusetts Institute of Technology (MIT) raises further issues about air currents and transmission.5 The following section summarises this research

Convection effects from people themselves.

People at rest generate about 75 W, (and 84 Watts from the teacher who is larger and moving about). This heats the surrounding air and creates rising plumes of warm air. These plumes have a typical velocity on the order of 0.1–0.3 m/s, As they rise, they entrain cooler surrounding air and continue up until they encounter a layer of air at the same temperature. At this layer, the plumes will dissipate and mix with the surrounding air.

The investigators found that only the air that leaves the mouth at very low speeds can rise with the human plume. Without masks, human exhales have an initial velocity of around 1 m/s. However, stronger exhales can have an initial velocity around 2 m/s, and talking or coughing can result in even faster speeds. When individuals are wearing a mask, air escapes mainly around the sides and out the top. The researchers argue that exhale speed has a large impact on spread of aerosols throughout the room since air that remains close to the body for extended periods rises relatively quickly with the human plume to the ceiling, whereas air that escapes the plume remains at breathing level for much longer and is likely to be pulled by other air currents in the room and spread to infect others.

Positioning of students in relation to windows

Although airing classrooms by opening the windows is a natural instinct and the main method of ventilation in many classrooms, the study found a caveat. The team found that, counterintuitively, open windows can sometimes contribute to the horizontal spread of particles.

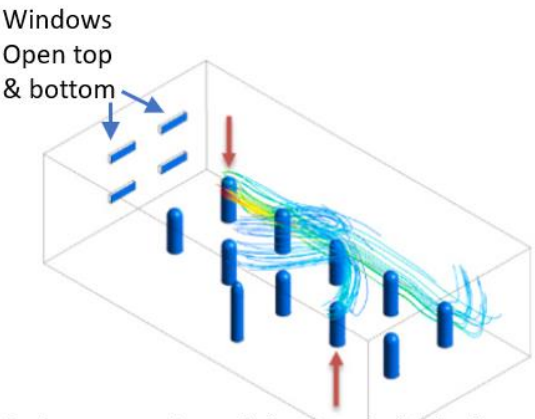
If the windows are on the same level as students' desks, simulations showed that the cold air that enters the room contributes to the horizontal spread of particles

[5] Patterns of SARS-CoV-2 aerosol spread in typical classrooms. Gerhard K.Rencke, Emma K.Rutherfor,NikhileshGhanta, JohnKongoletos, LeonGlicksman July 2021

and droplets. The speed of the airflow will overcome the convection plume effect mentioned earlier.

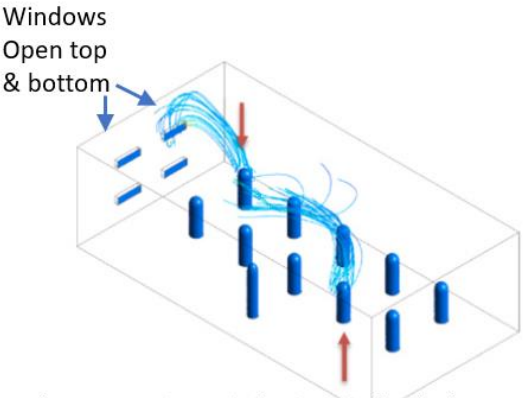
Looking at arrangements, the researchers reached a few conclusions on this aspect of ventilation:

- If the open windows are roughly at head level and in line with rows of students, (as shown to the right) then this is likely to lead to infection as particles are carried along with air currents.



Red arrows point to infectious individuals
Viral load goes from blue (low) to red (high)

- On the other hand, if the same windows, open at roughly head level, are between the rows of students this is reduced as the pattern of air currents is different.



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- An additional factor that can assist in reducing the airflow-related infection is the presence of baffles inside the lower part of the window to deflect incoming air downwards (at a 45° angle).

Conclusions

- Use CO_2 monitors to see if further ventilation is needed. Actions should be taken if the level is consistently above 800ppm and especially if it is over 1500ppm.
- If your room has mechanical ventilation, ensure it is switched on and working.

- Where possible, open as many windows and doors as you can and as widely as possible for a short period every so often.
- At lunchtime and breaktime for instance and possibly for a few minutes between lessons if there is the time to do this. Fire doors should not be propped open but they can be opened for short periods like this.
- Where possible have windows (and possibly doors) open a little on a constant basis to produce a good level of background ventilation.
- If possible, have windows open top and bottom.
- Ensure all adults are wearing masks:
    - exhaled particles of modest velocity (such as a person with a mask or face shield) are entrained in the thermal plume of the body heat and rise toward the ceiling.
    - exhaled particles of higher horizontal velocities (such as a person without a mask or face shield) can escape the thermal plume and can linger within the breathing plane of others.
- If possible, stagger seating arrangements or if rows are still needed try to have the open windows in between rows rather than in line with them
- Where possible, is a baffle to redirect window air towards the ground as this allows for the buoyant plumes to redevelop and bring contaminants out of the breathing plane.

Permanent or semi-permanent groupings

There is no requirement to have learners in fixed or semi-permanent groupings but, if possible, It is still a good idea to limit children's contacts.

The government's advice is that if possible it is preferable to keep learners in fixed groupings. This is particularly relevant in group investigative work which, but its very nature, is likely to involve closer interactions.

Consistency of groups is beneficial (though not required), and efforts should be made to keep children within the same groups for the duration of the day or session, where possible. More than one group can use a large space, but trying to keep learners in smaller groups rather than larger groups is sensible.

It is important to emphasise that **these are not all-or-nothing approaches**, and will bring public health benefits even where used partially (for example if membership of groups stays consistent throughout the day, but changes across the week). Additionally, the words, where possible' are important here. If it would negatively impact on teaching then don't do it.

Managing hands on activities

Planning

We know that, for a range of reasons, practical activities are most often carried out in groups. While there is no longer a strict expectation that learners will need to work individually, Wherever possible, working independently should be the first choice. Your approach to planning will need to take account of the following:

Equipment

Does your school have enough equipment for individual working, as each learner would need to have their own set of equipment. This needs to be assessed before school starts and extra purchased if needed.

Assisting learners

It is no longer expected that teachers (and classroom assistants) will keep any separation from learners and each other. But it would help if, where possible and where it does not interfere with good teaching and learning, a moderate distance is kept.

Government guidance does not **require** the use of face coverings in these cases though if individual teachers may feel it appropriate, they are quite entitled to. Likewise, any children who have a desire to wear a face covering should be allowed to.

Choice of activity

1. Some learners may struggle to work alone. For activities that involve solo working, they should be planned that can be undertaken without much need for additional hands-on support.
2. Some types of inquiry or activity will be more suited to working alone than others. For example, a simple classifying activity - such as exploring magnetic and non-magnetic materials e.g. **Marvellous Magnets** or exploring **Optical Illusions** should be possible. Learning opportunities that rely upon comparative testing, such as investigating **Hydrogels** or **Let's Talk Bogs** - where learners compare the absorbency of different materials, will be difficult for a single learner to complete. This doesn't mean the activity cannot be done.
3. Try simplifying activities, for example by cutting down the number of variables, alternatively, you can give each learner a different material to test and then collate class data at the end.
4. Choose activities that the learners will have a reasonable chance of completing on their own, especially activities that have supporting video tutorials and require minimal resources, yet

support understanding of scientific concepts – **Build a Climbing Bug – Exploring Friction** or **Make a Balancing Butterfly – Centre of Gravity/Balance**

5. Challenging tasks may demotivate learners if they cannot finish them so do not feel that any mitigations put in place should interfere with this.
6. Do not rush to introduce new practical skills, certainly until the learners become more confident in working on their own, choose activities that you know they will be able to carry out safely and successfully. How skilled/dextrous are the learners when working with equipment? How much experience have they had in relation to using a piece of equipment?
7. Look for activities that use recyclable resources rather than the standard equipment that will have to be cleaned. Make use of recycled/recyclable materials that learners may be able to bring in from home themselves – e.g. experimenting with sound by making a **clucking cup** (with additional information available via SSERC STEM **Bulletin 69)** or exploring the properties of gases by making a **pneumatic snappy dragon** (with additional information via SSERC STEM **Bulletin 75**).
8. Step by step instructions and the explanation of key concepts could be viewed by learners via on-line tutorials, such as those provided by **SSERC's home learning pages** – further activities and advice will be posted on an on-going basis
9. Practitioners will need to consider the platform used to view these videos and ensure content is age and stage appropriate. If learners are spending a proportion of the week learning from home, practitioners may consider teaching key concepts in class and setting engaging practical STEM investigations/ challenges for completion out of school – for example exploring forces acting on a rocket in school and setting a **balloon rocket challenge** for completion at home. You may wish to share links with parents/carers if home schooling continues.
10. The incorporation of practical activities that require minimal, easy to source resources is essential to ensure that all learners can access these learning opportunities at home and school.
11. There is no need to worry about sanitising shared items like pencils and rulers (or science equipment) in the classroom. But it is prudent to reduce any sharing of items as far as is convenient. If there are kits available for each pupil, this is less of an issue.
12. Can you do activities outside where there is more space? Now is a great opportunity to think about activities that can be done in your school grounds. Learners could construct models in the classroom and then take them outside for testing e.g. **o-wing gliders** – there is a short **video** made by learners accompanies this activity. **Balloon powered cars** might be another possibility. Further examples include observing shadows and making a sundial, **photo-orienteering**, **Investigating bubbles**, bug hunts and making a simple **science pocket book** or even **making paper** Are there activities that you might normally do in your classroom that could be done equally well outside whilst keeping learners socially distanced? Examples include, **Launching a Rocket Mouse, Making a wormery and observing worms, Exploring**

transpiration in plants using food dye and white flowers - this investigation works well with daisies collected from the school grounds. Investigating chemical reactions with vinegar and bicarbonate of soda could also be carried out in the playground rather than in the classroom.

13. You might consider introducing discussion activities with a STEM theme to encourage learners to interact verbally. SSERC have a number of discussion activity resources, developed in partnership with the Primary Science Teaching Trust (PSTT):

    A Waste of Space

    A Level Playing Field

    Let's Talk Plants

    Let's Talk Bogs

    Let's Talk Environmental Issues

Spillages

If you are carrying out our **Hydrogels** or **Let's Talk Bogs** activities, there is no need to worry, as in previous guidance, about having resources for your learners to clear up by themselves. Of course, there are good reasons why this should be encouraged but there is no need and teachers or classroom assistants can step in to help with no concern.

Clearing up

As above, there is less concern about proximity and surface cleanliness than previously so it is safe to revert to pre-pandemic procedures where appropriate.

Carrying out practical work

1. While it is still sensible for all equipment for STEM activities to be clean before it is used, for a variety of reasons, the requirement for thorough cleaning/sanitising or quarantining is no longer in place. Where possible, it is prudent to clean items before re-use but if this would limit what is being taught then it does not need to happen.
2. Any learners with additional support needs that require extra support during a hands-on science or technology activity should get it. There is no need to worry about any Covid measures in this context.
3. Higher risk activities that may require extensive supervision or direct adult support as a matter of course do not need to be avoided. For example, investigating burning, or making a fire extinguisher, normally requires an increase in the amount of supervision, i.e. more adults in the room.
4. Taking learners outside is a great choice, but don't forget that. It is still a good idea to reduce interactions between learners and maintain distance where possible as if you were indoors.

Classroom management during a hands-on activity

The following advice is now merely an example of best practice – we are keeping it in the guidance for those who wish to 'go the extra mile'. If there are bits of it you can incorporate into teaching without it being disruptive then we recommend you do but if there are not, then it does not matter.

Before the lesson:

1. Setup any equipment at the tables before the lesson.
2. If learners are working individually setup equipment in individual trays. This will help speed up setup and clearing away and the trays will contain any spills.
3. If water is required for the activity, then this should be provided as part of the equipment. (Whether work is taking place as a group or as individuals). Learners should not leave their table to collect anything. Where it is not possible to do this then any access to, eg a tap, needs to be controlled by the teacher to minimise risk.
4. Adults will need time prior to and after the lesson for setting up/clearing up.

During the lesson:

5. Teacher demonstrations may be required for learners to access the activity. Learners must not leave their tables to crowd round a demonstration table, so make use of data projectors and digital cameras / visualizers/video clips to project what is being demonstrated.
6. Use large visual aids to support instructions. Within this highlight/incorporate safety messages, for example, step by step PowerPoint slides on a whiteboard.
7. If at any point during the lesson, you feel that the activity isn't working as you had planned or something is about to go wrong, for example, an accident may happen (even though nothing has yet), then stop the activity. This might mean stopping an individual child or stopping the whole class. Ordinarily you would intervene, but now this is much harder/you can't, so you need to take alternative steps. If necessary, swap to a pre-planned written/oral activity.

End of lesson:

8. Once the activity has finished, learners should place all equipment back into their tray. An adult must clear the trays away when the learners have left the classroom, and then carry out any cleaning of equipment as required by your school (see Risk Assessment).
9. If your planning has highlighted that clearing up will need to be done. Think about how this will happen and how long it will take.

Opportunities to extend learning using simple hands-on activities

None of this means you will have to compromise on learning outcomes or experiences. Use the time to extend the learning in other ways, simple or low risk activities present new and exciting opportunities. For more ideas about making the most of hands on activities during this time keep up to date with the SSERC website and social media posts.

If you have any questions about practical STEM activities in and out of the classroom contact primary@sserc.scot