

Dialogue

How can you ask a question in a way which leads to new ideas and then/also leads to more questions? How can you encourage your students to do this too, and to challenge and question some of the science they encounter in their everyday lives? When you have a dialogue with your students does it always need to be in words? Can you use a provocative image, a piece of physical theatre? There are some great examples of visual arts images that stimulate provocative questions in the CERN project [<http://arts.cern>], which pitch science and art directly 'in conversation' with each other. Other creative science projects focus directly on dialogue and debating difference to bring science alive for students [<http://www.scicafe.eu/jrCafes> and Student Parliaments - <http://www.student-parliaments.eu/>]. This can involve a great deal of conflict of ideas and attitudes. How can you be ready to take the risk of including difference and productive conflict into your science teaching?



OPINIONSTRAINJOIN IN THE PROJECT



For further information on these resources please contact Dr Kerry Chappell K.A.Chappell@exeter.ac.uk

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Interdisciplinarity

When the sciences and arts work best together they're really showing interdisciplinarity in action. No matter where we come from, as human beings we are interested in answering the same questions [<http://arts.cern>] to come up with new ideas. How can we find ways to use the different processes of the sciences and the arts to solve common problems? In your teaching how can you allow for problem-finding, exploring, reasoning, reflecting, questioning and experimenting? How can you mix learning facts with knowing how to experiment, how to make art, and help you and your students recognise feelings and emotions in all of this? And, importantly, how can you make sure the science and arts learning is of a high quality? Making sure you have access to the right equipment whether Bunsen burners or quality art materials is key here.



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Individual, collaborative and communal activities for change

Creativity in science education is rarely a solo process. The arts are a really fruitful way of encouraging collaboration within a communally driven experimental science classroom so that everyone can have a go at being creative with scientific ideas and questions. Initiatives like SketchBetter: DrawLove [<https://sketchbetter.org/2016/02/11/drawing-love-in-nottingham/#more-1972>] run as part of Nottingham Festival of Science and Curiosity [<http://www.stemcity.co.uk/festival.html>] are great examples of arts activities which allow individuals to question and experiment with arts processes around science themes in a collaborative and communal way. Using combined science and arts skills can be another engaging way to collaborate creatively, see CERN's Webfest where young people created 3D games about particle physics and cheap cell-phone enabled cosmic ray detectors [<http://webfest.web.cern.ch/>]



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Balance and navigation

Creative science teaching, which encourages creativity in science learning, is a constant balance in control and freedom, structure and openness. How can you develop the practice of stepping in with your expertise when students need it, but also stepping back and giving them the space to ask their own questions and follow them through scientifically themselves to generate their own new answers? Balance can also be about integrating existing scientific knowledge with engaging or enlightening arts processes so that children and young people's own everyday questions about the world are brought to life (the Imagineerium – <http://www.imagineerproductions.co.uk/content/6604/home/home> – is a good example of engineering and sculpture integrated and balanced together in education for children and their local community). Navigation is about acknowledging some of the common tensions and dilemmas we all face as educators - testing and assessment, the marketisation of education, and resource/time pressures.



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Empowerment and agency

Empowering students whilst covering everything in the curriculum can be extremely challenging – bearing in mind the constraints how can you give students more ownership of the science learning in small ways that might add together to help them be creative science learners? This might be about modeling your own passion for independently asking questions in science, to encourage them to do the same. Giving them agency is also about letting them see through the experimentation process even when it goes wrong so they own their mistakes as well as their successes. Engaging in larger scale creative science projects such as CERN@school (<http://www.thelangtonstarcentre.org/cern-atschool/>) can then build on students' day-to-day experiences of agency. CERN@school involves trusting students to use a pixel detector chip to detect ionising radiation. The IOP now supports local schools in using the CERN@school kit for curriculum learning and extension research projects which are owned by and relevant to teachers and students in their school.



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Risk, immersion and play

Taking risks is very connected to students and Facilitators being able to make mistakes and have agency within their learning. To do all of these things students and teachers need to be motivated and excited. This might mean grounding the IBSE process in real life burning questions or using the arts as a starting point for provoking questions [see how the Imagineers do this here http://www.imagineerproductions.co.uk/blog_entry/3109/news__events/latest_news/latest_news/go_ahead_for_the_festival_of_imagineers_2015__]. The art@CMS touring exhibition also provides strong motivation for students to play with science. It presents an introduction to the exciting work carried out by physicists at CERN in Switzerland, and its two pods containing audiovisual displays, including The Large Hadron Collider, can be installed in any school. For students this is a great opportunity to immerse themselves in cutting edge physics and take risks with their ensuing ideas supported by their teacher.



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Possibilities

Really creative science teaching and learning can allow for multiple possibilities both in terms of thinking and spaces. In this kind of practice, it is important to know when it is appropriate to narrow or broaden thinking in the context of asking ‘what if’ questions, so that teachers and students can capture interesting new ideas. The performing arts especially are extremely good at creating spaces to generate new ideas – music can create dynamic listening spaces, dance works with bodily relationships in space, drama can change who we are, and give us new perspectives on the world through role taking. The UK Fun Palaces are a great example of this openness to possibilities [<http://funpalaces.co.uk>]. The organisation believes ‘in the genius of everyone, that everyone is an artist and everyone is a scientists and that creativity in the community can change the world for the better’. Their project allows people to get immersed in connected science-arts experiences and playfully experiment with questions and processes. The outcomes show how vast the potential is for exploring ideas and constantly asking ‘what if?’



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The CREATIONS Features



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Ethics and trusteeship

This final feature may be a little abstract but it is an extremely important part of the full creative process in both the sciences and the arts. It means that Facilitators and learners need to consider the implications and impacts on those around them of their creative science processes and products. From the question of what it means for a scientist to develop the science capable of making the nuclear bomb?, to how might a dance performance portray the family difficulties that ensue from diseases caused by particular genetic mutations?, thinking about ethics as part of any making process is complex. Here, the arts with their mastery of felt experience can be powerful ways of engaging in these questions in classroom settings. Trusteeship means thinking about who holds the values in question; and within education helping young people to understand that they are the young trustees of their own community values, now and in the future. Dependent on their focus and content, Write a Science Opera [<http://www.reseo.org/project/write-science-opera>], Junior Science Cafe's [<http://juniorsciencecafe.de>] and Student Parliaments [<http://www.student-parliaments.eu/>] are rich practices within which this kind of consideration of ethics and trusteeship can take place.



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