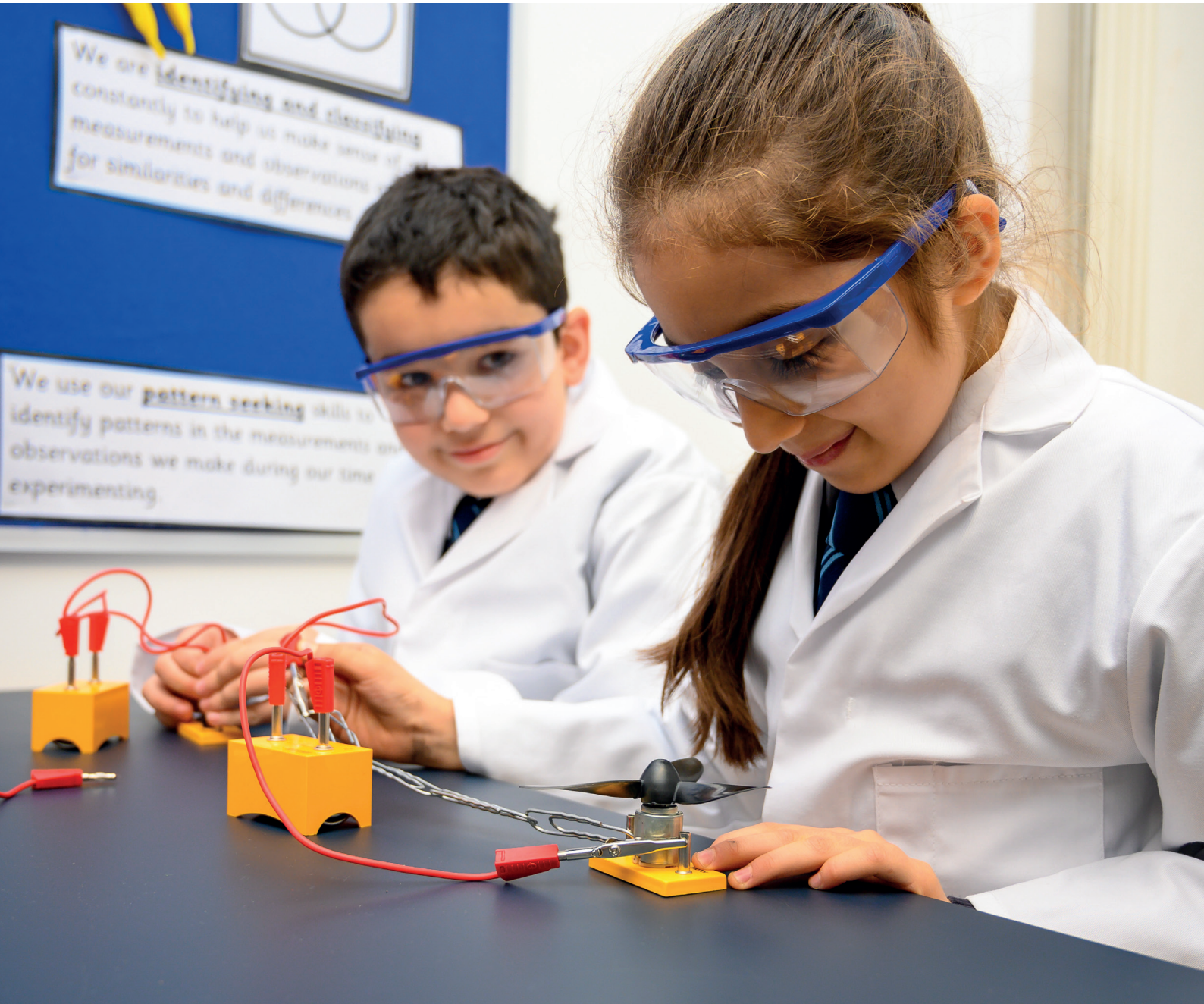
The Ogden Trust

making physics matter

Capturing impact:

an informal science education evaluation toolkit



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Introduction

The Ogden Trust has been supporting formal and informal physics education for over 20 years. We have learnt a lot in that time about what makes a good activity, and what doesn't. You might not be surprised to hear that there are no hard and fast rules! We have found over the years that what matters the most is the thought that goes into developing and delivering activities, no matter who they are aimed at.

Like any charitable organisation, we still need to try and understand what our progammes have achieved. Evaluation forms an important part of that. We work closely with our partnership schools, our teacher fellows, our outreach officers and all the other Ogden Trust affiliates to keep improving our understanding of how physics teaching and informal education is changing, and how we might best support their work. The tools and tips you'll see in the pages that follow have been developed and tested through working with and listening to our outreach officers and teachers.

This guide has been developed to help anyone working in physics education and informal education with evaluating their activities. We've included a series of tools to help evaluate different aspects of your activities, a case study of how one outreach officer has approached evaluation of their enrichment activities using these tools, and some pointers on analysis and ethics. They are designed to be a starting point; at the end of the day you are the expert in your activities, and will understand best how to know if they are working or not.

The most important part of this guide is its role in showing our thinking process for evaluation; it is our hope that by applying the thinking process this guide describes you will be able to more easily demonstrate the value of your activities, and that you will find reporting your work to senior colleagues or funders much easier. And most of all, that you will be able to work on improving your practice in developing your activities. By asking critical questions about why you are doing something early on in your planning, you, your participants and your funders will all have a better experience.

Physics capital approach

It is our aim to support young people in developing their **physics identity**, to become confident in their abilities in physics and also in their sense of belonging in physics. Science capital is one way we can consider all of the factors that affect how comfortable and included a young person feels with respect to science and science careers. These might be to do with how much that person already knows about science, their attitude towards science, the attitudes of their family and friends, their previous experiences in science, or any science resources they have access to. All of these contribute to their science capital. High science capital can help a young person to see themselves as a scientist in the future or to value science-based qualifications as something that might be useful to them. Low science capital and other societal disadvantages can lead to young people not seeing themselves as scientists, despite generally enjoying and valuing science. By providing experiences that make further study and careers in physics more accessible and tangible, we hope to make a potential future in science available to all.

The Ogden Trust is particularly interested in how this specifically relates to physics and careers from physics. To this end, the science capital themes have been distilled into several key areas for our work. All of our informal physics education activities should be designed to improve physics capital in at least one of these areas.

https://www.ucl.ac.uk/ioe/departments-and-centres/departments/education-practice-and-society/science-capital-research

The Ogden Trust physics capital areas for young people:

- How comfortable they are talking about physics
- Their understanding of the jobs available in physics
- Their understanding of the usefulness of physics
- Whether they know other people who are interested in physics
- Whether they enjoy physics-related activities
- Whether they consume media related to physics
- Whether they are interested in going on days out related to physics
- How much they consider themselves to be seen as a physicist
- How much they understand or know about physics
- How much they want to be a physicist
- How much they feel that people like them are included in physics

In this guide each of these physics capital areas is looked at one by one to explore ways in which we might understand how well an activity contributes to each element, with practical help each time.

A reflective evaluation approach

We know that a lot of informal science education happens in circumstances that make long-term evaluation studies and research-level analysis problematic to deliver. Because of this, we are taking a very pragmatic approach to evaluation. We trust professional voices, and value the feedback of teachers, outreach officers and other educators in the reporting we receive. We ask our outreach officers, grant holders and partnership schools to concentrate their evaluation on new activities, or ones where significant changes in approach have been adopted, so that we can learn the value of these approaches. We know that a lot of these activities happen as one-off events, and others as repeat interventions. We know that many are run in windows of time that are constrained by room bookings, or an imminently arriving school bus. We know that asking young people to concentrate on an evaluation task after an exciting workshop is hard!

With all this in mind, the tools that follow are designed to capture reflection from the participants.

- All tools can be used as pre- and post-activity tests, but we have assumed that this isn't always sensible or possible. This approach is most useful for multiple intervention activities.
- Questionnaire format tools can be used to create simple in-session collection activities such as raising hands or placing stickers on posters.
- Long-answer tools can be used post-activity to allow for more feedback from the participants and/or more nuanced questions.
- Both questionnaire and long-answer tools can be used to assess the student's own perceptions of their progress. This is particularly useful when you were not able to set up pre-activity evaluation!
- Reflection can also be useful when asking an associated authority figure (teacher, carer, outreach officer) to assess the progress of the young person.

Putting it into practice – **a case study**

We asked our outreach officers to tell us their experiences of evaluating their activities. As you can see in this example, there is nothing quite like handling a bad set of data to make you think about improving your evaluation plans for the future.

I first used the Ogden Trust evaluation toolkit after a large event we hosted in March 2019. I was not involved in the process design, but I was tasked with inputting and analysing the data after the event. At this point, I discovered that the questions had not been well designed and the resulting data, from pre-event and post-event evaluation, was unwieldy.

This situation made me realise how important it is for the design of the evaluation itself to be in place and in line with the overall goals from the start. In fact, thinking about what is being evaluated can help to plan real, measurable and achievable aims and objectives.

After this experience, the evaluation toolkit was something I went to before we even properly planned our next big event in November 2019.

The toolkit was very useful in helping me note down ideas for the impact we wanted to have on the school children we were working with but also made me realise that to see a measurable impact in a short time was difficult.

Using the toolkit, I was able to recommend to my department that we focus on three main areas:

- *How comfortable the students were talking about physics – where, when and to who.*
- *How physics relates to their everyday lives.*
- *How much they understand about physics.*

I also suggested that we look at the impact we were having on teachers, trying to find out if they were including some of the provided resources in their teaching. These were the main aims I decided were possible to measure in such a short time and the event was planned around these.

I also made sure that it was easy to obtain relevant data from questions for use in a macro counting spreadsheet to make my reporting easier. Data from this and teacher testimonials are being used as a REF case study.

Sarah Annand, University of Liverpool

Getting started

Start planning your evaluation as early in your activity planning as possible. There are four main steps to getting your evaluation plan in place.

1. Work out why you are doing your activity. You need to know which one (or two, or three, but no more) of the physics capital areas you are working towards, and have a clear idea of how your activity addresses them.
2. Work out which evaluation approach is going to work best for you. What do you have time for, what will get the information you need the most, what do you know how to collect and analyse?
3. Work out what you need to know versus what you would like to know. Anything you need to know is essential, anything you would like to know is a bonus that you can add in if there is resource available. These will help you understand how best to collect and analyse your data.
4. Allocate time and resource to the evaluation. This means time to design the collection tools (print questionnaires, buy stickers), time to collect the data (does it happen in the workshop? Do you need an additional session?), and time to do the write up (type up or count the responses, analyse it all, write a short report or case study). Identify who else is going to help with this, and make sure they are also ready.

Each of the tools that follow can be used directly as they are written but they can also be amended, or used as a template. You can design your own questions based on these or others you have seen, using this guide as a prompt.

Top tips for evaluation design

You'll find other tips throughout this guide marked with a lightbulb.

To get the best and most useful answers from your participants, make sure you have properly set the context for your evaluation. If appropriate, remind them of relevant details, such as who you are, what the project was or where it happened. For some questions you will need to remind them what is included in physics, except for when you are testing their new physics knowledge!

Make sure that there are no words in the questions that they might not understand. If you need to, then explain them.

Get help. It can be invaluable to have someone else to type up the responses before you do the analysis. For any audio recordings of interviews or focus groups, outsourcing can be much faster and more cost effective than doing it yourself. If you have a large project and resources, then why not bring in an external evaluator.

Be time conscious! A single one-off event isn't going to show you much change, so don't overdo your pre- and post-testing. Instead, focus on building a reflective activity into your sessions.

The longer-term interactions you have with young people or repeat interventions are where it might be worth trying to set baselines for comparison. But beware: the more you work with someone to improve their understanding of a topic, the more they might reassess their original knowledge/understanding. (This is called **metacognition** and is another factor in supporting disadvantaged students). In these cases, your measurements won't always show a positive trend if the students now know how much they didn't know before! It can be useful to add a long answer tool so they can reflect on their initial knowledge or attitude as part of their final feedback process.

This isn't a research project. If you are beginning to feel overwhelmed, try cutting everything back to the basics. Keeping it simple is essential.

If you are having trouble trying to measure something, perhaps you are trying to measure the wrong thing. If you aren't sure, come and ask.

https://royalsociety.org/-/media/policy/topics/education-skills/education-research/evidence-review-eef-royalsociety-22-09-2017.pdf

Using this toolkit

For each of the physics capital areas that we are interested, there are examples of questions you might use to help assess the impact you are making on the group you are working with. These might be deployed in a survey, on paper or online. But just because they are laid out like a questionnaire doesn't mean this is how you have to present them! There are suggestions throughout for practical ways you could build these into sessions, but you can afford to be creative. If you aren't sure if something will work, try running it past a colleague or peer. Even better, try it out on a pilot group if you have time and resource. But you can put them into a normal paper questionnaire if that works for you and your participants.

It is possible to look across all of the physics capital of a student, but it is not expected that you will be able to do this for most of your activities. In an informal science education setting you should only be trying to influence one or two elements in any one activity.

Finally, all the way through we have tried to keep coming back to the things you are trying to influence, and the ways in which you are doing that. There are some parts of science capital you can't ever hope to influence, and that's just fine. Planning your evaluation in from the start should make your activities better, as well your understanding of how and why they work. It's a win-win situation.

Evaluation tools

How comfortable they are talking about physics

Our assumption: ***the more our young people talk about physics, and the people they do this with, the more comfortable they are and the more knowledge they are picking up and using.***

Basic evaluation

How much our students talk about physics can say a lot about looking to measure their comfort levels, which might manifest as how often they do something, how well they do something, where or who with they do something, or even how confident they feel while doing it. This is not the sort of question that lends itself to one-off interactions, so any activities that address this aim are expected to be multi-intervention.

Short answer

Think about what a normal day is like for you. How much do you think you talk about physics? Choose the one that is most similar to you.

- ☐ I never talk about physics unless I am in class
- ☐ I talk about physics outside of class sometimes, if someone else brings it up
- ☐ I talk about physics outside of class sometimes, and it might be me that starts the conversation
- ☐ I talk about physics quite a bit with friends, especially if it is relevant to something else we are doing
- ☐ I talk about physics all the time
- ☐ Other

Depending on the age and ability of your participants you might want to collect data in different ways. In this case, how about asking for the responses in a new format, like in the example below?

Think about what a normal day is like for you. How much do you think you talk about physics? Circle the amount that seems most like you.

These questions can be put into a questionnaire if you like. But they can also be delivered in the session as an activity. For this one, why not try a simple show of hands, or getting them to place a sticky dot on a large print out on the wall.

For younger children, both of these questions could be deployed by changing physics to be more specific (eg forces), more relevant to the session (eg how fast cars go, how things float or sink), or more general (the different activities we have done today).

Short answers

Series

Sometimes it is useful to ask a series of complementary questions to get your participants thinking about different aspects of your work, like in this example.

How often do you think you talk about physics? Choose one answer.

- ☐ Only when it comes up in class
- ☐ Every now and then
- ☐ Most days
- ☐ Every day

Who do you talk about physics to? You can select more than one answer.

- ☐ My teacher
- ☐ My classmates, but only when I have to
- ☐ My classmates
- ☐ My friends outside of school
- ☐ My parents/guardians/carers
- ☐ My brothers/sisters/other children I live with

Series
cont'd

What makes you talk about physics? You can select more than one answer.

- ☐ An instruction
- ☐ An interesting news story
- ☐ An interesting thing we are learning at school
- ☐ My general interest

How do you feel when you are talking about physics? Choose one answer.

- ☐ Just the same as normal
- ☐ Like it's something people think I know a lot about
- ☐ A bit unsure of myself
- ☐ Really nervous

These are also the sort of questions you can use as prompts for a discussion, as an interview, or for some creative writing.

Long answer

Tell us what it is like for you when you talk about physics. You can talk about your home or while you are at school, with adults or with friends or whatever is most relevant to you.

If you have a bit more time, then getting the students to write a short statement at the beginning of the interventions that they will read again at the end when answering this question can help them to reflect on their progress.

When carrying out reflective pre- and post-activity work, don't forget to change the tenses in your questions between the baselining and review!

Deeper evaluation

For a detailed study, you might want to observe activities in action to create case studies on a small-scale sample. Getting an external evaluator or well-trained student ambassador in to follow the behaviour of a particular child or group of children would be particularly interesting, and they could do some numerical analysis (the number of times certain keywords come up) and/or some nuanced language or discourse analysis (what sorts of words do they use when talking about physics? Are they positive or negative? Are they defensive or confident? What responses do they get from others around them?). This sort of observation work would be particularly valuable when working with younger children.

Their understanding of the jobs available in physics

Our assumption: ***the more awareness our young people have about the different jobs that physics can lead to, and the different people that have physics jobs, the more expressively they will be able to talk about those jobs and the people who hold them.***

Basic evaluation

This one is straightforward in the main part, and we can look for a simple listing or counting of the jobs they are aware of, if that's the approach you are taking in your activity or particularly if working with younger children. For older students, we might be trying to explore how well they see that physics can help them with a much wider variety of jobs than they thought.

Can you think of any jobs that might involve using physics?

Short answer

This could be an individual written exercise, you could provide post-it notes for each student to write their ideas on and then group them, or if you have time to do this at the beginning and end of a session, students could shout out their answers. Think about what is right for your group.

Can you think of any jobs where having a physics qualification might be useful?

Short answer

What skills do you think physics gives you that might be useful to a future job?
Choose as many as apply.

Short answer

Empathy
Problem solving
Project management
Artistic
Creativity
Analytical skills
Planning
Literacy
Team work
Numeracy
Financial management
Physical abilities
People management
Motor skills
Attention to detail
Big picture viewpoint
Dedication
Caring
Collaboration
Negotiation

Long answer

During our sessions we've discussed a few careers that you might follow that use physics or need physics qualifications. Would you consider a career in physics?

Yes ☐ No ☐ Maybe ☐

What makes you say that?

If you want help finding physics-based careers to list with your participating students, there are lots of resources out there. You might consider looking at STEM Learning, the Big Bang Fair, NUSTEM or IOP your future with physics.

Deeper evaluation

For any longer-term studies or larger evaluations, extending the listing activity or identity activity to a larger cohort, and repeating over time is the first place to start. For a more nuanced approach, focus groups could be used for thematic or discourse analysis to look at the barriers or associations children experience when thinking about physics and jobs.

https://www.stem.org.uk/stem-careers
https://www.thebigbangfair.co.uk/careers/stem-careers/
https://nustem.uk/careers/
https://beta.iop.org/your-future-with-physics

Their understanding of the usefulness of physics

Our assumption: ***the more useful our young people see physics, the more ways they will be able to describe and explain its use in and relevance to their everyday lives.***

Basic evaluation

For most activities a simple approach will be fine, based closely on the original science capital items. The different approaches will be more or less relevant depending on your activity. The biggest issue with deploying these questions is that depending on the teachers, it is most likely that biology is the subject which is most obviously applied to our lives and they may have no previous experience of seeing physics made relevant.

At home, how could you use the physics we have learnt today?

Short or long answer

At home, what parts of your life are influenced by the physics we learnt today?

Short or long answer

You could ask for answers to be shouted out as part of the end of the session and write the answers on the board. Ask for a show of hands for which the group think are most important.

Sometimes it's helpful to get them started with a list of answers, tailored to your session such as:

- When playing with Lego
- When stacking food on a plate
- When deciding if it is safe to cross the road
- When choosing what car to buy
- When trying to be the best at long jump
- When deciding who is the best ice skater/dancer
- When fixing a cupboard door
- When knowing if an ambulance is approaching you
- When trying to understand our universe better
- When choosing a new fire detector

This list isn't prescriptive and will change depending on the content of your session and the age group you are working with.

For older students, you might want to push their understanding of physics that is further removed from their everyday lives, so your possible responses ought to include a more abstract one, such as "I'm not sure how this physics will be useful to me yet, but it might shape new technologies or societal advances in the future."

Short answer

How helpful will physics be in your future daily life? Choose one answer.

- ☐ It won't be helpful at all
- ☐ It will be helpful sometimes, for specific things like when you need to inflate your bike tyres
- ☐ It will be helpful often, for buying things, judging activities, or playing sports or games
- ☐ It's a way of thinking about the world that helps me make decisions about all sorts of things
- ☐ Other

This sort of question can be a tick-box type questionnaire item, or could be something you collect physically in session, by placing stickers on a poster, balls in boxes, or something else that works for you.

Short answer

How much do you agree or disagree with the following statement? "The physics I learn in these sessions will be helpful in my future daily life (eg making decisions about safety)". Choose one answer.

Strongly disagree ☐ Disagree ☐ Agree ☐ Strongly Agree ☐

Deeper evaluation

For more in depth studies of this theme, focus groups or interviews based on questions similar to these would be ideal. Thematic analysis can then be used to see the ways in which they perceive physics to have relevance to their lives.

Whether they know other people who are interested in physics

Our assumption: ***the more our young people feel that the people around them are interested in physics, the more confidence they will have in telling us specific people they know are interested in physics. Extending this, they will be able to describe in more detail how they know people are interested in physics.***

Basic evaluation

If you've been running sessions with this aim in mind, then you are likely to have done one of the following things:

1) introduced them to, or encouraged them to go out and find, some peers who might also be interested in physics
2) encouraged them to find out more about how interested others around them are in physics
3) tried to encourage friends and family to take an interest in physics.

We're going to treat 'knowing' someone as more than just having met/seen someone, ie you and your demonstrators don't count for this aim. What we want to measure is how much they feel that the people around them are interested in physics.

Short answer

How much do you agree or disagree with the following statement? "The people I know are interested in physics." This can be people at school, adults you know, friends and family. Choose one answer.

Strongly disagree ☐ Disagree ☐ Agree ☐ Strongly Agree ☐

You could ask this question by getting the class to stand in particular areas of the room for different responses.

Short answer

How much do you agree or disagree with the following statement? "The people I know are interested in physics". Tick one choice in each row.

	Strongly disagree	Disagree	Agree	Strongly agree
My friends				
My parents/guardians				
My brothers or sisters or the other children I live with				
Other adults I know				
Other children/young people I know				

Short answer

How interested in physics are the people that you know? Colour in the people below to show us how interested you think the different groups are.
The more people you colour in, the more interested you think this group is!

My friends

My parents/guardians

My brothers or sisters or the other children I live with

Other adults I know

Other children/young people I know

If your project is focused on a particular relationship, such as working with families or friends, then rather than giving generic groups you could give them freedom to specify the people they think about. Prefill as much of the questions as you can, and then get them to populate the relevant people on the form as part of the activity eg my grandma Liz, my brother Daniel, my friend Clare. In this case, ask them to put their names on it. Give it back to them at the end of the workshops to see if things have changed.

Deeper evaluation

A more in-depth study might look at how the young people identify how others are interested in physics, such as do they talk to you more, listen to you more, spend more time with you on related activities. Interviews with thematic analysis would be a good place to start for such a study.

Whether they enjoy physics-related activities

**see also section on physics days out*

Our assumption: ***the more our young people enjoy physics-related activities, the more different activities they will be able to tell you about, and in more detail.***

Basic evaluation

For this theme it is likely you've been working on doing things that are fun, or things that raise their confidence. You may just have helped them to understand what a physics activity might be. We want to look at how they make choices to take part in things and how they feel about doing so.

WATCH OUT: any question about activities done outside of school can carry an inherent judgement with it. Some will not have access to the internet, computers, time, adult support, or seemingly simple resources, no matter how cheap or accessible you think these are. Be careful that your question does not make those who don't have access go away feeling belittled by the way it was asked.

Short answer

Do you do any physics activities outside of school? This might be doing science experiments at home, going to a science club, doing your astronomy badge at Guides or Scouts. Tell us all the things you think are relevant.

Free text is important here. They may not be sure if something is physics-related or not. In person this could be an open question to the class for responses, and then hands raised for how many take part in each one.

For younger children, a simple raising hands for different activities should suffice, if you list the things they might be interested in.

Short answer

Do you take part in any of the following activities?
Choose as many as you are involved in.

- ☐ Coding club
- ☐ Science club
- ☐ Using electronics kits at home
- ☐ Building amateur radios
- ☐ Astronomy, by yourself or through a club
- ☐ Weather monitoring

This list isn't prescriptive, and other projects may have already developed one that is useful. Share your lists with other colleagues as you use the questions.

This listing approach is useful if you are interested in specific activities.

Short answer

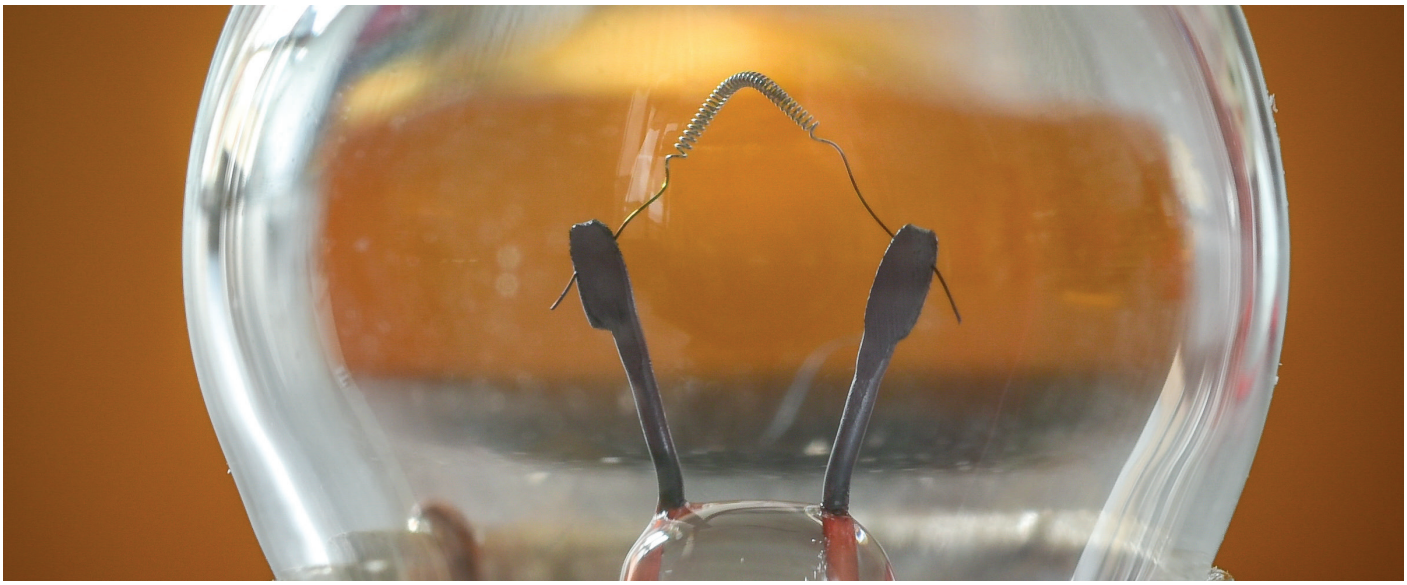
How do you feel about taking part in Wednesday Science Club?
Choose as many as apply.

Uncertain Good Bad Keen Unhappy

Confident Reluctant Glad

Don't forget to change the name of the activity to the one you are interested in

For younger kids you could give them stickers to put on a smiley face chart



Short answer

18. **We've been doing physics activities for the past six weeks. Before you started this activity, how did you feel about the idea of taking part in physics activities every week?** Choose as many as apply.

Reluctant Good Glad Excited Uncertain
Keen Confident Unhappy Bad Scared

Now that our activity has finished, do you feel differently about taking part in physics activities? Choose as many as apply.

Reluctant Keen Scared Happy Unhappy
Worse Excited Better More confident Less certain

Deeper evaluation

For in depth studies an observation approach would work well. This might involve observing younger children while they select free play activities, or up to 14-year-olds when given a choice between a range of different science activities. You might also consider focus groups and subsequent thematic analysis, asking the young people about how they feel when they choose different activities, to explore what makes them feel that way.

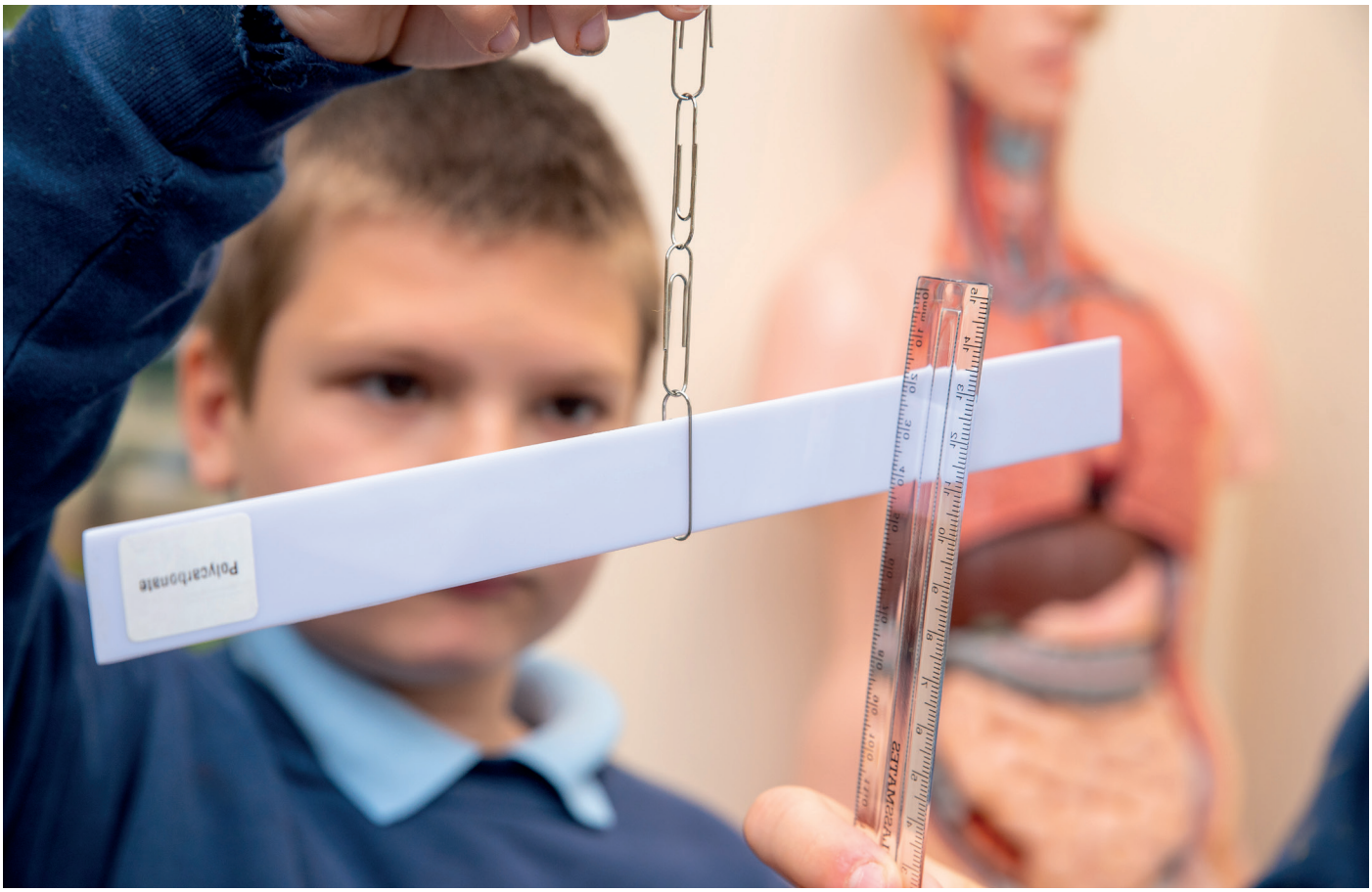
Whether they consume media related to physics

Our assumption: ***the more our young people consume physics-related media, the more different examples they will be able to give, and the more they will be able to describe how and why they chose those activities.***

Basic evaluation

This theme is unlikely to be the main focus of any outreach or engagement activity but is a common expected side effect of science interventions. It lends itself to more traditional survey techniques and can be collected from every participant in a pre- and post-activity questionnaire or interactive activity.

WATCH OUT: any question about activities done outside of school can carry an inherent judgement with it. Some will not have access to television, books, the internet, computers, or time, no matter how cheap or accessible you think these are. Be careful that your question does not make those who don't have access go away feeling belittled by the way it was asked.



Short answer

Do you ever watch, listen to, or read any information about physics?
If so, how often? Choose one option in each row below.

	Every day	At least once a week	Probably once or twice a month	Maybe a few times a year	Hardly ever	Never
Watch physics or astronomy programmes (factual, non-fiction) on the television						
Watch physics- or astronomy-related programmes (fiction) on the television						
Watch physics- or astronomy-related videos on a computer, tablet or smartphone						
Watch films (fiction) that are related to physics or astronomy						
Watch films (non-fiction or documentaries) that are related to physics or astronomy						
Read physics or astronomy articles in magazines or newspapers						
Read physics or astronomy articles on websites or blogs						
Read books (non-fiction, factual) related to physics or astronomy						
Read books (fiction) related to physics or astronomy						
Listen to physics or astronomy podcasts						

Long answer

Follow up

You indicated that you watch physics or astronomy factual programmes on the television.

What programmes do you watch?

When do you watch them?

Do others watch the programmes with you? Who?

Why do you watch these programmes?

The wording for this question makes it clear that it follows on from something else. If you want to use it separately, a small tweak to the language should be all you need.

These sort of follow up questions can help provide better understanding of what is happening and why, but aren't always necessary. You can decide to include them if you have time and resource for analysis.

You can give selection lists for these to make the data extra easy to analyse. But a free text box for simple coding can be sensible the first time you use a question like this, especially if you don't know what to expect from your group. You can always add the selection lists for the follow up survey or future events once you know more about what your participants are doing.

As ever, this question could be delivered in an introductory part of your activities as group work or as shows of hands if you do not need to track individuals.

Whether they are interested in going on days out related to physics

see also their interest in physics activities

Our assumption: ***that through interacting with our engagement activity, the young people become more comfortable in physics-related environments or venues, and so are able to describe feeling welcome, comfortable, and interested in going there in the future.***

Basic evaluation

As with the consumption of physics-related media, this theme is unlikely to be the main focus of any outreach or engagement activity but is a common expected side effect of science interventions. Efforts might usually be directed at trying to make the young people feel more at home in physics venues rather than pushing them to go on unsupported trips.

WATCH OUT: any question about activities done outside of school can carry an inherent judgement with it. Some will not have access to transport, ticket costs, adult support, or time, no matter how cheap or accessible you think these are. Be careful that your question does not make those who don't have access go away feeling belittled by the way it was asked.

Evaluating this theme should be handled after a relevant trip or intervention, and be done in a reflexive way, getting them to consider their own experience. For most projects, it is most relevant to consider this theme for older children (14+) or children with their families.

Short answer

You recently took part in a trip to (INSERT VENUE, eg CERN, Science Museum).

Before the trip, were you…

Excited ☐ Nervous ☐ Not bothered ☐

While you were on the trip, were you…

Bored ☐ Excited ☐ Confused ☐ Focused ☐ Happy ☐ Sad ☐

After the trip, how did you feel about the place you had been to?

Choose one answer that is closest to how you feel.

- ☐ It's something I've done, and don't need to again
- ☐ There was stuff I didn't get to do and I would like to have another chance
- ☐ I did everything, but I would still like to go again
- ☐ I would like to go to other places like this
- ☐ I don't want to go on a trip like this again

Long answer

What about the trip made you feel like that?

Follow up

With older kids you could use these questions as prompts for interviews, or long answer reflective statements/essays, but you don't need to do that unless you want to and have time for analysis.

There are some situations where 'trips' and 'activities' are combined, or related, for example a science club in a science museum, or a hands-on activity at a university. The best way to make sure your data is clean is to be really specific in the questions. Remind them the thing you are interested in, eg "While you were at the University of London, you took part in an activity about rocket ships".

If your situation is complicated (eg a series of events run in partnership at a variety of locations) then you may find that interviews or carrying out your survey market-research style with a person to ask the questions might help you keep your respondents on track and allow them to ask questions that set any uncertainties to rest.

Deeper evaluation

If you are considering a deeper study, it would be valuable to bring in a social sciences partner or external evaluator and to design a study based on home-life, family situations and personal narratives. The expert help will allow for the sensitive nature of the barriers a family or person might face to be considered responsibly and appropriately in the study.

How much they consider themselves to be seen as a physicist

Our assumption: ***that young people who are seen as a potential physicist by others will be able to report that this has been mentioned to them in a variety of contexts.***

Basic evaluation

This aim is a tricky one as there are so many people involved in the outcomes, be it the young person themselves or the adults and peers around them. It is normally our hope that by regularly participating in physics-related activities, a young person we work with might become more visibly a 'physics person' to those around them, including their teachers. Being seen as a physicist might involve the young person becoming more confident, more talkative about physics, and displaying many of the qualities other aims in this guide try to measure. What we are interested in here is how they perceive others to perceive them. In the first instance we might capture this through a straightforward count of times they've heard themselves referred to in this way.

Short answer

Series

Have your teachers ever recommended to you that you study physics at A-level? Please tick one option.

Yes ☐ They might have done ☐ Not that I'm aware of ☐ No ☐

Have your teachers ever recommended to you that you make sure you do well in physics because it would be good for you in the future? Please tick one option.

Yes ☐ They might have done ☐ Not that I'm aware of ☐ No ☐

Have other adults you know ever recommended to you that you study physics at A-level? Please tick one option.

Yes ☐ They might have done ☐ Not that I'm aware of ☐ No ☐

Do your friends think of you as someone who is good at physics? Please tick one option.

Yes ☐ They might have done ☐ Not that I'm aware of ☐ No ☐

You can do this as pre- and post-activity work, making sure to reword the questions for the post-activity round eg "Since you have taken part in activity X, have your teachers…"

You can also run the entire thing as a post-activity reflective question, so ask "Before you started/attended activity Y, did your teachers…" and then asking the post-activity version.

Deeper evaluation

For a more in-depth study, you might try focus groups or interviews, and narrative or thematic analysis. Adding in these long-answer follow-on questions might allow you to see if their perception has changed over time, or if they have changed how much they believe the person who thinks they would be good at physics. This would be a good project to bring in external collaborators as the analysis is nuanced and might require more specialist methodologies or techniques.

How much they understand or know about physics

Our assumption: ***that young people who have taken part in an activity and successfully learnt something will be able to recount some of the key facts they were exposed to. At a meta level, the students will be able to reflect upon their learning and talk to you about how much they have learnt through an activity.***

Basic evaluation

If you are interested in testing the students' knowledge before and after your interventions, then the test will need tailoring for your activity. Pre- and post-activity testing in this way is one way forward, but there are other indicators available to you that show that the group or individuals have understood the concepts you have been introducing.

Long answer

Teachers are an excellent, if time-poor, resource for us, so one solution might be to simply ask the teacher about the progress of the group with respect to a specific topic, eg forces, electricity, particle physics. A reflective statement from the teacher considering the group before the activity and comparing it to after the activity stands as much chance of being insightful as does a student survey.

Short answer

Ask them what they have learnt today and test the knowledge by reframing it in different ways/contexts. If you have resource, you can ask these same questions of the class again in a few weeks. This will work best in person but could also be done as a simple test.

This approach can work well with younger students.

This is the sort of activity you might do at the end of a session anyway to reinforce your messages.

Short answer

A simple test is possible, and you can design yourself two to three key questions on the topic that might show they have taken the information on board. Get the students to self-mark or mark a peer's responses. They can then hand them in, or just tell you how many they got right. Again, repeating this after some time has passed might be possible if you have resource.

Short answer

Series

Before you took part in the CERN in the real world workshops, how much do you think you knew about particle physics? Choose one answer.

- ☐ Nothing!
- ☐ I'd heard of it, but didn't know much
- ☐ I knew about it, and a bit about the things it's related to
- ☐ I knew quite a bit about it

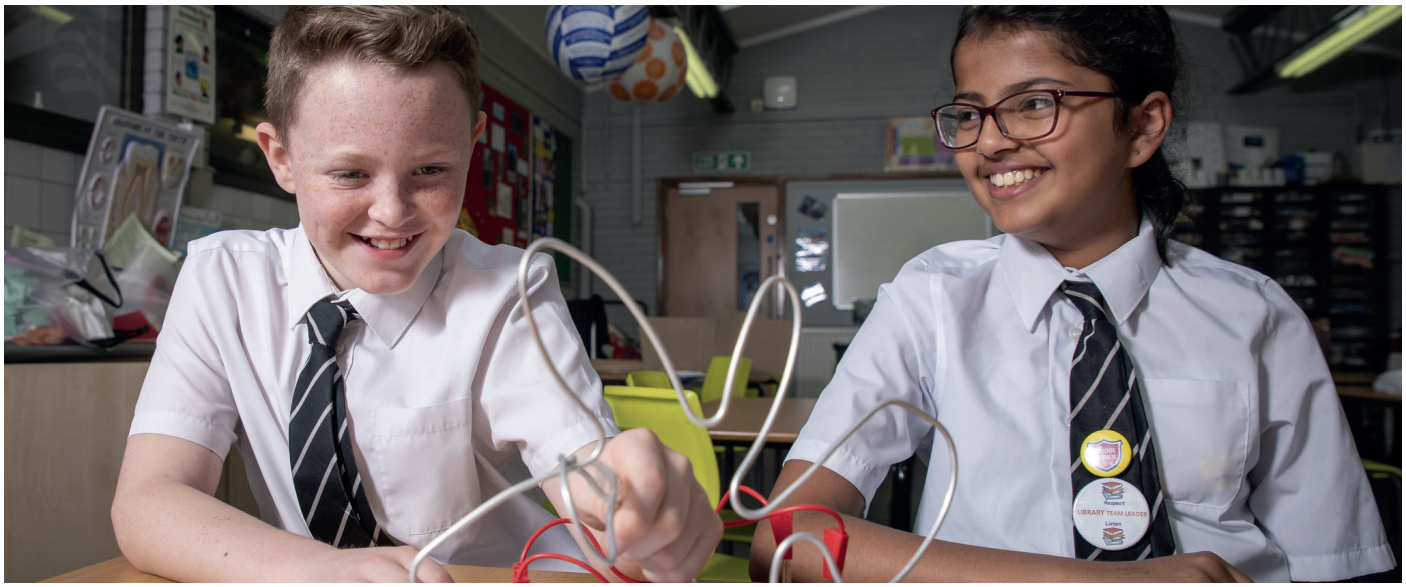
Since taking part in the CERN in the real world workshops, how much do you think you know about particle physics? Choose one answer.

- ☐ Nothing
- ☐ I know what it is, but I'm still not sure about some of it
- ☐ I could explain the basic concept to someone, but that's about it
- ☐ I know enough to help someone else try to understand what it is

Don't forget to change the details for your activity.

Deeper evaluation

If you are working regularly with a particular school then you can talk to the teachers there about monitoring attainment in tests and exams throughout the period you are working with them, and getting the teacher to identify what progress might be due to you as opposed to their schooling/external factors. For older students, you might get good results by using an unstructured or semi-structured interview approach to simply ask them about their knowledge or understanding.



How much they want to be a physicist

Our assumption: ***that young people who have taken part in our activities will begin to feel more decisive about seeing themselves as physicists in the future.***

Basic evaluation

This aim lends itself to simple reflective questions asked at the end of the activity or series of activities you have been leading. Depending on the content of your sessions, you will need to make sure your evaluation questions are clearly defined, splitting out working in physics and physics-related careers, and going on to do more physics study.

Short answer

Series

Before taking part in these activities, did you ever consider studying physics A-level/physics at university? Choose one.

- ☐ No, it wasn't something I thought was for me
- ☐ A bit, but I wasn't sure
- ☐ Yes, it's something I was sure about

Now that you've done activity Z, would you consider studying physics A-level/physics at university? Choose one.

- ☐ No, it's just not for me
- ☐ Maybe, but I'm still not sure
- ☐ Yes, I'm definitely sure

Did taking part in the activity change your mind at all? Choose one.

- ☐ No, it didn't make any difference
- ☐ Yes, I understand what's involved in physics A-level/degrees better now
- ☐ Yes, I am more excited by physics now
- ☐ Yes, I am less interested in physics now

Short answer

Series

Before taking part in these activities, did you ever consider that one day you might work in an area that is related to physics? Choose one.

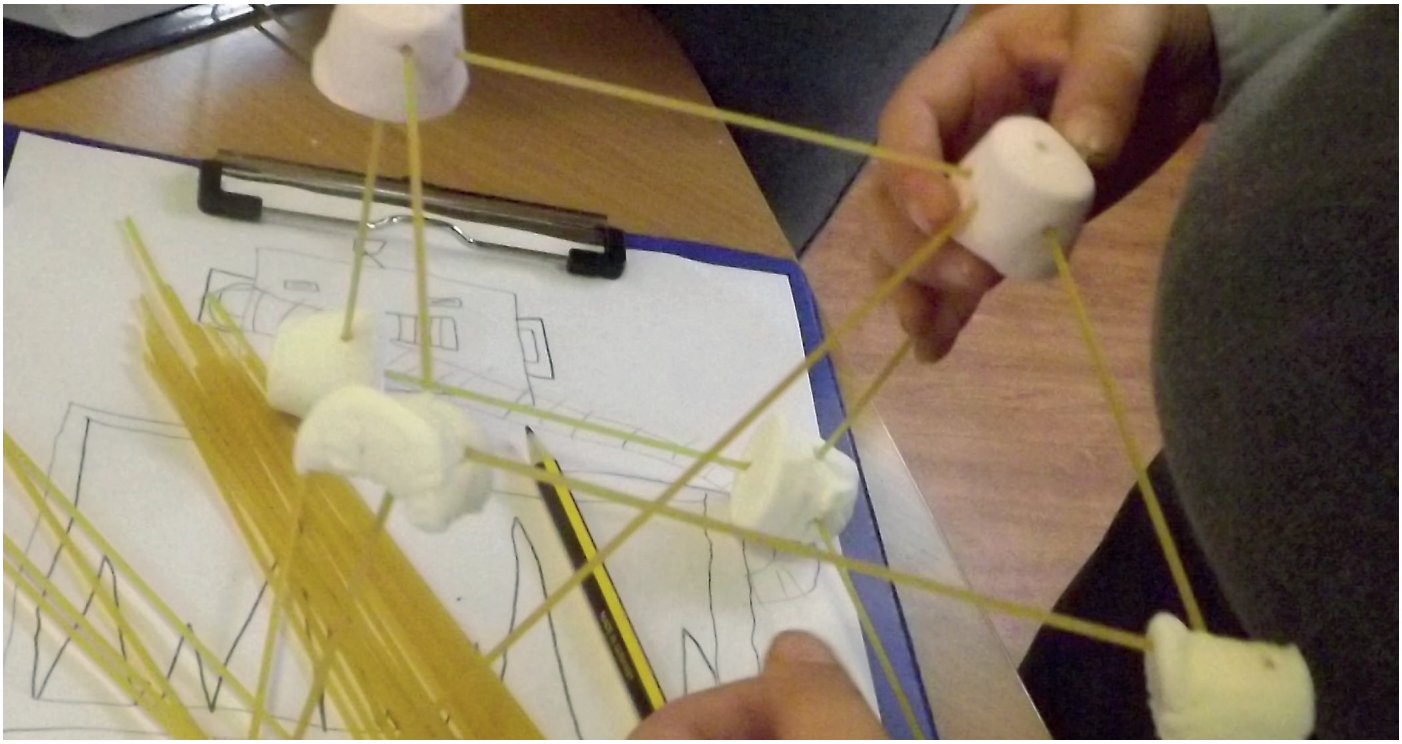
- ☐ No, it wasn't something I thought was for me
- ☐ A bit, but I wasn't sure
- ☐ Yes, it's something I was sure about
- ☐ Yes, I am less interested in physics now

Now that you've taken part in these activities, would you consider working in an area that is related to physics one day? Choose one.

- ☐ No, it's just not for me
- ☐ Maybe, but I'm still not sure
- ☐ Yes, I'm definitely sure

Did taking part in the activity change your mind at all? Choose one.

- ☐ No, it didn't make any difference
- ☐ Yes, I understand what sort of work is involved in physics better now
- ☐ Yes, I am more excited by working in physics now
- ☐ Yes, I am less interested in working in physics now



Whether they feel that people like them are included in physics

Our assumption: ***that young people who have taken part in our activities and been exposed to physicists who share characteristics with themselves, will begin to feel more comfortable seeing themselves as physicists in the future.***

Basic evaluation

Introducing young people to working physicists and showing them resources that help them to learn about a variety of different physicists, can go a long way to helping young people see themselves as physicists in the future. This is especially true if the physicists in question somehow share characteristics with the young people, be it race, gender, where they grew up, hobbies, or more. Simple evaluation of how this has impacted on them requires us to trust them to reflect on this.

Short answer

Before you took part in activity X, had you ever met or heard of someone who was a lot like you, who was also studying or working in physics? Select one.

- ☐ Yes
- ☐ No
- ☐ I don't know

For each of these questions, you might find it helpful to set the context for what characteristics they might share. This might be interests and activities, such as hobbies, clothes, sports, or might be based on personal and protected characteristics.

Short answer

During activity X, did you find out about someone who was a bit like you, who was also studying or working in physics? Select one.

- ☐ Yes
- ☐ No
- ☐ I don't know

What difference does it make if you know there are people like you who study physics or work in jobs that are to do with physics?

Long answer

Deeper evaluation

This strand would lend itself to a deeper study, and you could use a series of interviews at the beginning and end of the project to dig into the student's experiences, the barriers they perceive, and the importance of seeing people like them doing physics to know that they can do it to.

Any deeper study would likely collect protected characteristic data from the participants, such as:

- How old they are
- Whether they identify as a man, a woman or are questioning their gender
- The colour of their skin
- The country they were born in
- Where they lived while they were growing up
- The way they lived while growing up, the sort of house they had and how much money their family had
- Their ethnicity, or the country their families have descended from
- Their religion
- If they have a physical or mental disability, or not
- What sort of person they are attracted to

Because of this you would need careful ethics consideration, and should work with an evaluation/social science partner to ensure the data was taken appropriately.

Thinking about analysis

The planning process for evaluation should include thinking about not just how you will collect the data, but how you will input it, and how you will analyse and report it, and you should think about these aspects right from the beginning of your projects.

Don't collect anything you don't need to. The less data you have the less work needs doing and the less time and goodwill you use up from your participants.

Keep it simple. Most of the time your analysis will be best served by some simple descriptive numbers and charts, and a light touch thematic coding of your long answer questions.

If you really want to compare two bits of data, for example comparing what your participants think about science careers compared to what type of school they go to, then you need to make sure that your data is compatible. When you design your questions, make sure the data is collected in such a way that you'll be able to make any comparisons that you need to. Do you need any other information to make this possible? Will your participants be able to give you this, or do you need to look elsewhere, such as in the schools' databases or by asking the youth club leader? Working this all out upfront will save you a lot of heartache later on.

Thematic coding

This is not a definitive guide, but some simple analysis of long answer questions can be done with very limited training. Consider the images below:

How would you categorise these items? Might you choose colour? Might you choose a number of sides? Might you choose length? We make sense of them by applying different frameworks to how we see them. The same is true for our long answer responses. Different variables will be more or less important for different circumstances. The important thing is to be **clear** about the way you are categorising, be **consistent** and apply that thinking throughout, and **document** your reasoning. Explain what you are doing, why you are doing it this way, and what this means for your report, and this way the reader can understand how you drew your conclusions.

Whenever you are coding items, it's a good idea to get a second person in to have a go too, to see if they agree with your analysis. Take a random subset of your responses and give them to the other person to code, explaining your process. Anything over 60 per cent agreement is a good sign that you are on the right track.

A note on ethics

As with all activities where you are taking note of details to do with other people, there are ethical considerations. Providing evaluation data should always be consensual. The nature of schools and groups is that there is a power structure and the young people are often told they have to take part in activities, including evaluation. It is not good practice to make someone give you their input in this way. If someone refuses, don't make them complete the process, and make sure you have a plan for how your data will work if people drop out.

Make sure you check with teachers what their policies are with respect to collecting data and parental permission. For most evaluations, if you are not trying to track an individual's progress, the data will be anonymous and will not need any further permissions.

If you are trying to collect protected data, such as age or gender, you need to be very clear about why you need this data and how it will be safely collected, stored, analysed and reported. If at all possible, refrain from collecting data that identifies the student.

You will get the best responses if the questions are written well. Check your wording with others – peers, colleagues, family members – before deploying with your target group. Ideally you would test the questions through a pilot study before rolling out to your full cohort. If at all possible, make sure at least two people who share a lot of characteristics with your target group have read the questions and given you feedback.

When you ask questions, it is very easy to imply judgement. Check, check and check again that you have been careful of not making avoidable assumptions or projecting your privilege and values onto others through your evaluation.

All data should be stored as securely as possible and deleted when no longer needed. Your employer will have rules about this in compliance with GDPR, so do ask internally how to manage this. A good rule of thumb is not to retain data for more than six months, and to keep any identifying information such as names or contact details in password protected files on secure and encrypted hard drives.

A good place for advice on ethics is **BERA**, the British Education Research Association who have a statement on ethics that you can use to underpin your work, and lots of guides and resources.

You are most likely not carrying out a research project, just a simple evaluation, so don't collect anything you don't really need! That will keep your ethics considerations to a minimum.

https://www.bera.ac.uk/resources/all-publications/resources-for-researchers

Is this only for school children?

We know that many of the people likely to read this might also be offering activities to teachers, to scout or guide leaders, to young people outside of formal schooling, to young adults, to older people or grandparents… the list goes on. Whilst the tools shown in this guide are aimed at work with young people of school age, the processes should serve you well in considering evaluation for any demographic you can think of.

We have been working on our own sets of capital indicators for our work with physics teachers and with physics undergraduates who take part in our outreach activities. Shown below, these indicators are very much a work in progress but might be a useful starting point for your own considerations of how to evaluate your work.

Teachers

- **How aware they are of jobs in physics**
- **How aware they are of the usefulness of physics**
- **How confident they are as a teacher of physics**
- **How much they identify as a physicist**
- **How sure they are of their physics knowledge**
- **How much they are seen as a leader in physics teaching**
- **How much they act as a leader in physics teaching**

Undergraduates

- **How comfortable they are working with young people**
- **How confident they are talking to others about physics**
- **How aware they are of jobs in physics**
- **How sure they are of their physics knowledge**
- **How much they are seen as a leader in physics**
- **How much they act as a leader in physics**

This publication has been written by Dr Charlotte Thorley, evaluation consultant for the Trust, in consultation with the Ogden outreach officers who provided invaluable testing and feedback on the development of this toolkit (thank you).

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