The Teacher Assessment in Primary Science (TAPS) Pyramid Model

TAPS Cymru: examples from Wales

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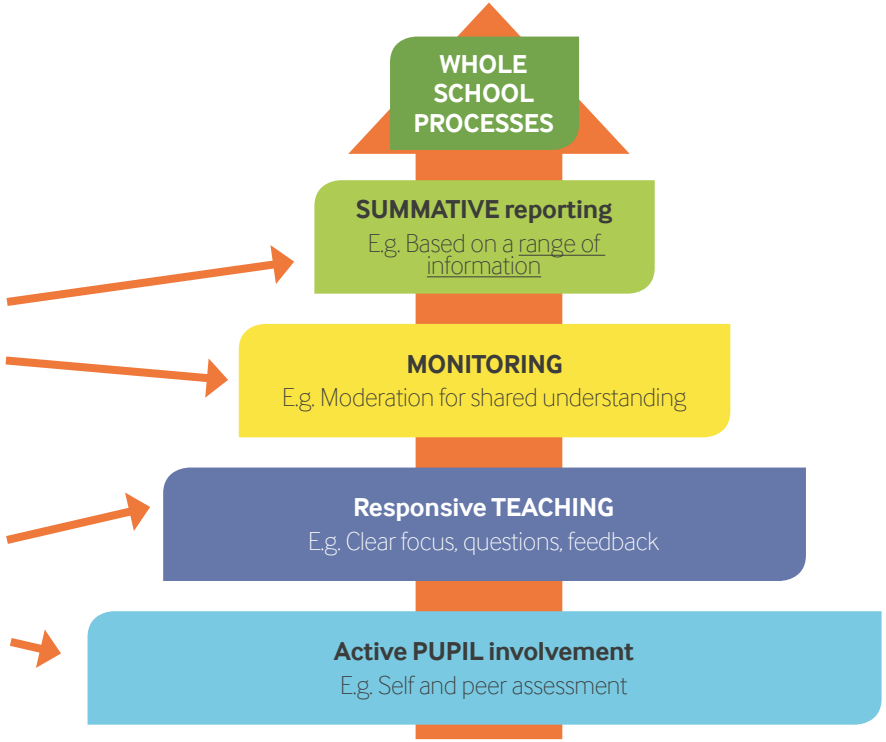
The ongoing formative assessment can be summarised for different reporting purposes.

The base of the pyramid encapsulates the principles of assessment for learning.



- Consideration of science in range of contexts supports VALIDITY (so that assessments consider all areas e.g. working scientifically).
- Discussions to develop shared understanding supports RELIABILITY (consistency of judgements).
- Focus, clear purpose and examples support MANAGEABILITY.

INTRODUCING TAPS CYMRU
http://tinyurl.com/TAPScymru

CONSIDERING THE POTENTIAL OF TAPS FOR WALES
http://tinyurl.com/TAPS4Wales

Introducing the TAPS pyramid model

The Teacher Assessment in Primary Science (TAPS) Cymru project is based at Cardiff Metropolitan University, and is part of the wider TAPS project, funded by the Primary Science Teaching Trust (PSTT). TAPS aims to develop support for valid, reliable and manageable assessment, which will have a positive impact on children's learning.

Where did this start?

The Nuffield Foundation (2012) recommended that the rich formative assessment data collected by teachers in the course of ongoing classroom work in science should also be made to serve summative reporting purposes. . They developed a pyramid model, which was operationalised by the TAPS team at Bath Spa University (Earle et al. 2015), where assessment information flowed from classroom practice to whole school reporting – this is represented by the ORANGE ARROW.

Where did this come from?

The TAPS project team have worked with local project schools, the Primary Science Quality Mark and the PSTT College to create this model of teacher assessment and populate it with examples . It can be used as a whole-school self-evaluation tool to support schools in identifying strengths and areas for development in school assessment systems .

Where do we start?

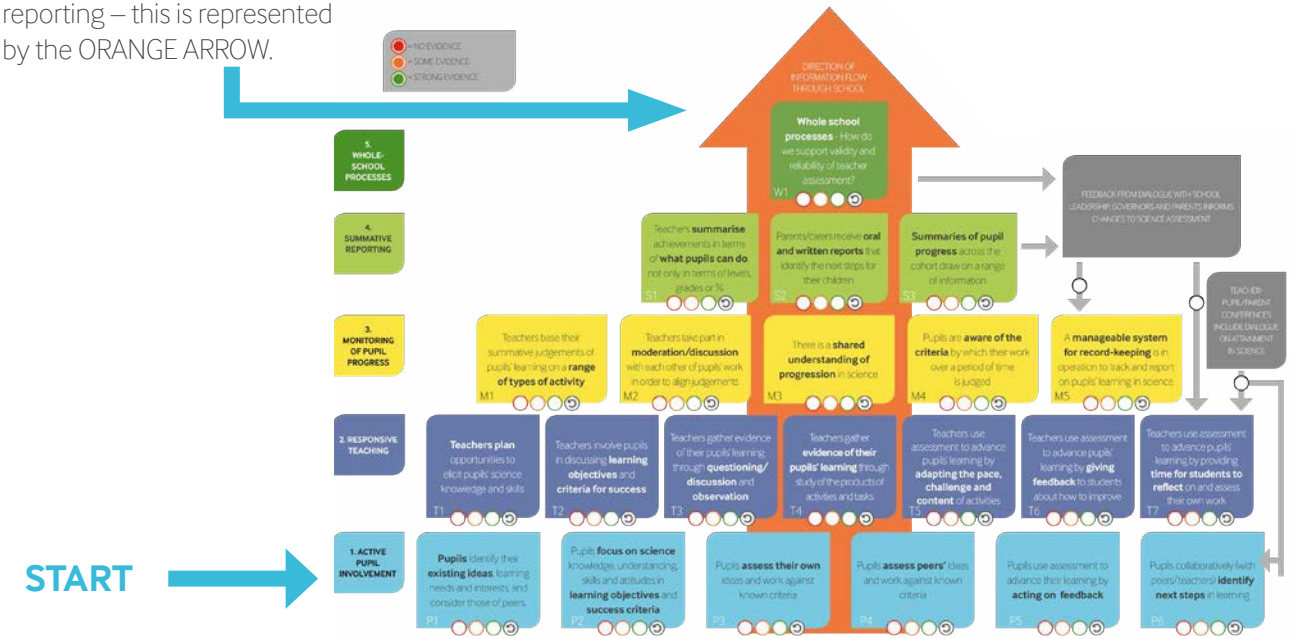
The '**Pupil layer**' and the '**Teacher layer**' at the base of the pyramid encapsulate the principles of Assessment for Learning; schools should begin by focusing on these layers since this is not only the foundation of the whole system, it is also where changes will have the most impact on pupil progress in Primary Science.

What can we do with this?

This pdf can be used as a supportive source of examples and/or as a structure to support school self evaluation. The interactive functions allow you to traffic light your assessment systems (on your own saved copy) and make notes on the approaches in your school.

On the pyramid page, each box will take you to examples if you click on it. The 'back to the top' button (bottom right) will take you back to the pyramid. Each box on the pyramid has buttons for red, amber, green and reset (if they are black in Adobe try clicking 'Highlight existing fields' on the toolbar). There is a page for making notes about your own school at the end of the document and a link for this on each page. If you prefer to do this on paper then a black and white pyramid for printing is also available on the PSTT website.

If you would like to offer further examples or provide the TAPS team with feedback, please email primary.science@bathspa.ac.uk



USING THE SCHOOL SELF-EVALUATION TOOL
http://tinyurl.com/pyramidintro

Next page >

= NO EVIDENCE
= SOME EVIDENCE
= STRONG EVIDENCE

DIRECTION OF INFORMATION FLOW THROUGH SCHOOL

SCHOOL: DATE:

5. WHOLE-SCHOOL PROCESSES

Whole school processes - How do we support validity and reliability of teacher assessment? W1

4. SUMMATIVE REPORTING

Teachers **summarise** achievements in terms of **what pupils can do**, not only in terms of levels, grades or % S1

Parents/carers receive **oral and written reports** that identify the next steps for their children S2

Summaries of pupil progress across the cohort draw on a range of information S3

FEEDBACK FROM DIALOGUE WITH SCHOOL LEADERSHIP, GOVERNORS AND PARENTS INFORMS CHANGES TO SCIENCE ASSESSMENT

TEACHER-PUPIL/PARENT CONFERENCES INCLUDE DIALOGUE ON ATTAINMENT IN SCIENCE

3. MONITORING OF PUPIL PROGRESS

Teachers base their summative judgements of pupils' learning on a **range of types of activity** M1

Teachers take part in **moderation/discussion** with each other of pupils' work in order to align judgements M2

There is a **shared understanding of progression** in science M3

Pupils are **aware of the criteria** by which their work over a period of time is judged M4

A **manageable system for record-keeping** is in operation to track and report on pupils' learning in science M5

2. RESPONSIVE TEACHING

Teachers plan opportunities to elicit pupils' science knowledge and skills T1

Teachers involve pupils in discussing **learning objectives** and **criteria for success** T2

Teachers gather evidence of their pupils' learning through **questioning/ discussion** and **observation** T3

Teachers gather **evidence of their pupils' learning** through study of the products of activities and tasks T4

Teachers use assessment to advance pupils' learning by **adapting the pace, challenge and content** of activities T5

Teachers use assessment to advance pupils' learning by **giving feedback** to students about how to improve T6

Teachers use assessment to advance pupils' learning by providing **time for students to reflect** on and assess their own work T7

1. ACTIVE PUPIL INVOLVEMENT

Pupils identify their **existing ideas**, learning needs and interests, and consider those of peers. P1

Pupils **focus on science** knowledge, understanding, skills and attitudes in **learning objectives** and **success criteria** P2

Pupils **assess their own** ideas and work against known criteria P3

Pupils **assess peers'** ideas and work against known criteria P4

Pupils use assessment to advance their learning by **acting on feedback** P5

Pupils collaboratively (with peers/teachers) **identify next steps** in learning P6

SAVE MY PROGRESS

Notes

Next page

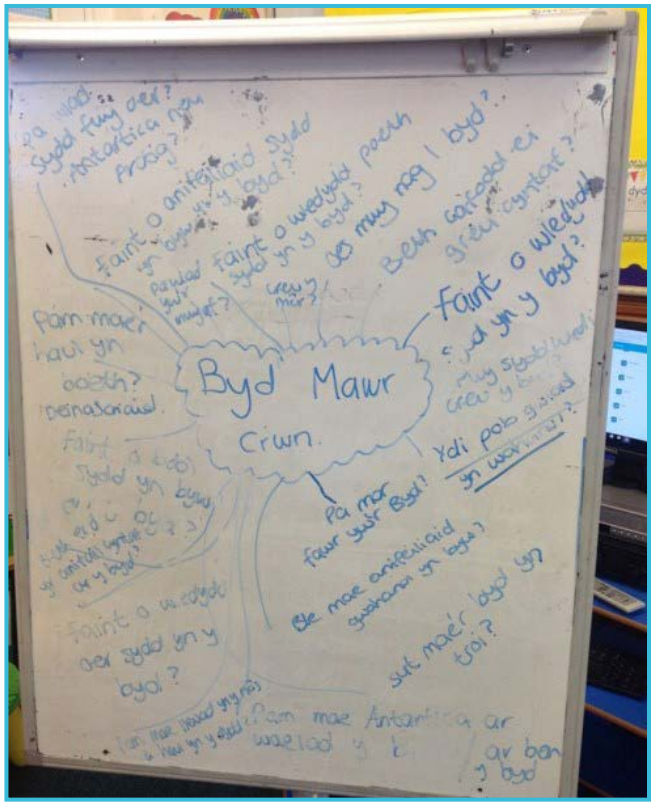
Produced by the Teacher Assessment in Primary Science Project, Bath Spa University, developed from the Nuffield Foundation (2012) and Harlen (2013)

PUPIL BOX 1:

PUPILS IDENTIFY THEIR EXISTING IDEAS, LEARNING NEEDS AND INTERESTS, AND CONSIDER THOSE OF PEERS

E.g. mindmaps, annotated drawings, KWL grids, mini whiteboards, post its, talk partners.

Pupil Voice Wall / Wal Llais Plant



Year 1, Ysgol Gymraeg Pencae, Cardiff

At the start of a topic the class teacher records pupils' questions on a Pupil Voice Wall (Wal Llais Plant). This strong pupil voice elicits what pupils are interested to find out and these questions lead the learning during the topic . During the lessons the teacher refers back to the Pupil Voice Wall to show how the pupils' questions are being considered.

In a similar way Key Stage 2 pupils complete KWL grids to show specifically what they want to learn.

Link to video of teacher explaining: http://tinyurl.com/TAPSpencae

KWL Grid

At the start of each new topic pupils are asked to record what they already know (K) about the topic, to list questions about what they would like to find out (W) and finally at the end of the topic pupils answer their own questions or write down the additional information that they have learnt (L). This example is based on the topic of electricity. Initially this child focused on the dangers of electricity (K) and therefore teaching focused on the understanding of how electricity works. One question asked 'why do we need to switch electricity on and off?' (W) the end of the topic the child learnt how to make a circuit and the purpose of switches in a circuit (L).

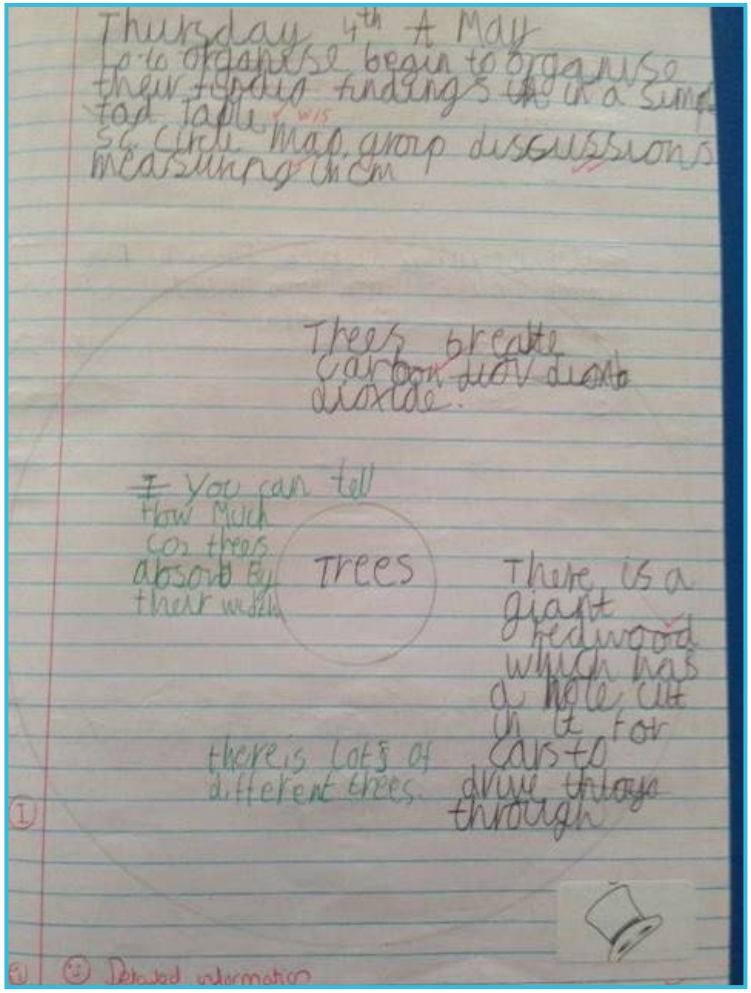
Topic: Electricity Name: _____

K What I Know	W What I Wonder	L What I Learned
• Electricity is very dangerous.	• Where does electricity come from?	• Years ago people didn't have electricity
• You plug things in to electricity to make them work.	• What is electricity made of?	• Batteries make things work.
• You can get an electric shock from electricity.	• How does it get to our houses?	• Batteries have a + and a −.
• You must never put electricity near water.	• Why do we need to switch it on and off?	• You have to make a circuit like a circle.
		• lightning is a type of electricity.

Year 1, Blaenycwm Primary, Brynmawr

Circle Maps

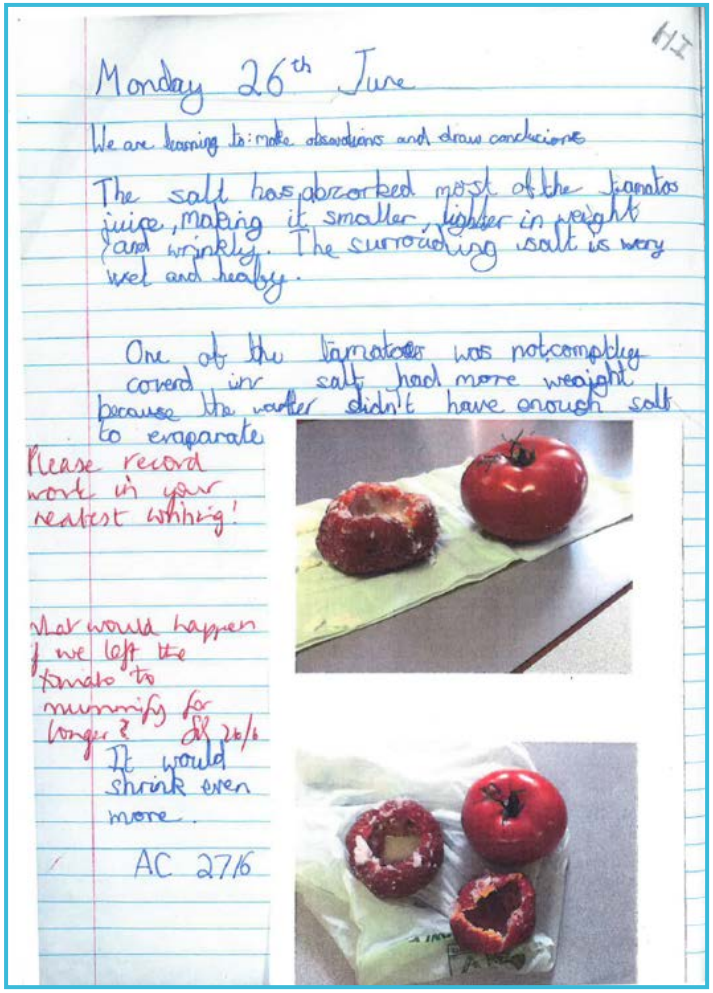
Eliciting prior knowledge at the start of a learning experience can support the pupils to identify what they already know, and also enables the teacher to build on prior knowledge. At Tongwynlais Primary this is done through the use of Circle or Thinking Maps. Pupils use these at the start of the session to record what they know, they then return to the thinking map at the end of the investigation to show what they have found out; this gives an indication to the teacher of progression. Teachers use these formatively to calculate next steps in learning. This example represents the use of a Circle Map to show a pupil's learning about trees in Year 3.



Tongwynlais Primary, Cardiff

Engaging pupil interest

Pupils are more likely to engage with their learning if they are asked to identify their existing ideas and follow their interests. In line with the approach of Successful Futures in the new Welsh curriculum, pupils at Marlborough Primary have a key role in leading their learning. In this example from Year 4 pupils were interested in Egyptian mummies and wanted to make their own. They learnt about mummification and then used the scientific principles to mummify tomatoes based on their previous learning of evaporation. The focus of the learning was to make observations and in the following lesson pupils used their observation results to draw conclusions.



Year 4, Marlborough Primary, Cardiff

PUPIL BOX 2:

PUPILS **FOCUS ON SCIENCE** KNOWLEDGE, UNDERSTANDING, SKILLS AND ATTITUDES IN **LEARNING OBJECTIVES** AND **SUCCESS CRITERIA**.

E.g. be clear about science focus rather than presentation etc.

Opportunities for science in continuous provision

In the Foundation Phase at Penllergaer Primary School, the continuous and enhanced provision includes opportunities for science exploration. For example, at the sand tray there was an activity for using sieves to separate rice and pasta from the sand. At the water tray the children were provided with pipettes and challenged to make big or small drops, then to investigate what happened when they dropped water onto different materials.

Year 1/2 Penllergaer Primary, Swansea

Natural material bridges

Year 1 pupils at Pencae engaged with a series of bridges activities for their science technology focused assessment task.

During an initial whole class carpet session the class explored and discussed pictures of different bridges which helped them understand the purpose of a bridge and it also supported the development of their scientific vocabulary. Many pupils adopted the various names of the bridges (trawst, bwa and consertina). One group worked with the teaching assistant in the outdoor forest area of the school hunting down suitable natural resources which they experimented with and used the most appropriate to construct bridges. Pupils were clear about the design structure and through trial and error everyone succeed to build a bridge. The teaching assistant recorded the work through photographs.

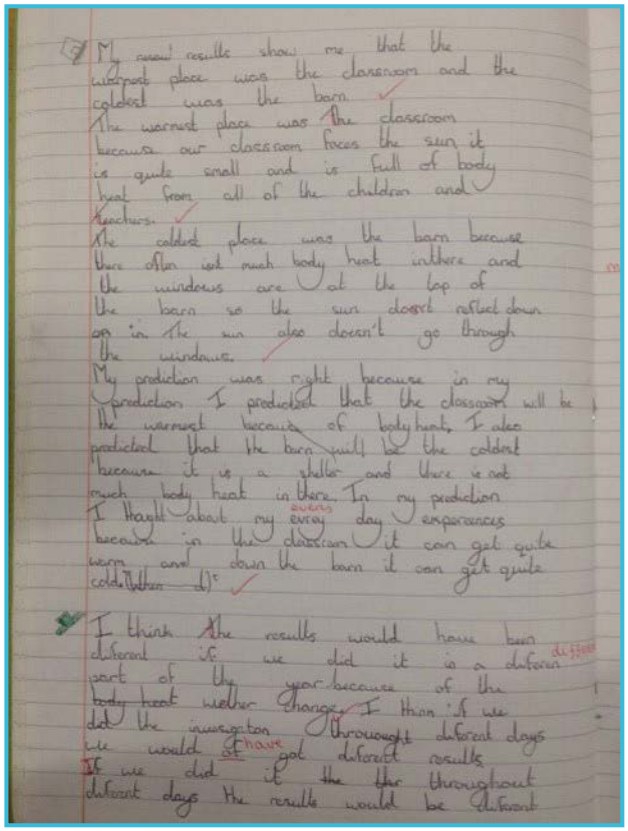
Bridges focused task

Year 1, Ysgol Gymraeg Pencae, Cardiff

Structure to support science thinking

At Tongwynlais primary pupils are supported to structure their thinking using de Bono's 'Thinking hats '. In this example the focus of the lesson was on taking accurate temperature readings around the school. The pupils used the 'white hat' to focus on information or facts, to describe their results:

> *"My results show me that the warmest place was the classroom because our classroom faces the sun, it is quite small and it is full of body heat."*



They then progress to using the 'green hat' to be creative and to think of different possibilities as to how the temperature might be different at different times of the year. The pupil states:

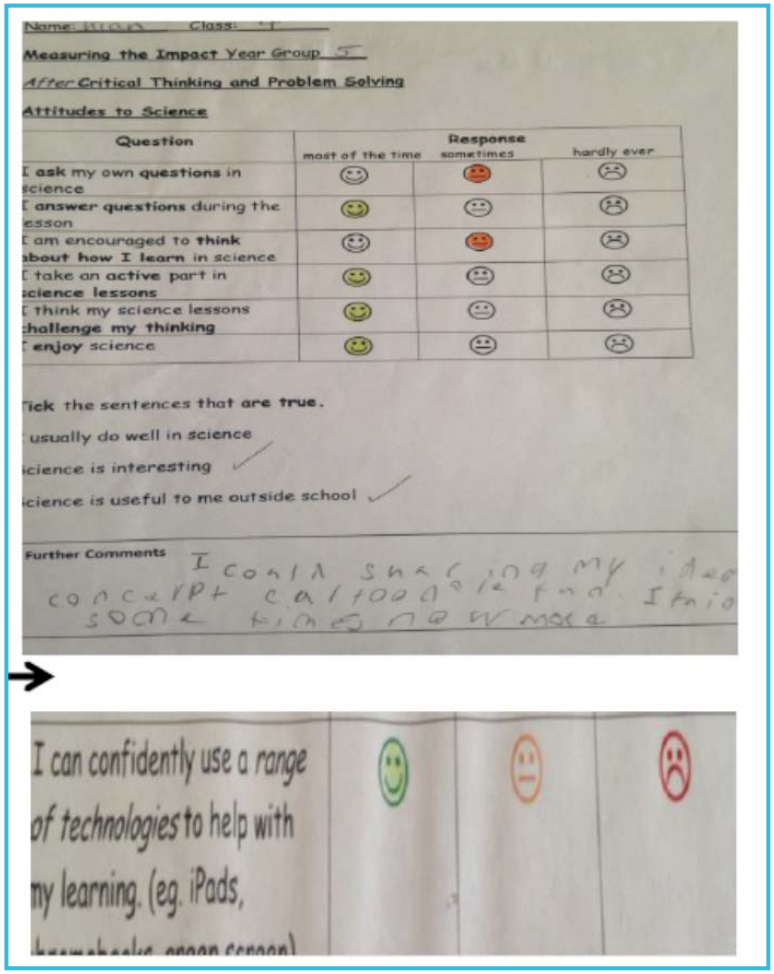
> *"I think the results would have been different if we did it in a different part of the year, because of the weather change."*

Familiarity with the thinking hats enables the pupils to structure their thinking and consider questions from different viewpoints.

Year 5, Tongwynlais Primary, Cardiff

Pupil attitudes

At Fochriw, there are opportunities for 'Listening to Learners' in a variety of contexts. This includes an attitude survey which is repeated to see how improvements in science across the school have affected pupil engagement.


Name: Class:

Measuring the Impact Year Group

After Critical Thinking and Problem Solving

Attitudes to Science

Question	Response: most of the time	sometimes	hardly ever
I ask my own questions in science	☺	😐	☹
I answer questions during the lesson	☺	😐	☹
I am encouraged to think about how I learn in science	☺	😐	☹
I take an active part in science lessons	☺	😐	☹
I think my science lessons challenge my thinking	☺	😐	☹
I enjoy science	☺	😐	☹

Tick the sentences that are true.

I usually do well in science

Science is interesting

Science is useful to me outside school

Further Comments

I can confidently use a range of technologies to help with my learning. (eg. iPads,

Fochriw Primary, Caerphilly

PUPIL BOX 3:

PUPILS **ASSESS THEIR OWN** IDEAS AND WORK AGAINST KNOWN CRITERIA

E.g. traffic lighting or highlighting objective, commenting on whether predictions are supported.

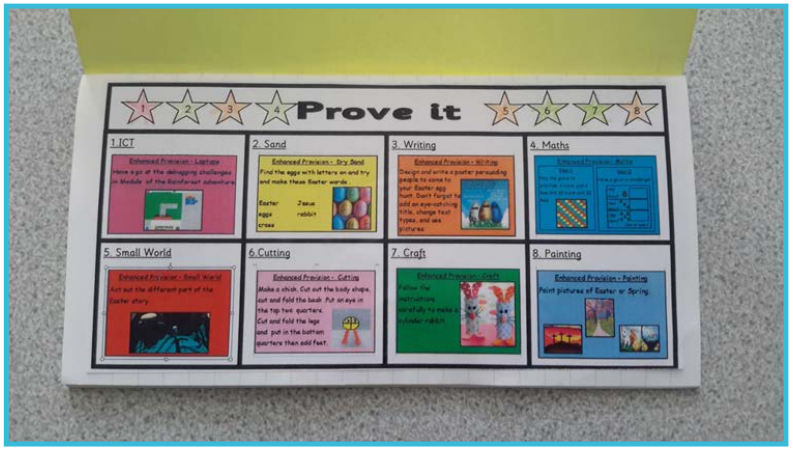
Self Assessment Pegs Chart

The **Self Assessment Pegs Chart** helps the pupils measure what they know or can do for a skill against RAG (red, amber, green) or smiley faces traffic lights. Every child has a peg with their name and they are able to place the peg on the traffic light/ smiley face they feel comfortable with at the start and end of a task. They can also record the traffic light colour and smiley face as a self assessment upon completion of their work. This Self Assessment Pegs Chart is a very visual way to see the progress of the whole class during the lesson and the teacher has an opportunity to consider the children's understanding in order to direct the next steps during the lesson.

Year 1, Ysgol Gymraeg Pencae, Cardiff

'Prove it' books for self assessment

In the Foundation Phase at Penllergaer Primary School, they had found it difficult to track which children had experienced which activity from the choice board of enhanced provision. They introduced a 'Prove it' book where the children complete a RAG self assessment for each numbered activity over the two weeks. This enabled teachers to both check that all children had experienced all activities, but also get a sense of whether the children felt confident or not, which would lead to discussions with the child as appropriate.



End of Year 1 into Year 2 Penllergaer Primary, Swansea

Pupils use Traffic Lights to assess their own ideas and work against known criteria

Pupils are asked to colour code their level of understanding against the lesson's learning objective and also against success criteria. They reflect on their learning at the end of the session as well as the beginning. The codes relate to the colours of traffic lights.

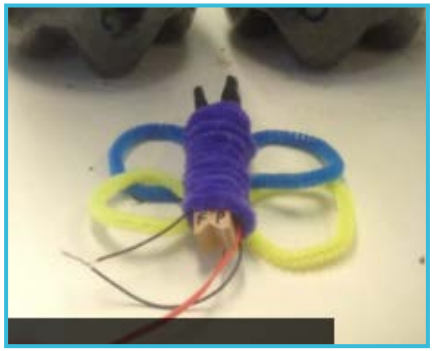
Green = very good understanding/found task suitable.

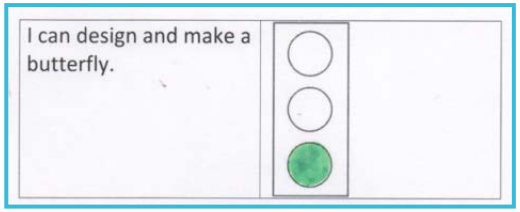
Amber – I am not completely sure about what I have been asked to do/found task a little tricky.

Red – I do not understand the task and found it hard to learn/found task too challenging.

In this example the child completed the task of designing and making a butterfly independently and therefore coloured the traffic light green.

Circuit bugs task





Year 1, Blaenycwm Primary, Brynmawr

Mr Men characters to support self assessment

Mr Men posters are displayed in all Foundation Phase classrooms as visual tool for assessment. Characters are visual references to prompt children in accurate assessment of achievement in their learning. There are 3 characters in the Nursery, 5 in Reception (these are the 3 from Nursery plus 2 extra), 7 in Year 1 and 9 in Y2.

There is a progression for each class in order to develop their ability to self assess.

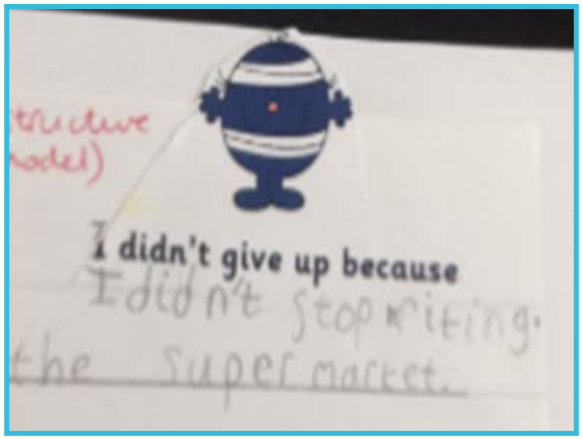
Nursery – express opinion of their likes and dislikes in their learning.

Reception – beginning to express an opinion of their strengths and weaknesses and to justify.

Year 1 - developing an opinion of their strengths and weaknesses and to justify.

Year 2 – mastering an opinion of their strengths and weaknesses and to identify a way forward to further improve learning.

The use of Mr Men characters leads to a dialogue between staff, pupils and their peers. The aim is that pupils will develop the ability to self and peer assess successfully.



Foundation Phase, St Philip Evans RC Primary School, Cardiff

PUPIL BOX 4:

PUPILS **ASSESS PEERS'** IDEAS AND WORK AGAINST KNOWN CRITERIA

E.g. comment on another group's presentation, give 2 stars and a wish for piece of work.

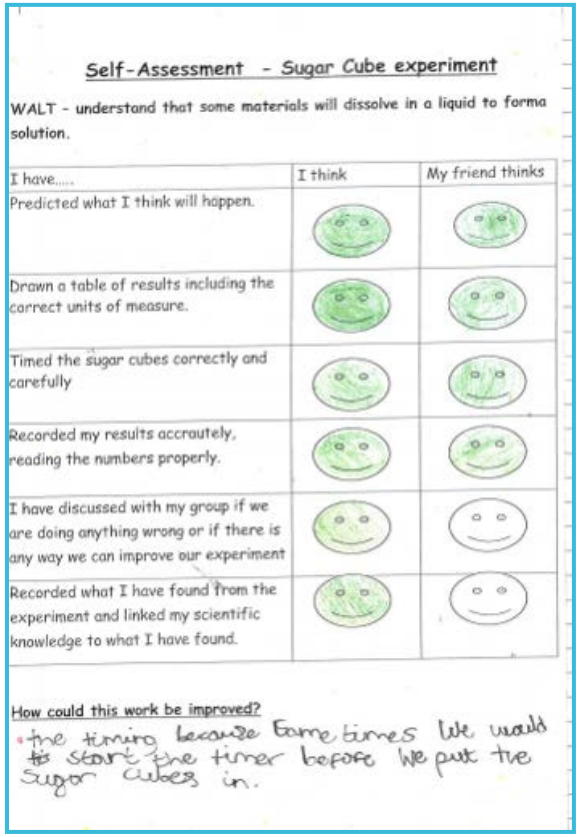
Magpie from peers

The 'Magpie' strategy is used in Year 5 at Tongwynlais. The teacher will ask the class what is going well, and the pupils will make suggestions; the other pupils can then use their peers' ideas within their work. In this example the lesson applied science and technology skills to make a marble run. These pupils had successfully used bendy straws to make a curved path, whereas other pupils had struggled to curve their paths. The teacher asked these pupils to show what had worked well and other pupils were then able to improve their work.

Marble run task

Year 5, Tongwynlais Primary, Cardiff

Peers support assessment



Self-Assessment - Sugar Cube experiment

WALT - understand that some materials will dissolve in a liquid to forma solution.

I have.....	I think	My friend thinks
Predicted what I think will happen.		
Drawn a table of results including the correct units of measure.		
Timed the sugar cubes correctly and carefully		
Recorded my results accrautely, reading the numbers properly.		
I have discussed with my group if we are doing anything wrong or if there is any way we can improve our experiment		
Recorded what I have found from the experiment and linked my scientific knowledge to what I have found.		

How could this work be improved?

the timing because Some times We would to start the timer before We put the Sugar cubes in.

When pupils finish a piece of work they are encouraged to check their work through to ensure that they have met all sections of the success criteria. They colour in the smiley face in green if they think they have, they colour the face in amber if they are unsure or colour in red if they think that an aspect is missing. The pupil then asks one of their peers to check their work. Any discrepancies are discussed. Where appropriate the peer marker adds a next step suggestion to move the pupil's learning forward. Pupils are encouraged to focus on scientific skills rather than presentation skills when writing next step suggestion for improvement.

Year 5, Garnteg Primary, Pontypool

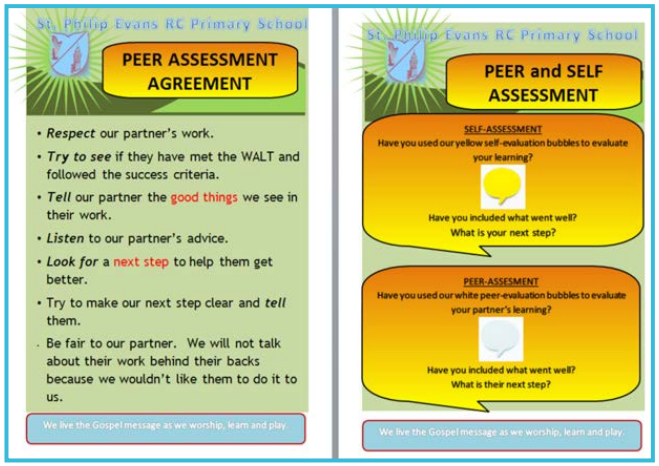
Peer assessment

Groups of children are able to improve their outcomes in science using peer assessment. As a class, children were given the opportunity to select a bubble mixture to create their own bubbles. The teacher adopted a child-led approach and allowed children to experiment and explore. Pairs of children had different rates of success with making a 'rainbow' bubble. To enable the children to progress in their learning, the teacher stopped the class when he saw a child being successful. The teacher supported learners by asking them to reflect on what they could see that may have meant the group were blowing bubbles effectively. Other groups of children were then allowed to observe these bubbles forming and given an opportunity to trial what they had seen with their own bubble mixture. By the end of the lesson all pairs of children were able to create their own 'rainbow' bubbles.

Year 5, Edwardsville Primary, Merthyr Tydfil

Peer assessment agreement

If it is only the teacher who gives feedback, then the balance is wrong and the learners do not actively participate in their own learning. However, we recognise that self and peer assessment are not something that learners can do instinctively and they will not happen overnight. Therefore, we coach learners to self and peer assess by modelling processes and strategies e.g. the kinds of questions and thinking which are helpful. We also train learners to work effectively in pairs and groups as this is an essential prerequisite to peer assessment. Usually learners need to be effective peer assessors before they become effective at self-assessment. To peer and self assess, the learners must fully understand the learning objectives and the success criteria – the success criteria will be understood and used most effectively if the learners have been involved in constructing them, as noted above. Otherwise, they have no frame of reference against which to assess and feedback will be low level and superficial. With this in place, learners can peer and self assess against the success criteria regularly throughout the lesson and make improvements to their work accordingly.



St Philip Evans RC Primary School, Cardiff

PUPIL BOX 5:

PUPILS USE ASSESSMENT TO ADVANCE THEIR LEARNING BY **ACTING ON FEEDBACK**

E.g. respond to mini-plenary advice in second half of lesson, make improvements in next investigation.

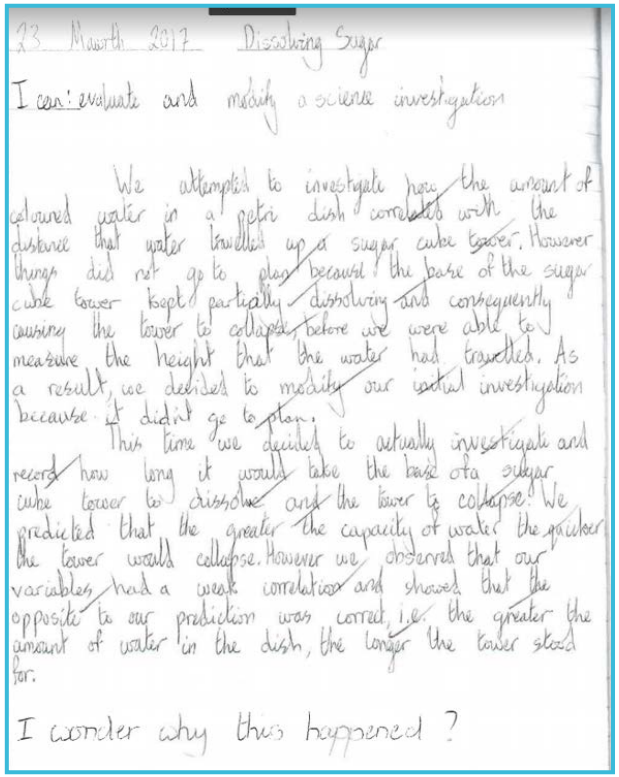
Pupils respond to teacher feedback

Pupils were asked to illustrate the process of germination in the form of a storyboard. When teachers mark pupils work, they add a comment to encourage pupils to reflect further on their learning. In this example the child was asked why it was so important for plants to germinate.

Year 5, Garnteg Primary, Pontypool

Pupils make improvements to a science investigation

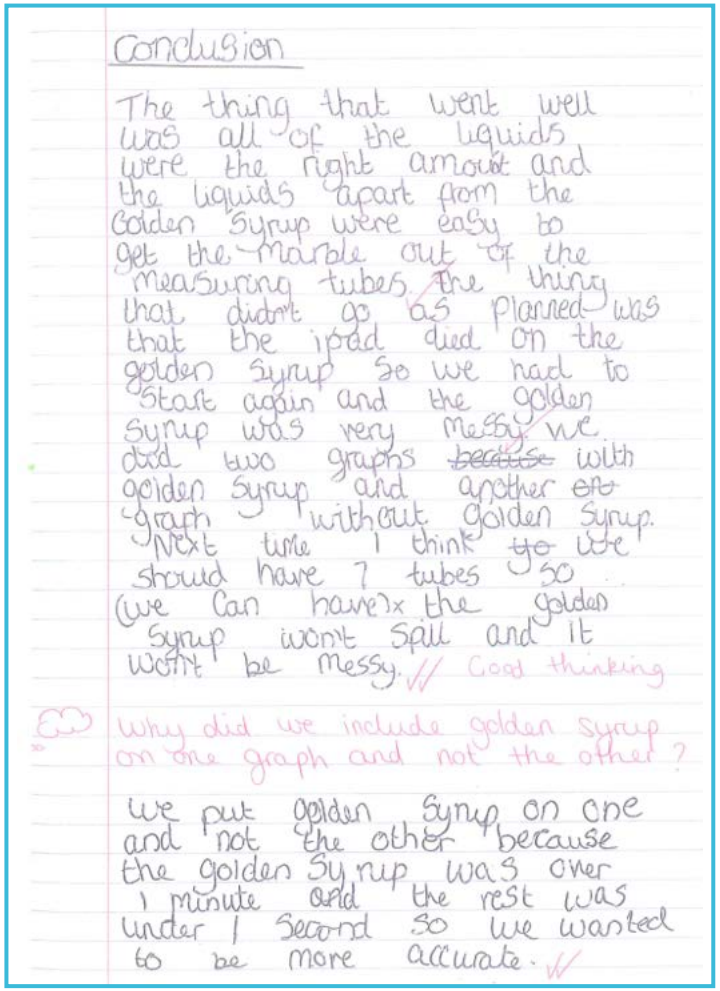
Year 5 and 6 pupils were encouraged to reflect on their learning and evaluate and modify a dissolving sugar cube investigation. The pupils had planned to time how long it took for the water to reach the top of the tower, but here the pupil has explained that *"the base of the sugar cube tower was collapsing before we were able to measure the height that the water had travelled"*, therefore they changed their investigation to record *"how long it would take the base of a sugar cube tower to dissolve and the tower to collapse."*



Y5 Sugar task

Year 5/6, Blaenycwm Primary, Brynmawr

DIRT time



Conclusion

The thing that went well was all of the liquids were the right amount and the liquids apart from the Golden Syrup were easy to get the marble out of the measuring tubes. The thing that didn't go as planned was that the ipad died on the golden syrup so we had to start again and the golden syrup was very messy we did two graphs ~~because~~ with golden syrup and another one graph without golden syrup. Next time I think we should have 7 tubes so (we can have) x the golden syrup won't spill and it won't be messy. // Good thinking

Why did we include golden syrup on the graph and not the other?

We put golden syrup on one and not the other because the golden syrup was over 1 minute and the rest was under 1 second so we wanted to be more accurate. //

Pupils can respond to feedback during DIRT time: Dedicated Improvement Reflection Time. In this example from Year 5 the teacher asked, "why did we include golden syrup on one graph and not on the other?" The pupil explains that the golden syrup produced a very different result to the other liquids.

In KS2 pupils are given one timetabled slot during the week to address written feedback from all subjects.

KS2, Tongwynlais Primary, Cardiff

Mini-plenaries to provide feedback which can be acted on

Mini-plenaries provide an opportunity to pause and provide feedback, which can then be acted on immediately within the lesson. For example, during a lesson on separating mixtures the class teacher paused a number of times to: check that the pupils knew which equipment was available; guide the pupils to separate one mixture at a time; and model the use of scientific vocabulary (in this case 'particles' to help with explaining which materials would go through the sieve). The use of questioning and prompts, for individuals, groups and the whole class, supported the pupils to be successful in separating the materials and provided the teacher with assessment information regarding which groups needed additional support.

Year 5, St Fagans Primary, Cardiff

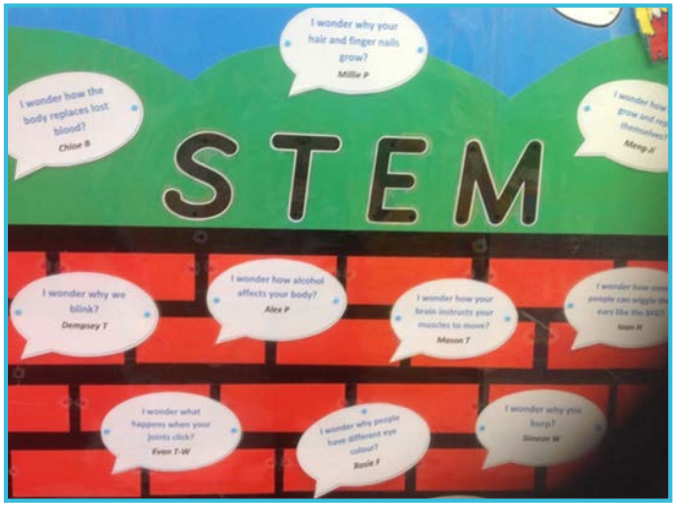
PUPIL BOX 6:

PUPILS COLLABORATIVELY (WITH PEERS/TEACHERS) **IDENTIFY NEXT STEPS** IN LEARNING

E.g. identify which part of the success criteria is missing, consider how to make the measurement more accurate.

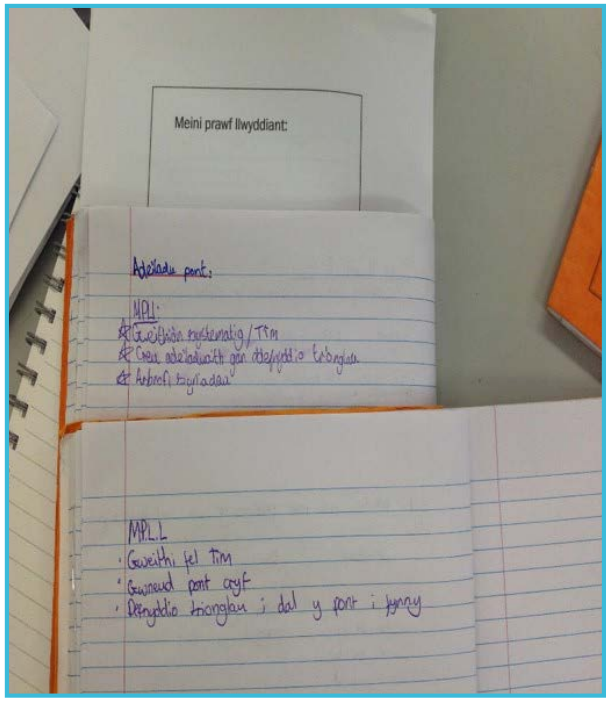
Pupil enquiry in STEM weeks

As part of school STEM (Science, Technology, Engineering and Maths) weeks, pupils at Blaenycwm Primary develop their own lines of enquiry. They identify what they would like to know next by raising questions on a Wonder wall, selecting an aspect of a topic that particularly interests them to investigate. The pupils work on their projects both at home and in school, and celebrate their projects in a School Science Fair.



Year 6, Blaenycwm Primary, Brynmawr

Identify next steps from class discussion of success criteria



Key Stage 2 pupils at Pencae have a class discussion about the Meini Prawf Llwyddiant (success criteria) Each pupil identifies their own next steps to focus on during the task. They independently record this using 'purple pens for progress' in their books. At the end of the activity pupils self assess how they have made progress during the lesson.

Ysgol Gymraeg Pencae, Cardiff

What to investigate next

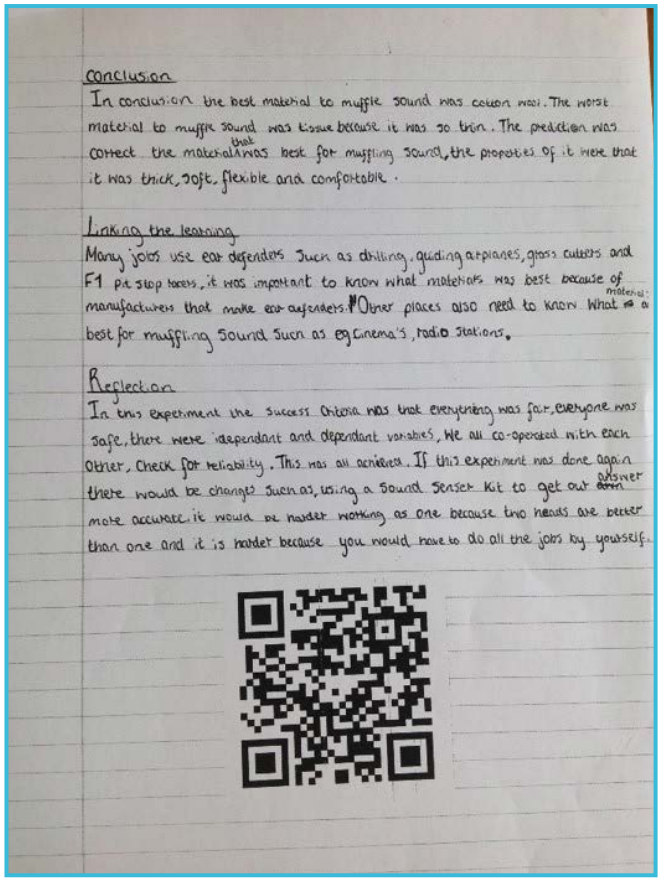
In this Nursery class activity the teacher encouraged pupils to reflect on their learning and to think about what they could do differently next time if they were to change the investigation. The teacher photographed the pupils carrying out their investigation on Rocket Mice and these were annotated to show the discussion between pupils and teacher.

The teacher asked the pupils 'if we could do the experiment again what could we change?' The pupils were able to respond with a variety of answers including using a bigger/smaller milk bottle or a bigger/smaller mouse, demonstrating they are beginning to understand cause and effect. Some children also suggested using a real space rocket.

Y2 Rocket mice task

Nursery , Marlborough Primary, Cardiff

Prompts to identify next steps



Conclusion

In conclusion the best material to muffle sound was cotton wool. The worst material to muffle sound was tissue because it was so thin. The prediction was correct the material that was best for muffling sound, the properties of it were that it was thick, soft, flexible and comfortable.

Linking the learning

Many jobs use ear defenders such as drilling, guiding airplanes, glass cutters and F1 pit stop boxes, it was important to know what materials was best because of manufacturers that make ear defenders. Other places also need to know what material is best for muffling sound such as eg cinema's, radio stations.

Reflection

In this experiment the success criteria was that everything was fair, everyone was safe, there were independant and dependant variables, We all co-operated with each other, Check for reliability. This was all achieved. If this experiment was done again there would be changes such as, using a sound sensor kit to get out answer more accurate. it would be harder working as one because two heads are better than one and it is harder because you would have to do all the jobs by yourself.

At the end of a sound muffling investigation, the pupils discussed their findings and recorded their conclusions. The 'QR' code contains a video clip of children testing out ear muffs they had made. The pupils concluded that 'the best material to muffle sound was cotton wool', and gave reasons based on scientific knowledge as to why this might be the case. The subtitles prompted the children to link their learning to real life contexts and reflect on success criteria and next steps. For example, next time for a more accurate reading they would consider using sound sensors.

Year 6, Edwardsville Primary, Merthyr Tydfil

TEACHER BOX 1:

TEACHERS PLAN OPPORTUNITIES TO ELICIT PUPILS' SCIENCE KNOWLEDGE AND SKILLS

E.g. plans show range of elicitation strategies at variety of times E.g. beg/mid/end lesson.

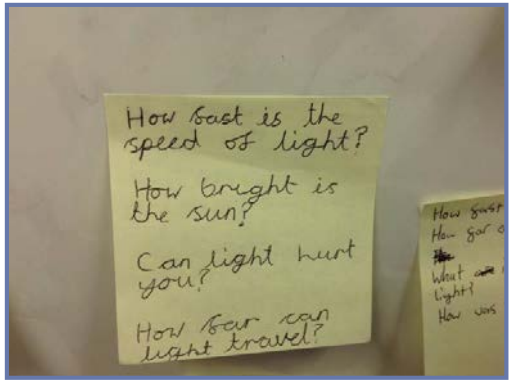
Investigation station

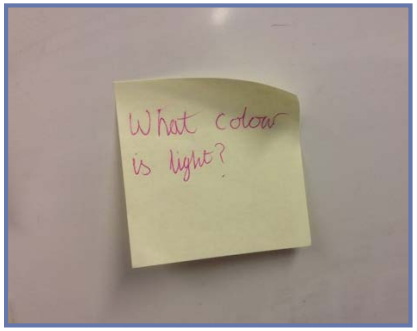
The Foundation Phase area included an Investigation Station where pupils could explore and observe. For example, pupils explored materials with the new digital microscope and saved their pictures onto the school server. Pupils could share their ideas with their peers and the teacher or teaching assistant.

Y1/2 Penllergaer Primary, Swansea

Opportunities for pupils to raise questions and make suggestions

Pupils in this lesson raised questions about light in order to decide on a line of enquiry. They generated a variety of questions then decided to explore whether it was possible to make their own rainbows. In a subsequent lesson, the class teacher collected pupil ideas for potential factors that may affect the rainbow nature of the bubbles; pupils suggested viscosity of the liquids, the size of the bubbles, whether bubbles had grouped and the darkness of the room.

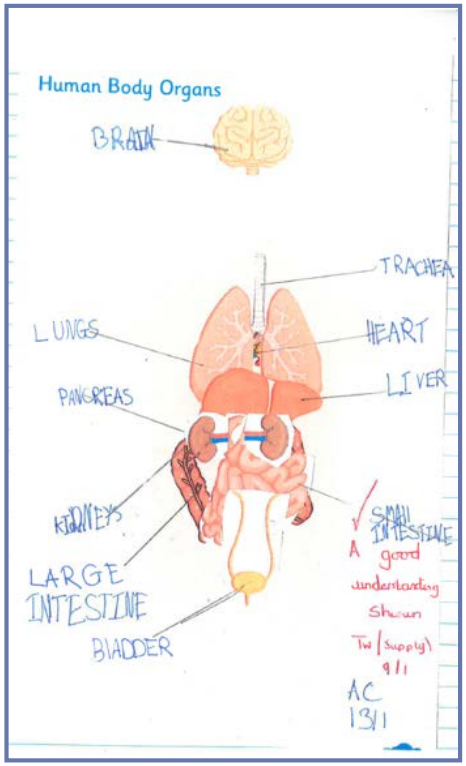


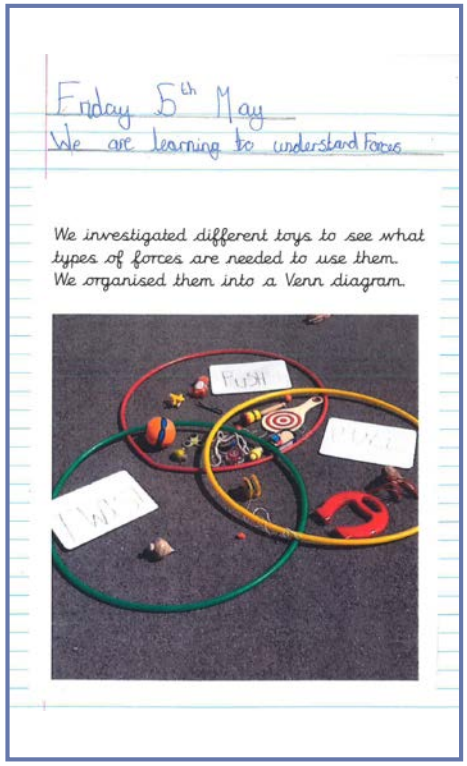


Year 5, Edwardsville Primary, Merthyr Tydfil

Teachers plan to elicit children's ideas

At Marlborough Primary, teachers use a variety of methods to elicit prior thinking, which will then inform their teaching. In the first example hoops have been used by Year 4 pupils to create a Venn diagram to show knowledge of different types of forces. In the second example Year 4 pupils demonstrated their understanding by sticking internal organs within a drawn outline of a human body. The teacher was able to identify any scientific misconceptions and build on the pupil's understanding to progress their learning.





Year 4, Marlborough Primary, Cardiff

Eliciting ideas for choice of equipment

During part of the lesson the aim was to encourage children to think about the most appropriate equipment to use to measure temperature of the water. The teacher wore the black 'thinking hat' for this part of the session as she wanted children to think 'what was wrong' with a particular choice of equipment for measuring temperature. In Foundation Phase the teacher or pupil wears the hat, whereas in KS2 the teacher will put the correct hat on display. Providing a choice of equipment supports the children to justify their choice.

Nursery, Tongwynlais Primary, Cardiff

TEACHER BOX 2:

TEACHERS INVOLVE PUPILS IN DISCUSSING **LEARNING OBJECTIVES** AND **CRITERIA FOR SUCCESS**

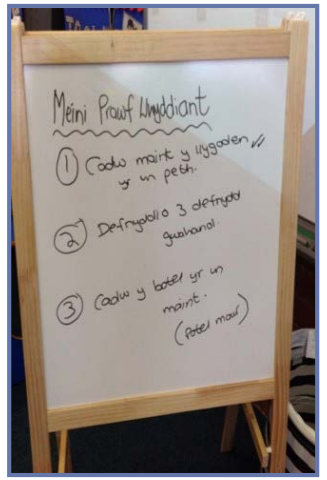
E.g. discuss what good observation or conclusions look like.

Children tick the success criteria

During lesson introductions at Ysgol Pencae the teachers involve the class in a discussion of what makes a task or activity successful. The Year 1 teacher scribed pupils' ideas as 'Meini Prawf Llwyddiant' (Success Criteria) on a small white easel and pupils reflected on them during the task. This example shows 3 success criteria for fair testing in the rocket mice focused assessment task.

Pupils were given 3 different roles when designing their rocket mice – success criteria manager (SCM), resource manager and 'everyone on task' manager. The SCM had to tick each success criteria as and when they were being achieved by the group. This ensured younger pupils were involved in reflecting on the success criteria during the task.

Older pupils recorded and self assessed the SC independently in their books using purple pens.

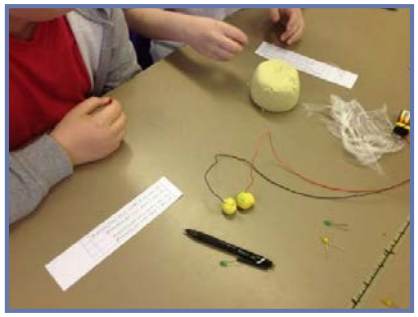


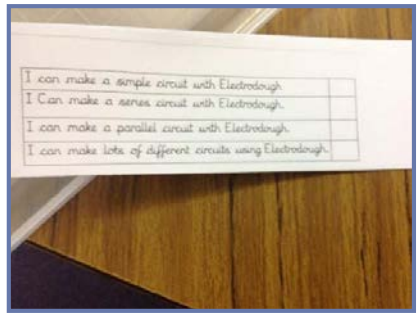
Ysgol Gymraeg Pencae, Cardiff

Y2 Rocket mice task

Teachers involve pupils in discussing success criteria

Before the electrodough lesson began the pupils had been given an opportunity to learn about simple series and parallel circuits using traditional equipment such as crocodile clips. At the start of the lesson the teacher gave pupils 'I can' statements to focus their learning on success criteria. The level of complexity of the criteria increased as the children progressed in their learning e.g. I can make a simple circuit, to a series circuit, to a parallel circuit. Finally the pupils were given the opportunity to play and experiment and to apply their learning in a variety of contexts e.g. can they make a 3D model of their name that lights up, or a monster that lights up?. The example given here is a series circuit where an LED lights up when an electrical current is applied.





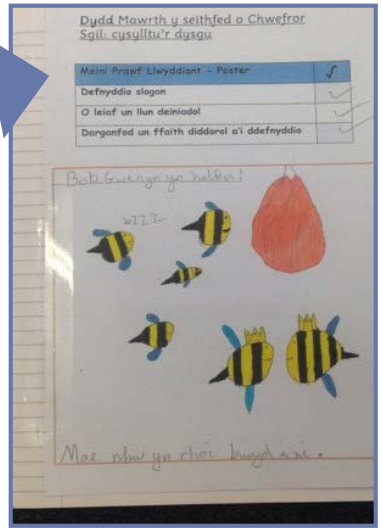
Electrodough task

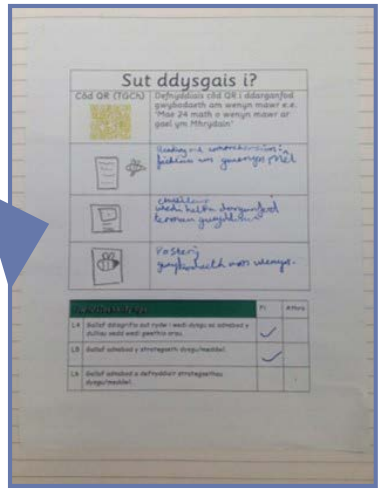
Year 5, Edwardsville Primary, Merthyr Tydfil

Reflecting on success criteria

Science lesson start and end with the pupils and teacher reflecting on the learning goals. These are generated in advanced by the teacher in a success criteria grid (meini prawf llwyddiant). In the example opposite the pupils were researching interesting facts about bees on ipads and they needed to produce an individual poster. They started by making rough notes on a mini white board and then worked on their posters always closely following the 3 achievable success criteria. They gave pupils a clear steer; in the example the pupil included a slogan, an attractive picture and useful/ interesting fact. Thus this pupil had accurately self assessed their work against the teacher's success criteria.

The second picture demonstrated how the pupils reflected back on their learning at the end of the lesson. Again the teacher had produced a grid but this time it was mainly open ended. The first box included a picture of the QR codes (ICT) and prompted the pupils to write a comment about the ICT they had used.

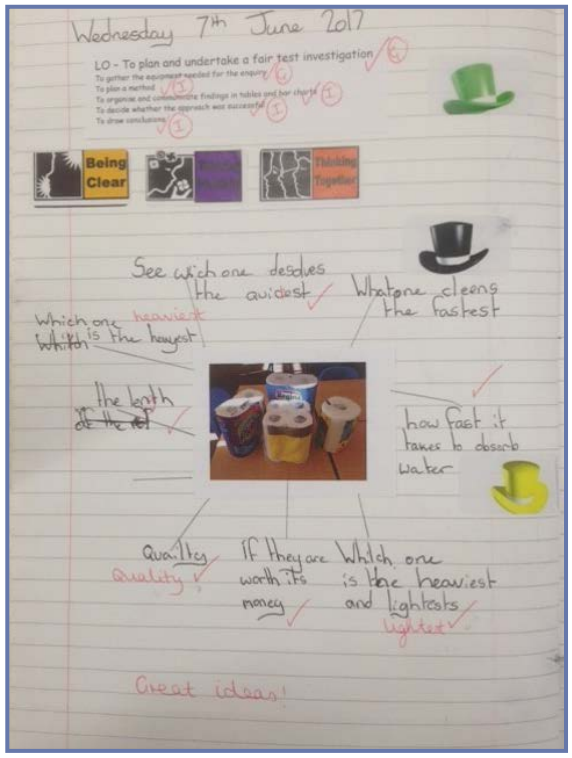




Ysgol Gymraeg Coed Y Gof, Cardiff

Self assessment with 'Thinking hats'

Pupils have a better understanding of their own learning when they are given opportunities to assess their own ideas against the criteria, which in this school is supported by using de Bono's 'Thinking hats'. In this example, the teacher gave a green hat to pupils at the start of the learning to outline the type of thinking that would be taking place- the green hat for creative thinking was placed against the learning objectives. Pupils then were asked to self assess their ideas using the black and yellow hats. In this example the pupils used the stickers to identify their most (yellow hat) and least (black hat) practical ideas for investigations associated with assessing the effectiveness of different paper towels.



EXPLAINING THINKING HATS
http://tinyurl.com/tongwynlais

Year 5, Tongwynlais Primary, Cardiff

TEACHER BOX 3:

TEACHERS GATHER EVIDENCE OF THEIR PUPILS' LEARNING THROUGH **QUESTIONING/DISCUSSION** AND **OBSERVATION**

Puppets for science talk

Puppets are being used in Year 2 to help children to think about their science concepts. The children and staff use the puppets to generate ideas and develop science thinking.

Concept cartoons engage children in discussion, for example, here in Year 6. They have been found to help those who are more reluctant to talk in front of others.

St Paul's Primary, Cardiff

Partneriaid trafod (Talk partners)

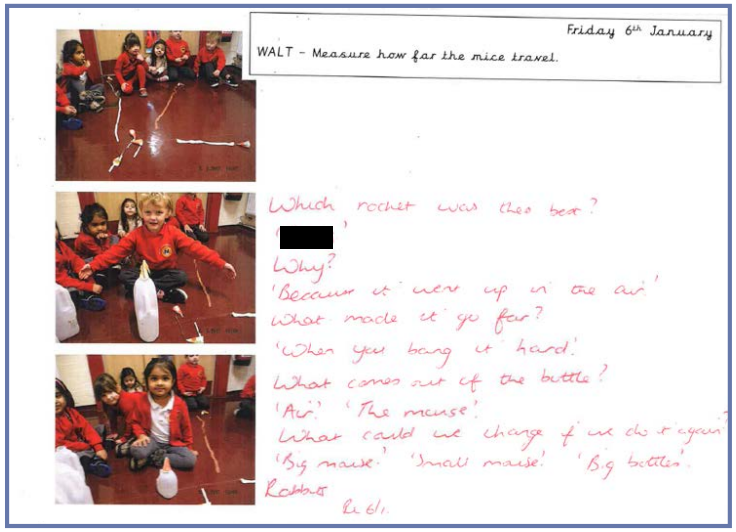
In year 1 the teacher actively encourages paired work and collaborative discussion and uses this to gather evidence of pupils' learning. The teacher systematically organises Talk Partners on a Partneiriaid Trafod (Talk Partners) sheet. During carpet time pupils are encouraged to discuss ideas with their Talk Partner and to think/pair/share ideas and different pairs are targeted for observations at various times. The teacher regularly changes the Talk Partners by moving the velcroed/blue tacked pupils names on the sheet.

Ysgol Gymraeg Coed Y Gof, Cardiff

Teacher questions

In Nursery, the class teacher wanted to find out if the pupils were able to use scientific enquiry to suggest answers to questions. The teachers elected the focused assessment activity Rocket Mice from the TAPS database to do this. Photographs were taken of each child participating in the focused assessment task and these were annotated as shown in the example. The teacher was able to gather evidence of the pupils' learning through questioning, discussion and observation.

As can be seen from the annotations the class teacher asked the pupils a variety of open and closed questions, for example, 'which rocket was the best?' and 'what made it go far?' The teacher asked the pupils to explain their reasoning by asking them 'why?' The recorded responses clearly showed the teacher whether the pupils were able to meet the learning objective.



Y2 Rocket mice task

Nursery , Marlborough Primary, Cardiff

Gathering evidence through observation - floorbooks

At Tongwynlais Primary, the science subject leader ensures that 'rich science activities' are recorded through a class floorbook, particularly within Foundation Phase. The floorbook can include electronic annotations (e.g. pic-collage) or handwritten notes of the children's utterances during investigations.

The subject leader shares these examples with other teachers and with parents, therefore whilst the recorded comments are linked to assessment tick sheets.

Nursery and Foundation Phase, Tongwynlais Primary, Cardiff

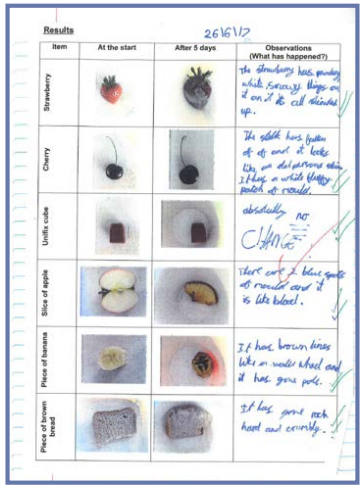
TEACHER BOX 4:

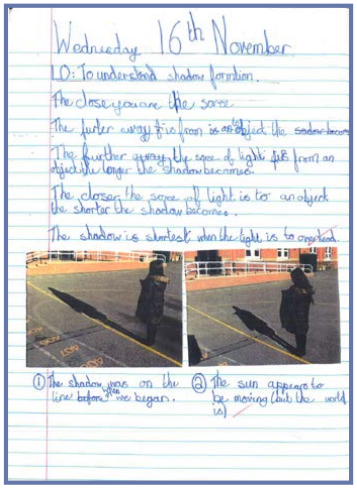
TEACHERS GATHER **EVIDENCE OF THEIR PUPILS' LEARNING** THROUGH STUDY OF THE PRODUCTS OF ACTIVITIES AND TASKS

E.g. any recording, models, sorting.

Pupils annotate photos

As a part of ongoing formative assessment at Marlborough Primary teachers provide a range of opportunities for pupil recording, for example, annotating photographs. In the first example, pupils had been learning to make careful observations through observing changes over time in different types of foods. Over a time period of five days foods became mouldy, but different effects were noticed with different foods. Pupils were asked to study the photographs, identify any changes and describe these on the template seen. In the second example pupils used photographs of themselves acting as 'shadow sticks' to describe how the length of a shadow changes over the day.

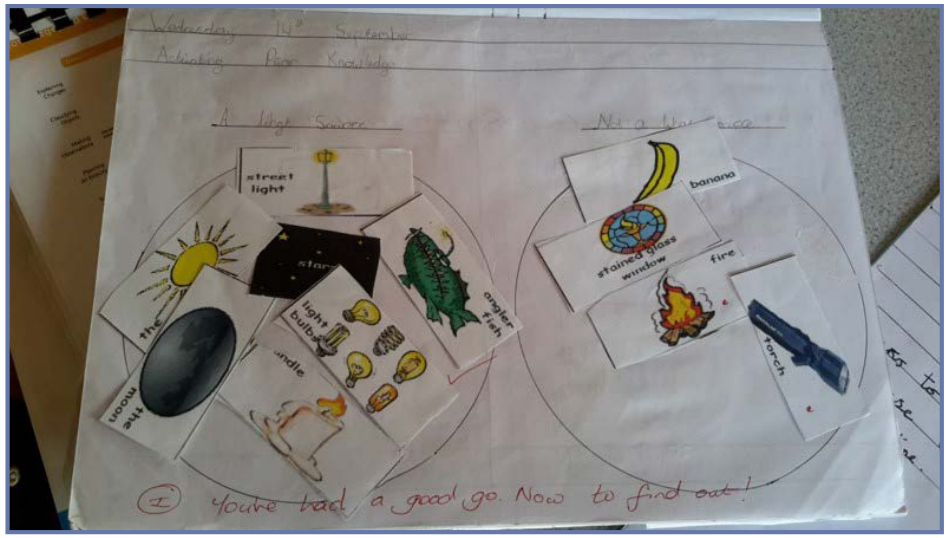




Year 4, Marlborough Primary, Cardiff

Support codes

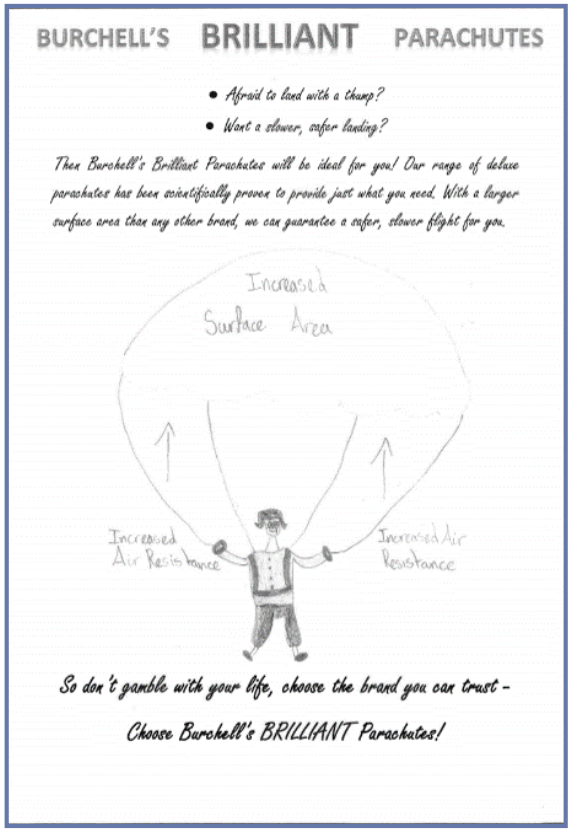
Teachers provide opportunities to elicit pupil ideas, for example by sorting pictures by whether they are a light source or not. To help with summaries of assessment later on, teachers note the amount of support that the pupil received: I for independent, S for support, G for group or W for wordbank.



Year 2 Penllergaer Primary, Swansea

Y6 Parachute poster

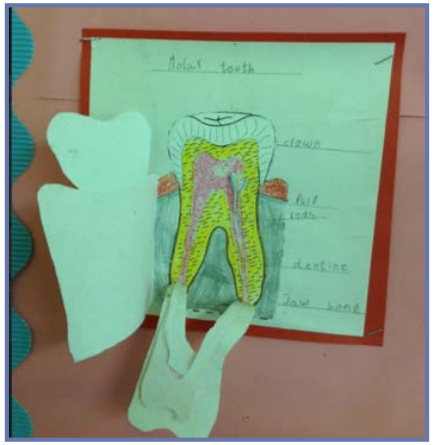
Teachers gather evidence of pupil learning through a range of cross curricular activities. This Year 6 pupil has designed a poster to advertise the important features of a parachute. This information is used by the teacher to assess the next steps in the pupil's learning.

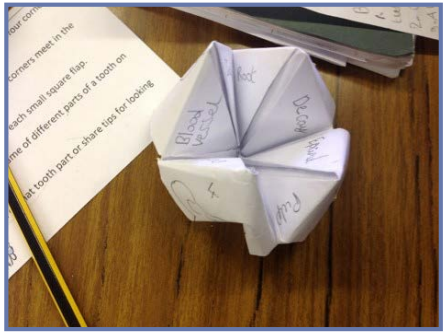


Year 6, Blaenycwm Primary, Brynmawr

Pupils use models

Pupils can create models to show their thinking. In this example pupils were learning about healthy eating and taking care of their teeth. Pupils were given a variety of tasks both written and practical to illustrate their understanding. Following written instructions pupils created 3-D models of human teeth. Further opportunity to show learning was given through the creation of 'chatterboxes'- pupils were asked to name four types of teeth, draw a picture and provide information 'hidden' inside the chatterbox for the player to find.





Year 3, Edwardsville Primary, Merthyr Tydfil

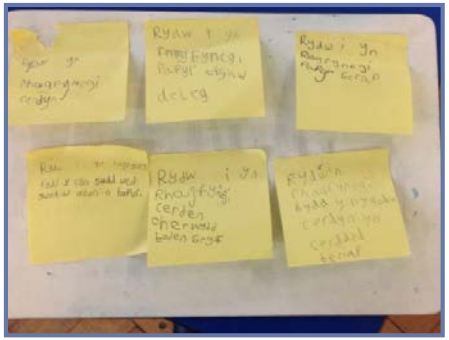
TEACHER BOX 5:

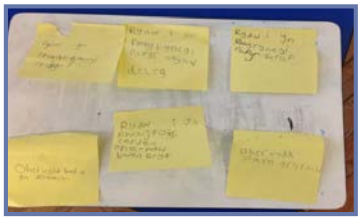
TEACHERS USE ASSESSMENT TO ADVANCE PUPILS' LEARNING BY **ADAPTING THE PACE, CHALLENGE AND CONTENT** OF ACTIVITIES

E.g. support or challenge in response to pupils.

Teachers challenge pupils to extend their ideas

Teachers at Ysgol Pencae use assessment to advance pupils' learning by adapting the challenge of activities. During a rocket mice investigation the pupils were invited to record their predictions on a post it note. The upper white board shows one pupil (centre bottom row) managed to give a scientific reason for their prediction. The teacher offered this challenge to others and following this prompt two further pupils gave a justification for their prediction on the back of their post it notes.





> *"because it [the bottle] was thinner"*

> *"because it [the push] was stronger"*

Ysgol Gymraeg Pencae, Cardiff

Use of mini-plenaries

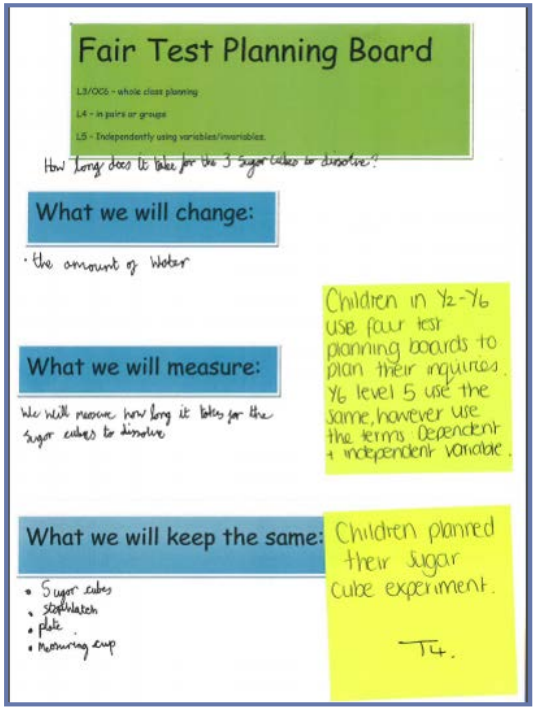
Pupils have increased chance of meeting their learning objective when presented with an opportunity to learn from a mini-plenary. The focus of this lesson was that pupils ask questions about light and decide on a line of investigation. The teacher adopted the use of mini-plenaries at pertinent points during the lesson to help the pupils progress. At the start of the lesson only a small number of pupils successfully 'created' bubbles, however, it was evident after each mini-plenary that more children were able to create a bubble. This is an example of a teacher adapting the pace of the lesson to enable all learners to achieve.

Year 5, Edwardsville Primary, Merthyr Tydfil

Adapting use of planning boards

Key Stage 2 pupils are encouraged to use planning boards if planning a fair test enquiry.

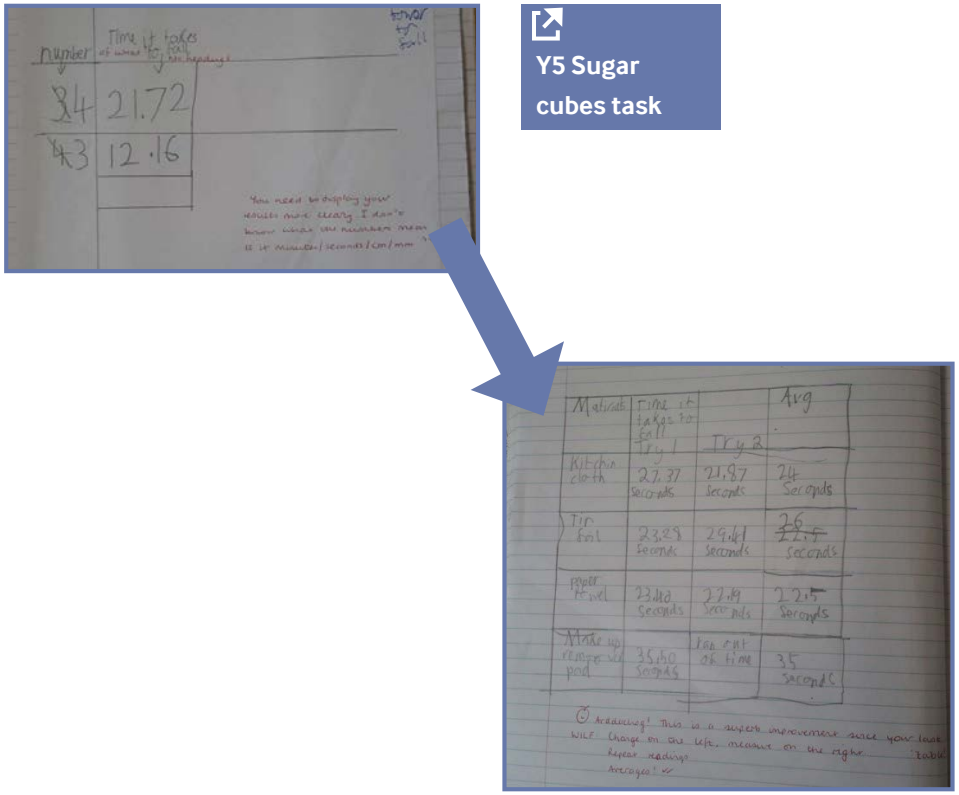
Pupils who need more structure use the planning board as a whole class, to share ideas and decide on the best ways forward. Pupils who need less structure are encouraged to work in small groups or pairs to plan the investigation. For further challenge, pupils are encouraged to use the terms 'variables' in their planning and to record their ideas independently in science work books rather than on planning boards, but with the same headings and structure. The amount of support the children need to complete the planning board informs teacher assessments.



Year 5, Garnteg Primary, Pontypool

Using information from a focused assessment

St Fagans Primary used a TAPS focused assessment activity to assess attainment for drawing results tables (Y5 sugar cube stacks). The teacher was surprised at the children's results tables and decided to do an extra lesson before moving on. She used an activity from 'Science Enquiry Games' by Anne Goldsworthy which helped the children to practice drawing tables. They then chose a different variable to investigate for timing how long the sugar cube stacks took to fall over (e.g. different food dye or materials between the cubes).



Year 5, St Fagans Primary, Cardiff

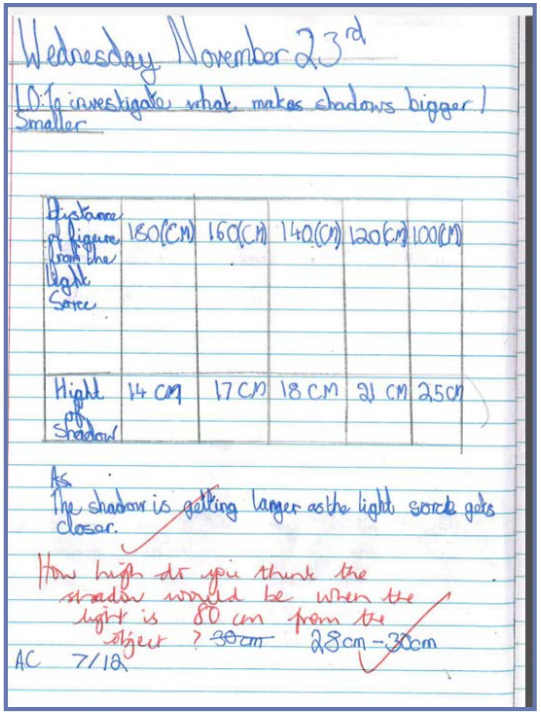
TEACHER BOX 6:

TEACHERS USE ASSESSMENT TO ADVANCE PUPILS' LEARNING BY **GIVING FEEDBACK** TO STUDENTS ABOUT HOW TO IMPROVE

E.g. marking, oral feedback, next steps, extension Qs.

Challenge marking

Challenge marking occurs at Marlborough primary across the whole of KS2. In this activity pupils in Year 4 were given the opportunity to investigate factors that affect the size of shadows. The pupils had carried out an investigation where they changed the distance of the object from the light source and then measured the height of the shadow. The pupils collated their data in a table and completed a partially completed line graph. The pupil in this example correctly identified that the shadow is *"getting larger as the light source gets closer"*. The teacher then provided a challenge marking comment by asking *"How high do you think the shadow would be when the light is 80 cm from the object?"* This requires the pupil to use their results to make a new prediction. The teacher also notes that this pupil will need to focus on drawing a table in a future lesson.



Year 4, Marlborough Primary, Cardiff

On the spot feedback

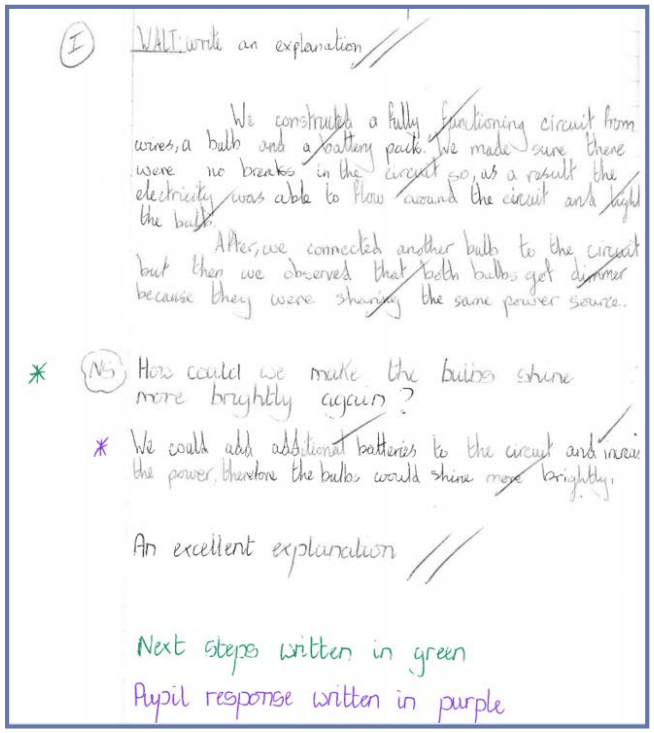
Teacher feedback can be most successful if it can be acted upon immediately, for example, within a science and technology lesson. The focus of this lesson was for pupils to design the most effective packaging to ensure that eggs would not be broken when being taken to market. The teacher gave pupils feedback about how to improve during the lesson. For example, one group of children were refocused from consideration of the landing surface to look more closely at the package development. Another group had forgotten that the package would actually need to open to hold the egg. Both groups of pupils listened to feedback and produced a more effective package.

Egg packaging task

Year 3, Edwardsville Primary, Merthyr Tydfil

Time to respond to teacher feedback

When teachers mark pupils work, they look for ways to further pupil's learning by adding next steps, which they write in green pen, so that they are easily identified by pupils. Pupils are given time to respond to the teacher's next steps and write their responses in purple pen. In this example pupils had made a fully functioning circuit from a bulb and a battery pack. Next pupils connected another bulb to the circuit, and they noticed that the light got dimmer. So in this example the teacher has asked the pupils to explain: How they could make the bulbs shine more brightly in a circuit? The pupil wrote their reply in purple pen: we could add additional batteries to the circuit and increase the power therefore the bulbs would shine more brightly.

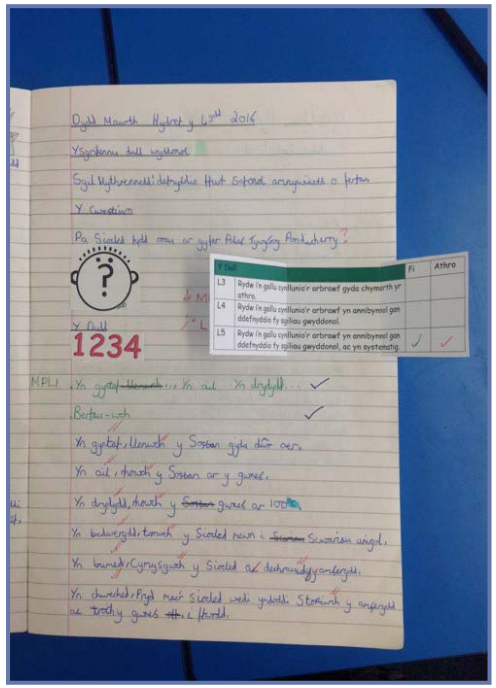


Year 6, Blaenycwm Primary, Brynmawr

Teacher generated grid for self assessment of skills

At Coedygof pupils only focus on one or two scientific enquiry skills at a time and child friendly logos are provided for each skill. In the chocolate investigation example below two logos are shown, a face with a question mark (raising a question for an investigation) and "1 2 3 4" (designing a scientific method).

In this Year 6 piece of work the pupil has used a teacher generated grid to self evaluate one skill 'Y Dull' (writing a method). Within the grid the teacher has included 3 statements/criteria for the pupils to consider which match the desired outcomes for attainment at Level 3, 4 and 5. The pupil has evaluated the work as Level 5 (systematic method, working independently) and ticked the first column 'Fi' (self). Later the teacher has also reviewed the work (evidenced in red pen) and agreed that L5 is the criteria that best suits the work. The teacher has marked the column Athro (Teacher). These grids were used regularly during scientific tasks.



Yr 6 pupil's work – chocolate investigation.

Ysgol Gymraeg Coed Y Gof, Cardiff

TEACHER BOX 7:

TEACHERS USE ASSESSMENT TO ADVANCE PUPILS' LEARNING BY PROVIDING **TIME FOR STUDENTS TO REFLECT** ON AND ASSESS THEIR OWN WORK

E.g. read and respond time.

Time to reflect on learning

At St Fagans Primary practical science lessons often follow a pattern of: engage, explore, challenge, apply, reflect. This lesson structure provides the opportunity for pupils to discuss and reflect a number of times during the lesson. For example, in a lesson on separating solids:

Engage: solids mixed by mistake, need your help to separate, but can't use hands.

Explore: groups discuss how to separate mixtures using a range of equipment.

Challenge: separate each mixture in turn (rice/salt, paperclips/counters, sand/water, gravel/soil).

Apply: explain equipment choices. How separate if all mixed together?

Reflect: What have you learnt today? How have you learnt it?

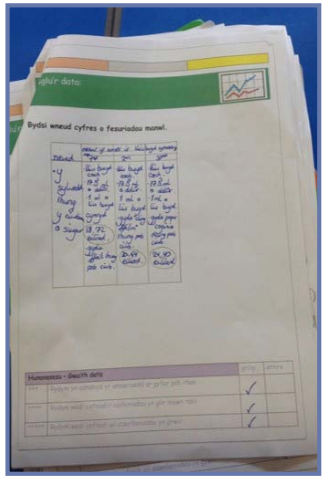
Year 5, St Fagans Primary, Cardiff

Reflect on self assessment of skills

Teachers in the FPh and KS2 at Ysgol Pencae use self assessment to advance pupils' learning by providing time for students to reflect on and assess their own work.

In the FPh smiley faces and traffic lights are used to invite a pupil response about a scientific skill under focus during the task – rhagfynegi (prediction).

The self assessment grid becomes more sophisticated in KS2 because the teacher offers a differentiated self assessment grid 'Hunan asesu gwaith data' (Self assessing data work). The pupils choose whether they are achieving at three, four or five stars. (For the teacher's assessment purposes these stars correspond to the Welsh NC Levels.)



Ysgol Gymraeg Pencae, Cardiff

Teachers make provision for thinking time

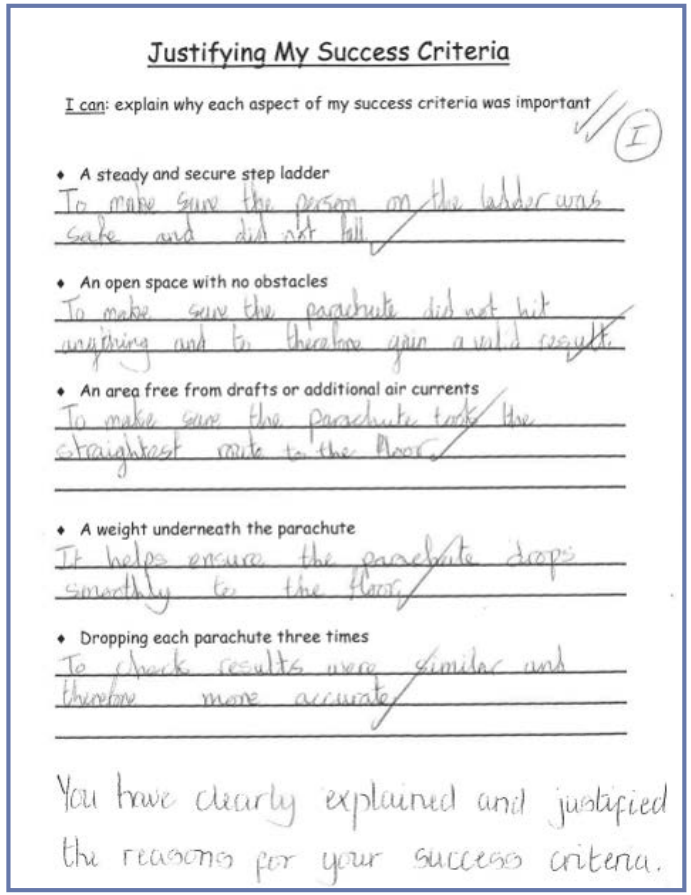
Teachers can support pupils in their learning by providing time for pupils to reflect on and assess their own work. In this example at Nursery, pupils were learning about suitable materials to make a shelter for Incy Wincy. The pupils had worked with the teacher to generate success criteria for this. After the pupils had designed their shelter the teacher supported the children in assessing how suitable their shelter was. The pupils looked to see if firstly they could fit Incy in the shelter, next to see if the material was waterproof and finally to see if there were any holes. After this test the teacher supported the children in reflecting against the previously generated success criteria.

Incy spider task

Nursery, Tongwynlais Primary, Cardiff

Reflect on success criteria

When pupils had completed a parachute investigation they were asked to explain and justify the success criteria that they had devised for the investigation. Children were given time to reflect on and assess their own learning. They were asked to justify their chosen success criteria to ensure the investigation was successful. This gave them the opportunity to change steps if necessary.



Justifying My Success Criteria

I can: explain why each aspect of my success criteria was important

I

- A steady and secure step ladder

To make sure the person on the ladder was safe and did not fall

- An open space with no obstacles

To make sure the parachute did not hit anything and to therefore gain a valid result.

- An area free from drafts or additional air currents

To make sure the parachute took the straightest route to the floor.

- A weight underneath the parachute

It helps ensure the parachute drops smoothly to the floor.

- Dropping each parachute three times

To check results were similar and therefore more accurate.

You have clearly explained and justified the reasons for your success criteria.

Year 6, Blaenycwm Primary, Brynmawr

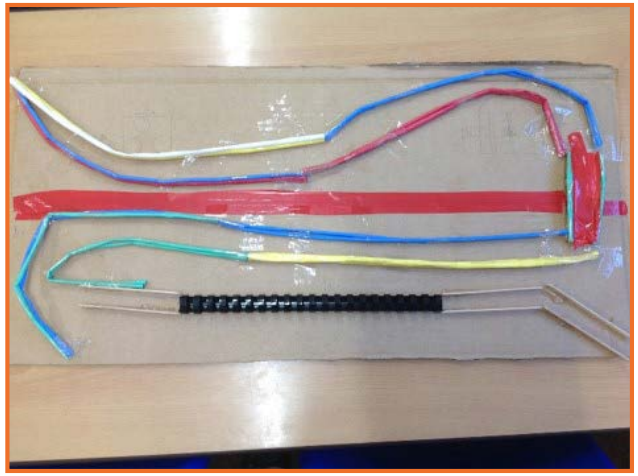
MONITORING BOX 1:

TEACHERS BASE THEIR SUMMATIVE JUDGEMENTS OF PUPILS' LEARNING ON A **RANGE OF TYPES OF ACTIVITY**

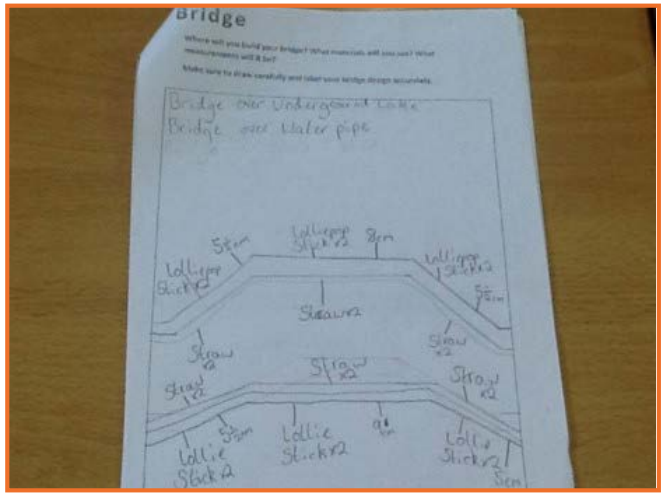
I.e. not reliant on one snapshot to make overall judgement.

Summative judgements based on a range of activity

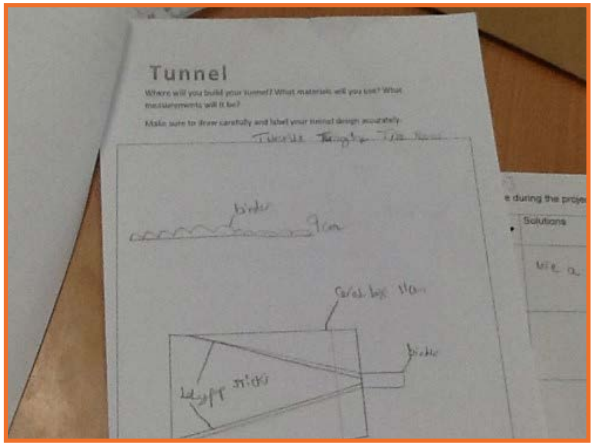
End of topic judgements can be informed by a range of activities during the topic. For example, pupils were asked to design and make their own 'mail run' (marble run). They were asked to design a bridge, tunnel and pathway resulting in a final product. They had to decide which materials and tools to use. Next the teacher asked them to evaluate their work, reflecting on the functionality of their prototype, what worked well, what did not go well and what they would do next time. Analysis of these activities enabled the class teacher to make a summative judgment on a variety of scientific skills. The example also shows a completed 'mail run'.



Year 5, Tongwynlais Primary, Cardiff

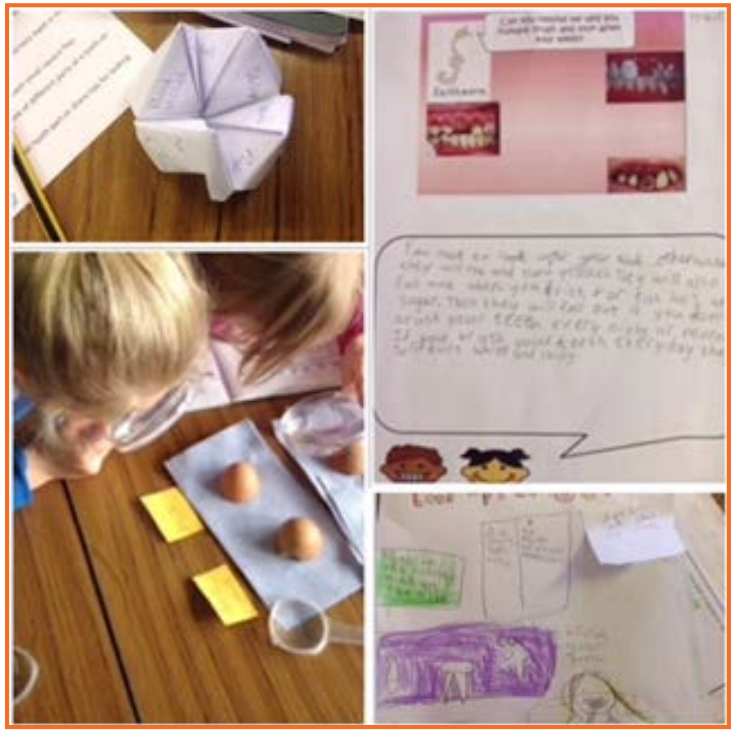


Marble run task



Judgements based on a range of activities

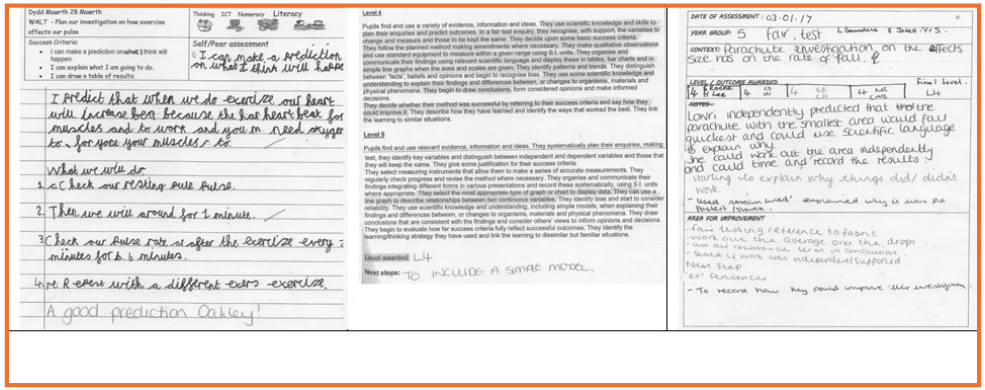
Summative judgements can be more valid if based on a range of information. Edwardsville Primary use a range of types of activity to provide information which can be used formatively or summatively. For example, during the latter half of a Year 3 topic on healthy eating the pupils: investigated egg shells, predicting and collecting results about which liquid would stain teeth; made models of teeth and 'chatterboxes' to name teeth and their functions; and designed posters to promote healthy eating and dental care. The teacher used information from these tasks and her own observational notes to support her summative judgements.



Year 3, Edwardsville Primary, Merthyr Tydfil

Pupil investigations inform summative judgements

All pupils within the school take part in at least one full investigation or enquiry each half term, based on a Science (KS2 pupils) or Knowledge and Understanding of the World (Foundation Phase pupils) topic. Teachers mark and level pupils' work using the Welsh National Curriculum (NC) Level descriptors or Foundation Phase (FPh) Outcomes and add next steps to move pupils' learning forward. Each class teacher brings examples of children's work to a whole school staff meeting, where teachers work in pairs to moderate and agree the levels awarded.



Y5/6, Garnteg Primary, Pontypool

MONITORING BOX 2:

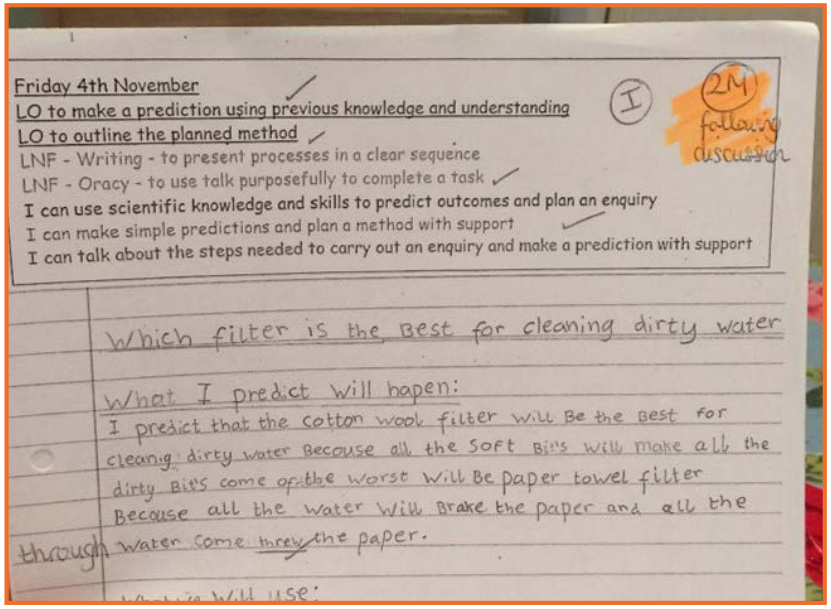
TEACHERS TAKE PART IN **MODERATION/DISCUSSION** WITH EACH OTHER OF PUPILS' WORK IN ORDER TO ALIGN JUDGEMENTS

E.g. staff meeting discussions of science work.

Whole school involvement

When teachers take part in moderation discussions with each other they can gain more confidence in their ability to judge a piece of work. This will bring more consistency and develop a greater understanding within a school of what progression in skills looks like. At Tongwynlais primary the staff of Foundation Phase and the staff of Key Stages meet during INSET to moderate science work.

Portfolios of work are produced from these meetings to give staff examples of what different levels look like. Staff can use these to inform their own judgements and portfolios also can be used if there is a 'lack of agreement' with regard to a particular Welsh National Curriculum level. Portfolios can also be shared at cluster moderations, which can help develop shared understanding within a cluster of what progression in skills looks like.

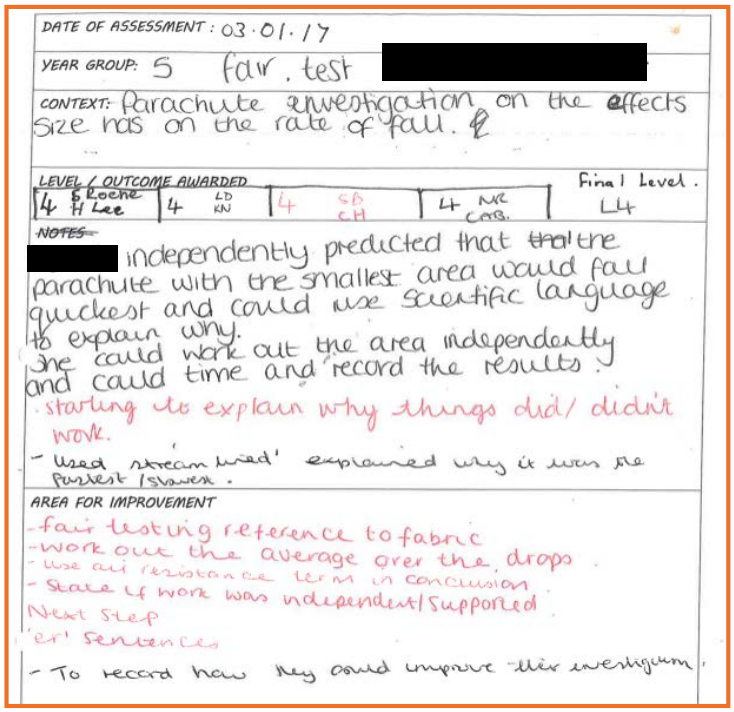


Tongwynlais Primary, Cardiff

Teachers moderate in pairs to support discussion

Teachers work in pairs to moderate pupil work, for example, a parachute investigation. The pairs identify features of the work which indicate the meeting of Welsh National Curriculum levels. Teachers also identify next steps to move learning forward. More than one pair look at each piece of work. The levels awarded are discussed and agreed, any discrepancies are discussed and resolved.

A similar process also takes place with samples of Year 6 work at cluster moderation meetings. These meetings take place throughout the year so that there is time to act on the next steps.



DATE OF ASSESSMENT: 03·01·17

YEAR GROUP: 5 fair. test [redacted]

CONTEXT: Parachute investigation on the effects size has on the rate of fall.

LEVEL / OUTCOME AWARDED — Final Level.

4 S Roche 4 H Lee	4 LD KN	4 SB CH	4 NR CAS.	L4

NOTES

[redacted] independently predicted that ~~that~~ the parachute with the smallest area would fall quickest and could use scientific language to explain why.
She could work out the area independently and could time and record the results.
- starting to explain why things did/ didn't work.
- Used 'streamlined' explained why it was the fastest/slowest.

AREA FOR IMPROVEMENT

- fair testing reference to fabric
- work out the average over the drops
- use air resistance term in conclusion
- State if work was independent/supported

Next Step

- To record how they could improve their investigation.

EXPLAINS MORE ABOUT MODERATION PROCESSES
http://tinyurl.com/TAPSgarnteg

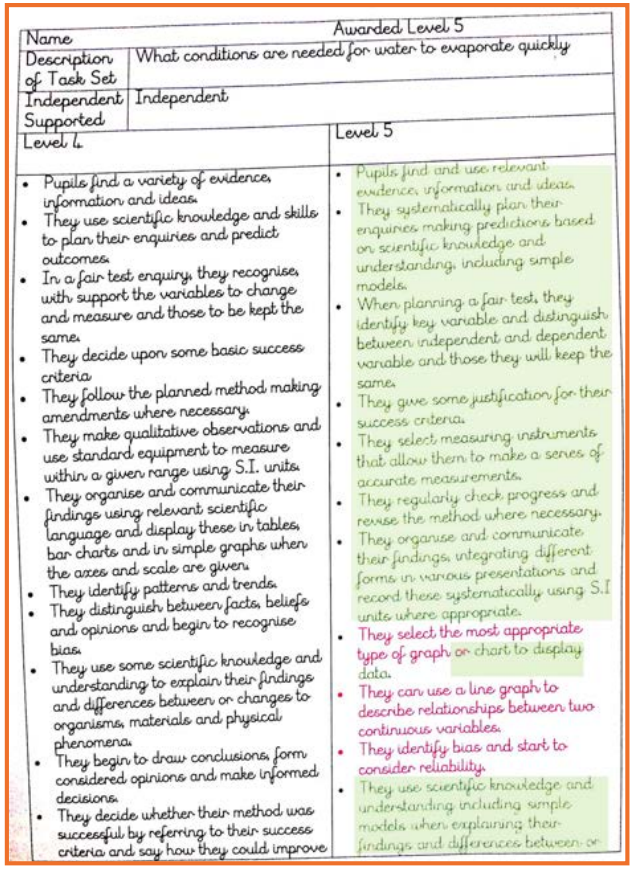
Year 5, Garnteg Primary, Pontypool

Moderation across the school

In Year 2 a piece of work is assessed each half term to identify which enquiry skills have been achieved and which need further practice. This process ensures that teachers have an accurate record of pupils' skills so they can help them progress.

In Key Stage 2 teachers collaboratively moderate three pieces of work to agree standards of a higher, a middle and a lower attainment. Time was given to teachers to work alongside the more experienced subject leader which gave them confidence in delivering their own judgements. The subject leader was able to offer guidance about how to challenge the high attaining pupils.

In the Year 6 example pictured here, green text indicates enquiry skills achieved and pink text indicates those enquiry skills which need to be the next focus.



Name	Awarded Level 5
Description of Task Set	What conditions are needed for water to evaporate quickly
Independent Supported	Independent

Level 4	Level 5
• Pupils find a variety of evidence, information and ideas. • They use scientific knowledge and skills to plan their enquiries and predict outcomes. • In a fair test enquiry, they recognise, with support the variables to change and measure and those to be kept the same. • They decide upon some basic success criteria. • They follow the planned method making amendments where necessary. • They make qualitative observations and use standard equipment to measure within a given range using S.I. units. • They organise and communicate their findings using relevant scientific language and display these in tables, bar charts and in simple graphs when the axes and scale are given. • They identify patterns and trends. • They distinguish between facts, beliefs and opinions and begin to recognise bias. • They use some scientific knowledge and understanding to explain their findings and differences between or changes to organisms, materials and physical phenomena. • They begin to draw conclusions, form considered opinions and make informed decisions. • They decide whether their method was successful by referring to their success criteria and say how they could improve	• Pupils find and use relevant evidence, information and ideas. • They systematically plan their enquiries making predictions based on scientific knowledge and understanding, including simple models. • When planning a fair test, they identify key variable and distinguish between independent and dependent variable and those they will keep the same. • They give some justification for their success criteria. • They select measuring instruments that allow them to make a series of accurate measurements. • They regularly check progress and revise the method where necessary. • They organise and communicate their findings, integrating different forms in various presentations and record these systematically using S.I units where appropriate. • They select the most appropriate type of graph or chart to display data. • They can use a line graph to describe relationships between two continuous variables. • They identify bias and start to consider reliability. • They use scientific knowledge and understanding including simple models when explaining their findings and differences between or

Edwardsville Primary, Merthyr Tydfil

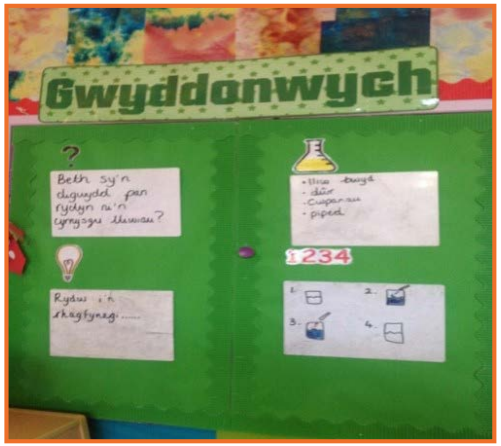
MONITORING BOX 3:

THERE IS A **SHARED UNDERSTANDING OF PROGRESSION** IN SCIENCE

E.g. staff map progression of skills, TAs are involved in assessments.

Skills symbol structure

At Coedygof a consistent approach has been adopted for developing pupils' scientific skills. The subject leader has devised a framework called 'Gwyddonwych' (Excel-Sci) which supports the development of one or two specific skills at a time. Each skill has a child friendly logo, e.g. conical flask for choosing equipment and light bulb for prediction, and these visible logos help pupils recognise the skills focus. During science activities a success criteria grid highlights the progression within each skill and through this teachers and teaching assistants develop a shared understanding of progression within each skill. The pupils also self assess their work against the success criteria.

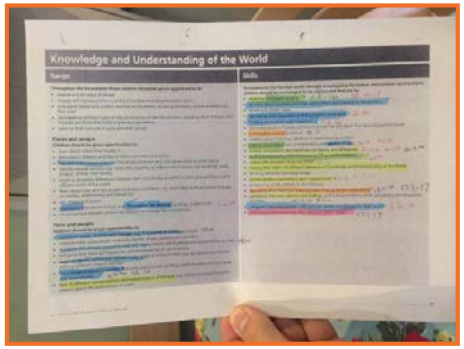


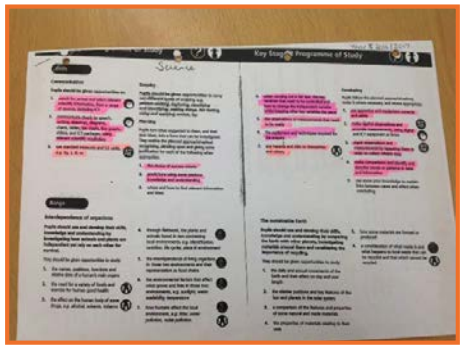
Ysgol Gymraeg Coed Y Gof, Cardiff

Skills coverage to support shared understanding of progression

One way for a subject leader to monitor the curriculum is to ask staff to highlight taught objectives. Tracking coverage can support discussions within and between year groups, especially where there are mixed classes and a two year rolling programme. Such coverage documents and discussions can help to build a shared understanding of progression through the school, which supports teacher assessment.

The picture on the left is an example of the range and skills from the Foundation Phase curriculum, the second is from Key Stage 2. The highlighted curriculum documents and skills ladder are passed on to the next class teacher so lessons can be planned to build upon what has already been covered.





Tongwynlais Primary, Cardiff

A checklist of enquiry types

The range of experiments that the children undertake was identified as an area for development.

Teachers began to use a checklist to ensure they are providing opportunities for a range of enquiries; for example, pattern-seeking and classifying. This supports a shared understanding that not all investigations are a 'fair test.

Teachers are now planning experiments and ensuring that they are using the checklist in the scheme of work to teach the range of experiments that the pupils need to engage with.

Experiment Check List

Pupils should be given opportunities to carry out different types of enquiry.

Below are the various types of inquiry. Please make sure that instead of just fair tests all learners can investigate the different types of inquiry.

Please tick and date the type of inquiry that you have undertaken and make sure all are covered during the year.

	Topic 1	Topic 2	Topic 3	Trec Study
Pattern-seeking				
Exploring				
Classifying and identifying				
Making things				
Fair testing				
Using and applying models				

St Paul's Primary, Cardiff

Progression ladders

A shared understanding of science enquiry is supported by the use of progression ladders which are used by teachers and pupils. Science enquiry (Planning, Develop and Reflect) sheets are glued into each pupils science book and objectives are highlighted and dated by the teacher when they have been achieved. Children also self assess using the sheets.

The books are passed on each year enabling the new class teacher to see the children's prior attainment in detail.

	Planning	Develop	Reflect
2 FO5	• **Together with the teacher** find information • Children talk about what to do and if it will work well	• Sort, group and compare • Make simple records and describe simple differences	• Can answer questions about what worked and what didn't
3 FO6	• **In pairs or groups** find information • Contribute to whole class planning (Fair Test use planning boards) • Make simple predictions • Explain why they expect the enquiry to work	• Follow instructions safely to get results • Record in a given table • Display in a given bar chart • Begin to notice simple patterns and trends • Explain using own words (simple because)	**As a class:** • Give a simple explanation about why things did/did not work • Talk about how their plan could be improved •
4	• **Independently** research information • Plan enquiries in groups (Fair Test use planning boards) • Give reasons for prediction using scientific language • Explain, using scientific language, why they expect the enquiry to work	• Carry out plan and make changes if required • Measure using S.I. units • Record in their own table • Display on bar chart or line graph (axes and scales given) • Give an explanation using scientific language	**As a group:** • Give an explanation about why things did/did not work • Discuss how their plan could be improved • Discuss how they worked as individuals in the group •
5	• **Independently** research specific information • Independently plan the enquiry (Fair Test use Upper Junior planning boards) • Give reasons for predictions using simple models • Explain, using simple models, why they expect the enquiry to work	• Select appropriate measuring equipment • Work methodically and use repeat reading for reliability • Select and construct the appropriate graph (bar/line graph, scatter gram) using simple scales • Give an explanation using simple models • Use 'er' sentences to describe relationships	**Independently:** • Begin to give an explanation about why things did/did not work • Begin to discuss how their plan could be improved • They can talk about the learning/thinking strategy they have used •

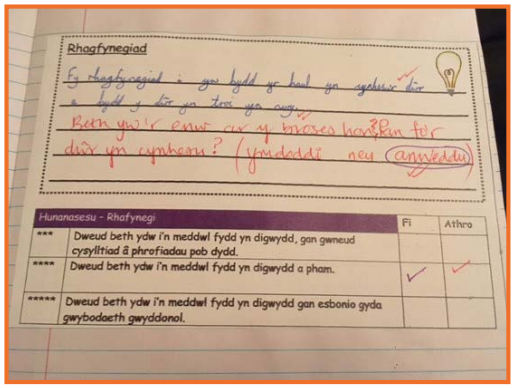
Year 5, Garnteg Primary, Pontypool

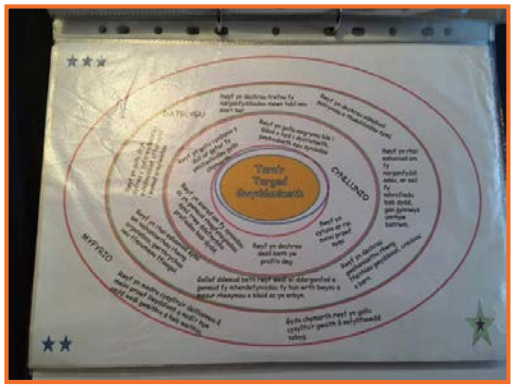
MONITORING BOX 4:

PUPILS ARE **AWARE OF THE CRITERIA** BY WHICH THEIR WORK OVER A PERIOD OF TIME IS JUDGED

E.g. examples of what good science looks like are displayed.

Skills target boards





We have taken the science skills ladder from the Welsh National Curriculum and have adapted these a little so that the children understand the descriptions. We have created purple cards of each skill with a choice of 3 sentences to choose from. This is one way the pupils assess themselves and peers at our school.

We are also in the process of introducing these on target boards for each pupil. The pupils colour the targets when they practise the skills.

Ysgol Pencae, Cardiff

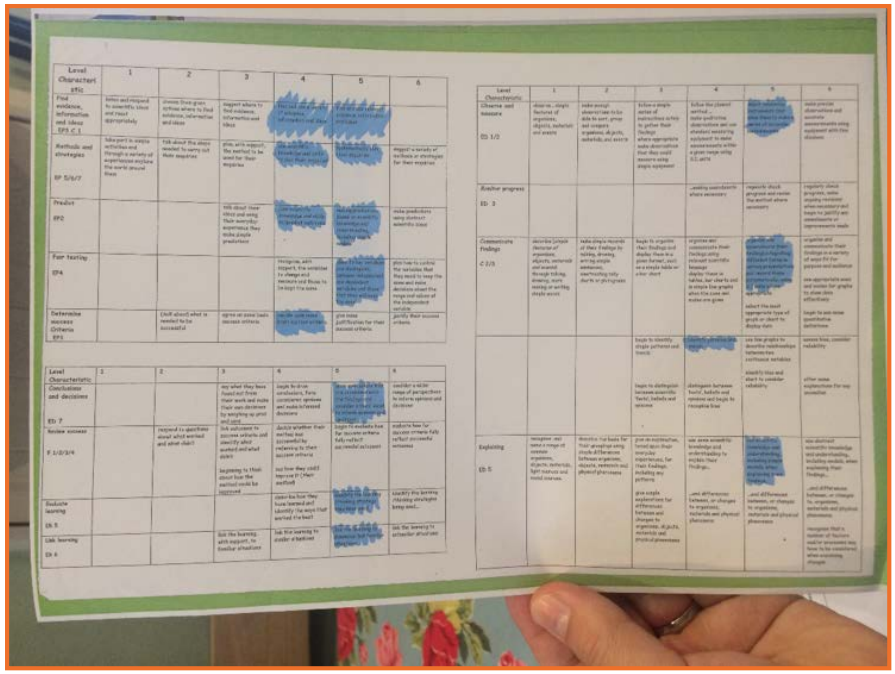
Scientific skills pyramids for scaffolding

Scientific skills pyramids are used in the Foundation Phase at Coed Y Gof to scaffold learning. In a mixing colours investigation in Year1 children were considering predictions and the red side of the pyramid prompted pupils to select and use appropriate scientific vocabulary (the teacher had handwritten offer-equipment, rhagfynegi-prediction, sugno-absorb and cymysgu - mix). The teacher could change the vocabulary to suit a specific task. This pyramid helped raise the awareness of the criteria with the pupils and regular scaffolding helped to support pupil progress with time.

Ysgol Gymraeg Coed Y Gof, Cardiff

Pupil skills ladder

At Tongwynlais Primary pupils in Key Stage 2 have a sheet stuck into the back of their books which displays the Welsh National Curriculum levels for Scientific Enquiry appropriate for KS2 against each skill covered within Plan, Develop and Reflect. Such a skills ladder can be used by staff and pupils to focus learning on a particular element of Scientific Enquiry.



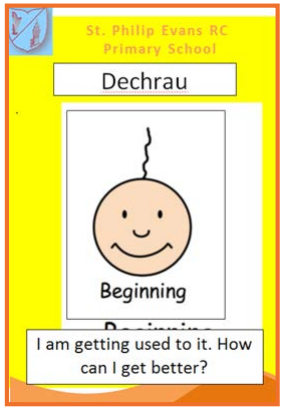
KS2, Tongwynlais Primary, Cardiff

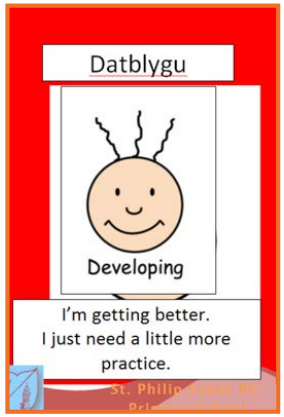
Beginning, Developing, Mastering

'Beginning, Developing and Mastering' (BDM) or 'dechrau, datblygu, meistroli' was developed to provide a positive, child friendly strategy that provides a progressive framework to enhance assessment for learning strategy opportunities .

BDM is based upon the successive characters of Beginning, Developing and Mastering; these three successes steps are represented pictorially with progressive images. These images or logos are used in Assessment for Learning rubrics and success criteria. Teachers can use these logos to differentiate and provide successive skill learning continuums (within rubrics) in which pupils can use as guidelines for target setting and self/peer assessment.

The BDM strategy enhances children's ability to become self/peer evaluative as it provides them with appropriate language and progressive structure. Teachers are able to reinforce this further by adopting the language in their marking/praise. E.g. "Da iawn, you are developing this skill because... to be mastering you need to... ."





St Philip Evans RC Primary School, Cardiff

MONITORING BOX 5:

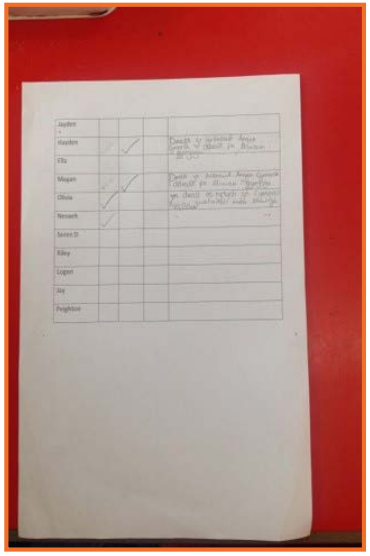
A **MANAGEABLE SYSTEM FOR RECORD-KEEPING** IS IN OPERATION TO TRACK AND REPORT ON PUPILS' LEARNING IN SCIENCE

E.g. expectations on planning which annotate, end of topic grids, I cans.

RAG rating sheet for teaching assistant

There is a shared responsibility for record keeping at Coed Y Gof. This provides a manageable system to report on pupils learning in science.

The teaching assistant worked with every group over the week and she recorded every pupil's RAG rated self evaluation and wrote observation notes in the Tracking Sheet. For example, 'understands which colours to mix to get different colours', 'needs help to mix the colours'.

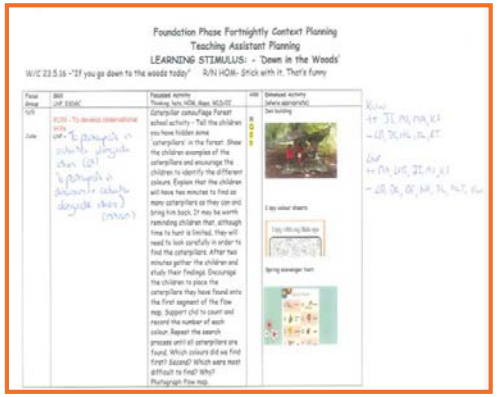


Ysgol Gymraeg Coed Y Gof, Cardiff

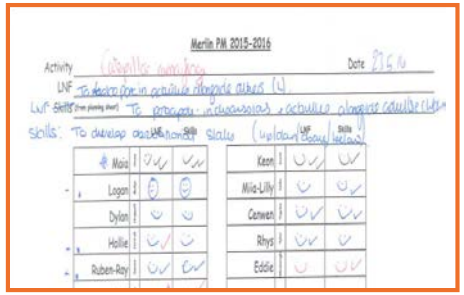
Annotating planning

At Tongwynlais primary teachers annotate the planning to represent how well individuals or groups of pupils have achieved against the learning objectives.

An example of this in Foundation Phase is given here.


Foundation Phase Fortnightly Context Planning
Teaching Assistant Planning
LEARNING STIMULUS: - 'Down in the Woods'

In Foundation Phase teachers also keep tick sheets that list the children's names against the learning objective. A whole school approach is taken via the marking policy. A smiley face is used to show met in one lesson, one tick means met at level, two ticks exceeded.


Merlin PM 2015-2016

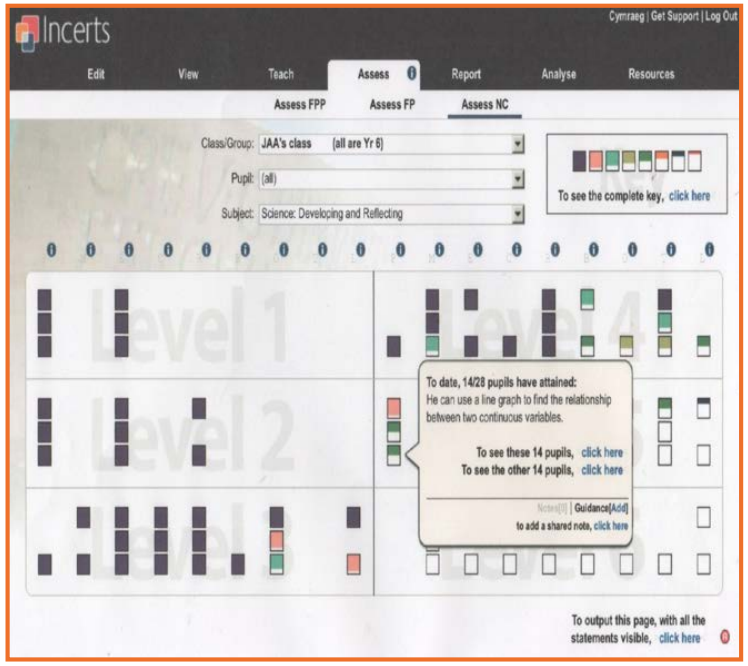
Tongwynlais Primary, Cardiff

Recording progress using Incerts

Incerts, from the Assessment Foundation, is a formative assessment system that Blaenycwm school use to record and track the progress of whole cohorts, vulnerable groups, and individual pupil's progress in all National Curriculum subjects. Staff use the system to support their teacher assessment of pupils.

In this example Incerts is used to record how many Year 6 pupils in a class have achieved Level 5 science objectives in Developing and Reflecting skills.

Typed notes and digital evidence can also be added to the ladders to give additional information about pupils.

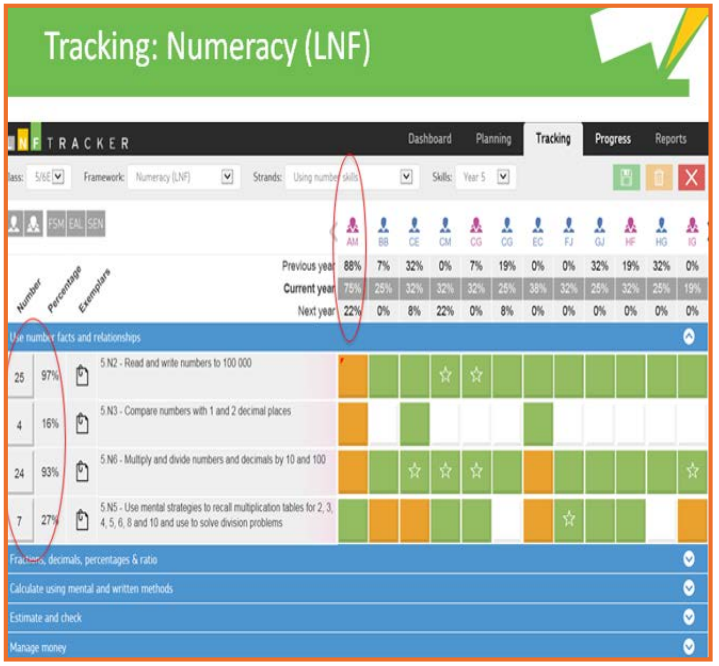


Blaenycwm Primary Year 6

LNF tracker

Schools in Wales have been required since September 2014 to track children's progress against the Literacy and Numeracy statements in the (LNF) framework. The Education and Achievement Service (EAS) for South /East Wales have devised an on-line tracking tool that enables school's to track the progress of each pupil, class and groups from Nursery to Year 9. The tracker can also analyse class, group and pupil levels. It can also provide comparisons with other key English/ Maths data and it can generate end of year reports and allow narrative text.

This example shows a year 5 pupil's progress in Maths. Green indicates the objectives that the pupils is competent in and amber indicates the objectives that need reinforcing.



Lisa Fenn

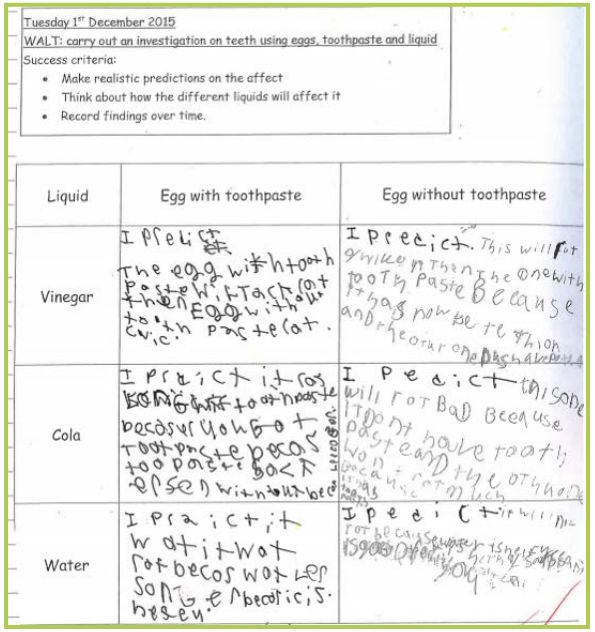
SUMMATIVE BOX 1:

TEACHERS **SUMMARISE** ACHIEVEMENTS IN TERMS OF **WHAT PUPILS CAN DO**, NOT ONLY IN TERMS OF LEVELS, GRADES OR %

E.g. progress in skills is passed onto the next teacher.

Pass on pupil books

Pupil books are passed on to the next class teacher at the beginning of a new school year; this process helps teachers to be informed of the pupil's prior learning. Teachers carry out a handover session at the end of each school year with the new teacher, discussing the children's prior attainment and pastoral information.



Tuesday 1st December 2015

WALT: carry out an investigation on teeth using eggs, toothpaste and liquid

Success criteria:

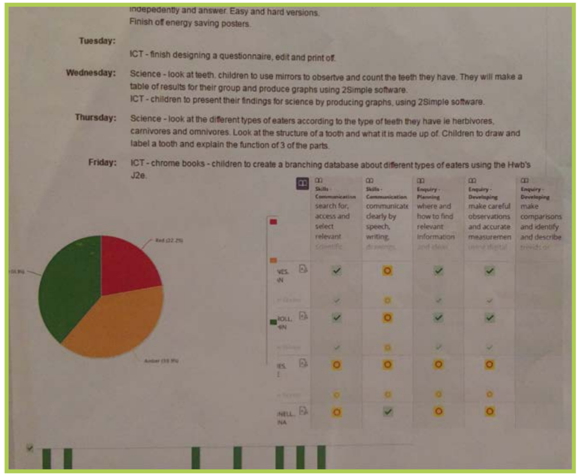
- Make realistic predictions on the affect
- Think about how the different liquids will affect it
- Record findings over time.

Liquid	Egg with toothpaste	Egg without toothpaste
Vinegar	[illegible]	[illegible]
Cola	[illegible]	[illegible]
Water	[illegible]	[illegible]

Year 3 to Year 4, Garnteg Primary, Pontypool

Teachers summarise pupils' achievements

At Edwardsville Primary teachers plan using Informentor. In this Year 3 example it can be seen that the pupil's work was assessed against a variety of skills e.g. searching for and accessing relevant information and making careful observations. A tick and colour code system is used to represent whether pupils have demonstrated the skills. This lesson shows that under half of the pupils had met the learning objective. The teacher will use this data then to help consolidate learning in the next lesson. This information also gets passed up to the next teacher.

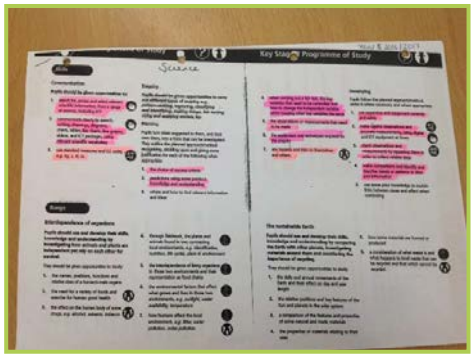


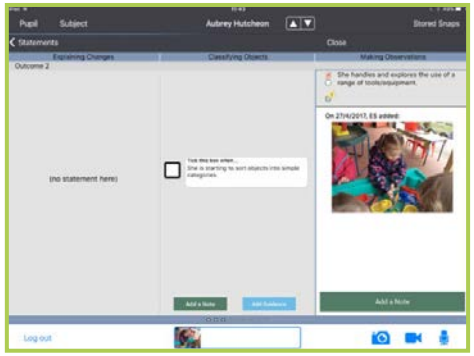
Edwardsville Primary, Merthyr Tydfil

Teachers summarise what pupils can do

At Tongwynlais primary teachers summarise pupils' achievements so they can be passed onto the next teacher. At both Foundation Phase and KS2 'Skills Ladders' are annotated and passed onto the next class teacher. Teachers plan together (eg N/R, Y1/2, y3/4 and y5/6) to ensure a good coverage across a two year period.

The second example is that of Incerts, a whole school tracking system. In this example you can see that the Nursery pupil is 'able to handle and explore the range of tools and equipment'. Incerts are updated regularly and this information gets passed on with the class. It is also possible for all staff to view Incerts of all classes.



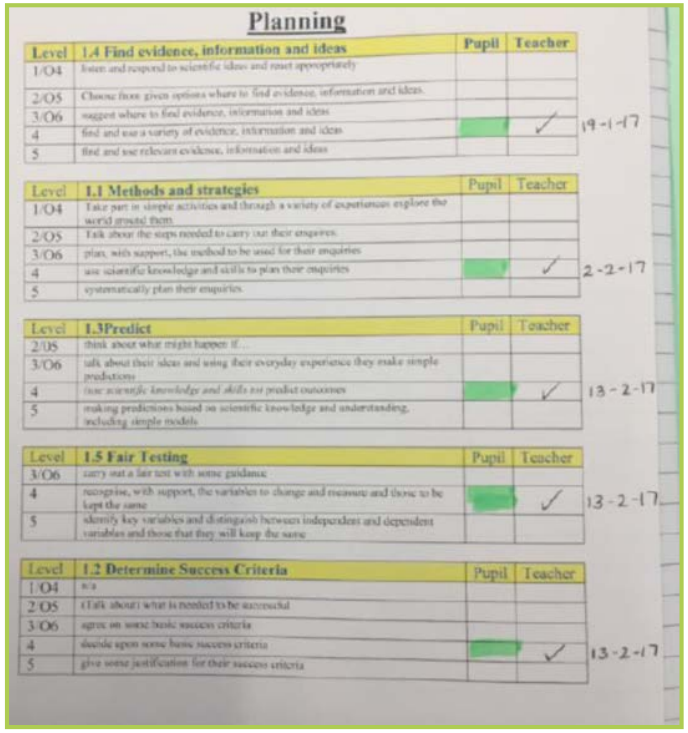


Tongwynlais Primary, Cardiff

Self assessment and teacher tracking

Self and peer assessment are embedded across the school. Pupils are given opportunities to self assess against the same criteria as their teacher on a tracking sheet.

Staff meetings are dedicated to target setting and challenge. Staff share 'pen portraits' of learners considering prior and future attainment. Termly moderation led by the subject leader in school and in the cluster (and shared with the 'link school') ensures consistency of teacher assessment.



Planning

Level	1.4 Find evidence, information and ideas	Pupil	Teacher	
1/04	listen and respond to scientific ideas and react appropriately			
2/05	Choose from given options where to find evidence, information and ideas.			
3/06	suggest where to find evidence, information and ideas			
4	find and use a variety of evidence, information and ideas		✓	19-1-17
5	find and use relevant evidence, information and ideas			

Level	1.1 Methods and strategies	Pupil	Teacher	
1/04	Take part in simple activities and through a variety of experiences explore the world around them			
2/05	Talk about the steps needed to carry out their enquiries			
3/06	plan, with support, the method to be used for their enquiries			
4	use scientific knowledge and skills to plan their enquiries		✓	2-2-17
5	systematically plan their enquiries			

Level	1.3Predict	Pupil	Teacher	
2/05	think about what might happen if...			
3/06	talk about their ideas and using their everyday experience they make simple predictions			
4	use scientific knowledge and skills to predict outcomes		✓	13-2-17
5	making predictions based on scientific knowledge and understanding, including simple models			

Level	1.5 Fair Testing	Pupil	Teacher	
3/06	carry out a fair test with some guidance			
4	recognise, with support, the variables to change and measure and those to be kept the same		✓	13-2-17
5	identify key variables and distinguish between independent and dependent variables and those that they will keep the same			

Level	1.2 Determine Success Criteria	Pupil	Teacher	
1/04	n/a			
2/05	(Talk about) what is needed to be successful			
3/06	agree on some basic success criteria			
4	decide upon some basic success criteria		✓	13-2-17
5	give some justification for their success criteria			

Fochriw Primary, Caerphilly

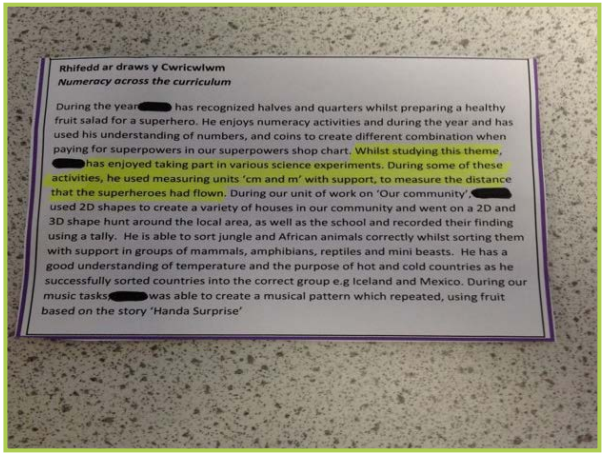
SUMMATIVE BOX 2:

PARENTS/CARERS RECEIVE **ORAL AND WRITTEN REPORTS** THAT IDENTIFY THE NEXT STEPS FOR THEIR CHILDREN

E.g. at parents evening, comments on homework.

Report to parents

The end of year report for Year 1 parents at Pencae provides written commentary about some of the scientific knowledge, understanding and skills developed. This is reported within Numeracy across the Curriculum and comments can be seen about the pupil's ability to measure with standard units and classify vertebrate groups.



Rhifedd ar draws y Cwricwlwm
Numeracy across the curriculum

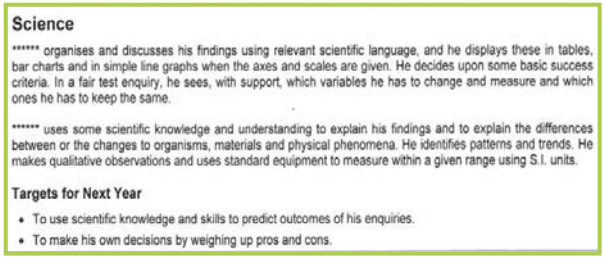
During the year [redacted] has recognized halves and quarters whilst preparing a healthy fruit salad for a superhero. He enjoys numeracy activities and during the year and has used his understanding of numbers, and coins to create different combination when paying for superpowers in our superpowers shop chart. Whilst studying this theme, [redacted] has enjoyed taking part in various science experiments. During some of these activities, he used measuring units 'cm and m' with support, to measure the distance that the superheroes had flown. During our unit of work on 'Our community' [redacted] used 2D shapes to create a variety of houses in our community and went on a 2D and 3D shape hunt around the local area, as well as the school and recorded their finding using a tally. He is able to sort jungle and African animals correctly whilst sorting them with support in groups of mammals, amphibians, reptiles and mini beasts. He has a good understanding of temperature and the purpose of hot and cold countries as he successfully sorted countries into the correct group e.g Iceland and Mexico. During our music tasks [redacted] was able to create a musical pattern which repeated, using fruit based on the story 'Handa Surprise'

Ysgol Gymraeg Pencae, Cardiff

Incert report to parents

This is an example of a Year 5 science report written to parents showing academic achievement for the current year.

This report has been generated using the Incerts system which automatically gives next steps for the pupil for the following year based on their previous academic achievement.



Science

****** organises and discusses his findings using relevant scientific language, and he displays these in tables, bar charts and in simple line graphs when the axes and scales are given. He decides upon some basic success criteria. In a fair test enquiry, he sees, with support, which variables he has to change and measure and which ones he has to keep the same.

****** uses some scientific knowledge and understanding to explain his findings and to explain the differences between or the changes to organisms, materials and physical phenomena. He identifies patterns and trends. He makes qualitative observations and uses standard equipment to measure within a given range using S.I. units.

Targets for Next Year

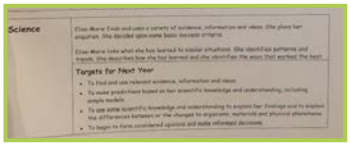
- To use scientific knowledge and skills to predict outcomes of his enquiries.
- To make his own decisions by weighing up pros and cons.

Year 5, Blaenycwm Primary, Brynmawr

Reports to parents and carers

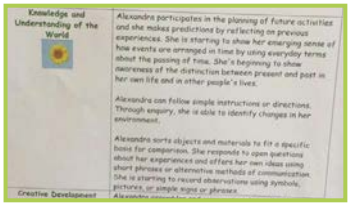
Parents will be more able to help their children at home if they are given oral and/or written reports in science that identify next steps for their children. At Tongwynlais Primary verbal discussions take place with parents of pupils in Foundation Phase twice yearly in the format of parents evenings. This is where progress and possible next steps would be shared with parents.

At Key Stage 2 next steps in science are identified on the written report. Across the whole school following receipt of summative end of year report, parents are able to send in a written reply and also attend an open afternoon to speak to class teachers and discuss further.



Science

Targets for Next Year



Knowledge and Understanding of the World

Creative Development

Tongwynlais Primary, Cardiff

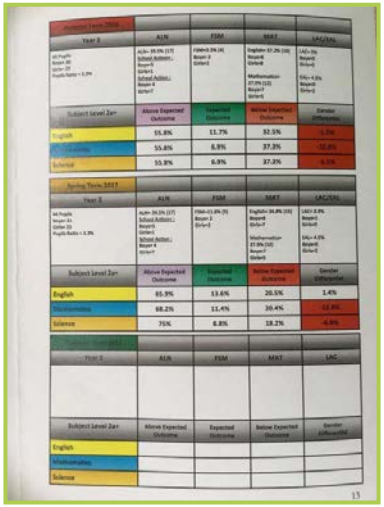
SUMMATIVE BOX 3:

SUMMARIES OF PUPIL PROGRESS ACROSS THE COHORT DRAW ON A RANGE OF INFORMATION

E.g. learning across a range of contexts is used to decide support or extension needs.

Group summaries

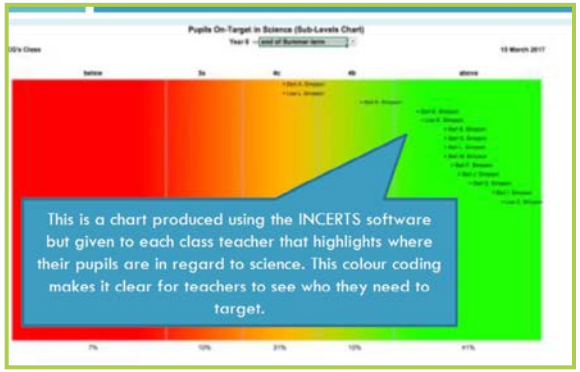
Pupils of all groups are regularly assessed and information gathered as to their progression across the year in English, maths and science. This progression in learning is monitored closely to ensure that all groups of pupils across the school progress effectively. This example illustrates the progress made by pupils that have been identified as, for example, Free School Meals. If pupils are not seen to be progressing at the appropriate rate a targeted intervention would be put in place. This is an example from Year 3 but is part of a whole school approach.



Edwardsville Primary, Merthyr Tydfil

Summary of cohort

This is a chart produced using the Incerts software from the Assessment Foundation. It is given to each class teacher to summarise pupils' attainment in science across their class. The colour coding makes it clear for teachers to see who they need to target.



St Paul's Primary, Cardiff

RAG meetings

Members of staff meet up twice a term to discuss the progress of pupils. They analyse pupils' data on the school system SIMS. They highlight the progress of pupils. Green is used to highlight pupils on track to achieve predicted targets. Amber is used to track pupils who are not quite achieving as predicted and red is used to highlight pupils who are not achieving at the predicted level. Interviews are conducted with underachieving pupils' teachers to establish what support should be put in place. Where necessary interventions are put in place to raise pupil's attainment.

Year 4, Garnteg Primary, Pontypool

WHOLE SCHOOL PROCESSES - HOW DO WE SUPPORT VALIDITY AND RELIABILITY OF TEACHER ASSESSMENT?

Is the summary of pupil achievement VALID?

Is it an assessment of primary science?

Are knowledge, understanding, skills and attitudes considered?

Have a range of types of activity been taken into account?

Is the summary of pupil achievement RELIABLE?

Would other teachers agree with the assessment?

Is there a shared understanding?

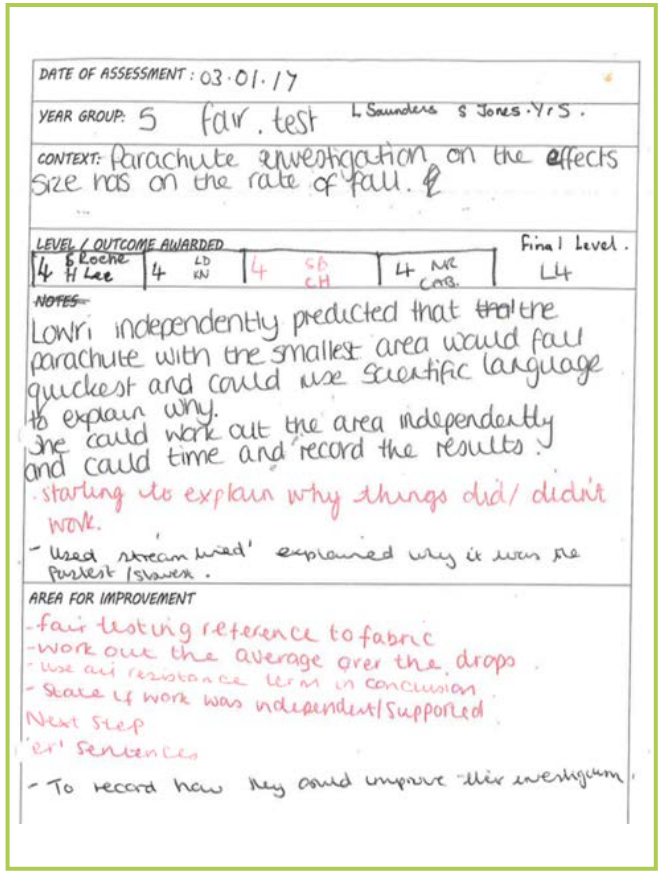
Is there consistency?

Professional learning through moderation - Garnteg Primary

Moderation can be more than matching or checking, it can provide opportunities for professional learning. For example, moderation discussions can support teachers to understand expectations for different year groups, progression of science skills and concepts and 'what a good one looks like'.

At Garnteg, moderation has become an ongoing discussion between schools in the cluster, including the feeder secondary school. By meeting earlier in the year, the teachers are able to spot gaps and areas for development which can then be acted upon within that year. Working with the secondary school has also enhanced transition discussions, with primary teachers becoming clearer about what comes next for pupils, and secondary teachers understanding what has been achieved in the primary school. Collating annotated examples and teacher commentaries from the cluster moderations electronically on Hwb provides a bank of exemplars to draw upon in future years.

Link to video with further explanation of the school's approach: http://tinyurl.com/TAPSgarnteg


DATE OF ASSESSMENT: 03.01.17

YEAR GROUP: 5 fair. test L Saunders S Jones Yr 5.

CONTEXT: Parachute investigation on the effects size has on the rate of fall.

LEVEL / OUTCOME AWARDED				Final Level.
4 S Roche H Lee	4 LD KN	4 SB CH	4 MR CAB	L4

NOTES

Lowri independently predicted that ~~that~~ the parachute with the smallest area would fall quickest and could use scientific language to explain why.
She could work out the area independently and could time and record the results.
- starting to explain why things did/ didn't work.
- Used 'stream lined' explained why it was the fastest/slowest.

AREA FOR IMPROVEMENT

- fair testing reference to fabric
- work out the average over the drops
- use air resistance term in conclusion
- state if work was independent/supported

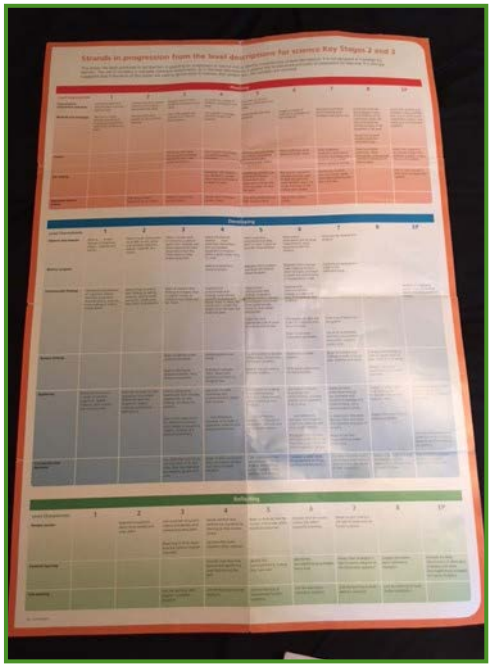
Next Step

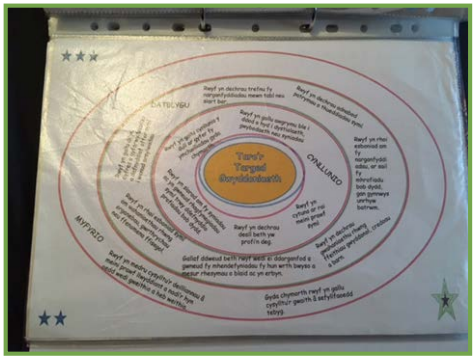
- To record how they could improve their investigation.

A shared understanding of skills at Ysgol Pencae

Pupils and staff have a shared understanding of science skills, based on the descriptors from the National Curriculum strands of progression ladder.

A particular focus is chosen for each lesson and the relevant science skill descriptors are referred to on planning and during lessons, provided for self and peer assessment and displayed on target boards.





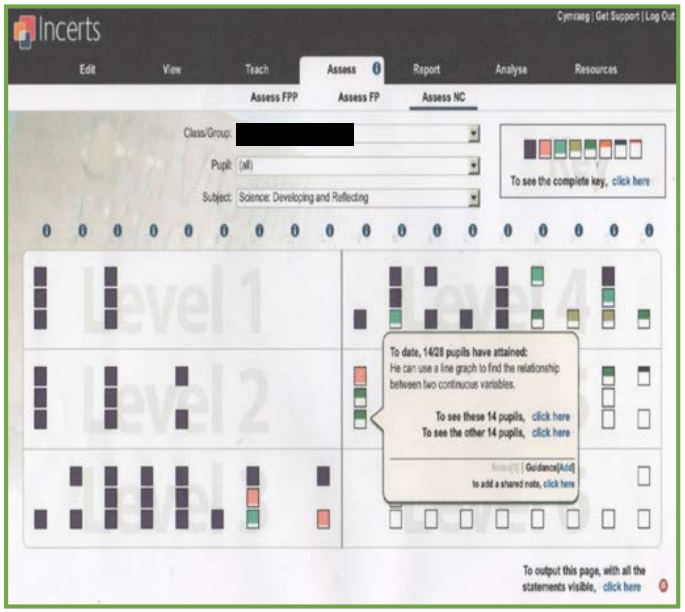
A shared ethos at Tongwynlais Primary

Tongwynlais Primary has developed a shared ethos across the school which raises the expectations for thinking skills across the curriculum. Supported by De Bono's thinking hats and the TASC wheel, the staff have developed ways to support children of all ages to engage in metacognition. This supports their self-assessment and ability to reflect on their science.

Link to video with further explanation of the school's approach: http://tinyurl.com/tongwynlais

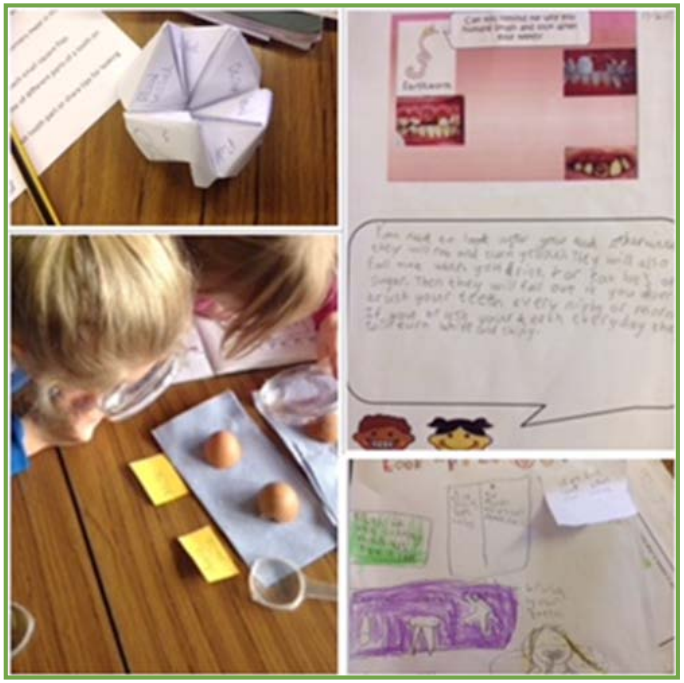
Recording of assessments at Blaenycwm Primary

Incerts, from the Assessment Foundation, is a formative assessment system that Blaenycwm Primary school use to record and track the progress of whole cohorts, vulnerable groups, and individual pupil's progress in all National Curriculum subjects. Staff use the system to support their teacher assessment of pupils.



Judgements based on a range of activities at Edwardsville Primary

Summative judgements can be more valid if based on a range of information. Edwardsville Primary use a range of types of activity to provide information which can be used formatively or summatively. The teachers use information from pupil outcomes, together with informal observations within lessons to support their summative judgements.



NOTES:

SAVE MY PROGRESS

Pupil 1 - identify existing ideas

Pupil 2 - focus on science obj

Pupil 3 - assess own ideas

Pupil 4 - assess peers

Pupil 5 - act on feedback

Pupil 6 -identify next steps

Teacher 1 - plan elicitation

Teacher 2 - discuss LO and SC

Teacher 3 - use Q, discn and obn

Teacher 4 - gather evidence

Teacher 5 - adapt teaching

Teacher 6 - give feedback

Teacher 7 - time to reflect

Monitoring 1 - judge range of activity

Monitoring 2 - moderation/discussion

Monitoring 3 - shared und of progn

Monitoring 4 - pupils aware of criteria

Monitoring 5 -manageable record-keeping

Summative 1 - descriptive summaries

Summative 2 - wr and oral reports

Summative 3 - use range of info

Whole school processes

Acknowledgements

Our thanks goes to all the children and staff at:

Blaenycwm Primary, Brynmawr

Ysgol Gymraeg Coed y Gof, Cardiff

Edwardsville Primary, Merthyr Tydfil

Fochriw Primary, Caerphilly

Garnteg Primary, Pontypool

Marlborough Primary, Cardiff

Ysgol Pencae, Cardiff

Penllergaer Primary, Swansea

St Fagans Primary, Cardiff

St Paul's Primary, Cardiff

St Philip Evans RC Primary School Cardiff

Tongwynlais Primary, Cardiff

We would also like to thank the:

Primary Science Teaching Trust

Bath Spa University

Cardiff Metropolitan University

TAPS advisory board members

Primary Science Quality Mark

Primary Science Teaching Trust College Fellows

and

All the teachers who have given us feedback on the pyramid through its stages of development.

TAPS project lead:
Sarah Earle, Bath Spa University

TAPS Cymru project team:
Bethan Jones, Ruth Coakley, Lisa Fenn and Dan Davies, Cardiff Metropolitan University

If you would like to offer further examples or provide the TAPS team with feedback, please email primary.science@bathspa.ac.uk