



FEEDBACK AND FEEDFORWARD TO IMPROVE LEARNING



Acknowledgements



Ministry of Education

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For information on OpenSTEM Africa see: www.open.ac.uk/ido



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OpenSTEM Africa: Ghana

The overarching aim of OpenSTEM Africa, Ghana, is to make a contribution to Government of Ghana/Ministry of Education policy to the effective teaching of practical science.

Effected by:

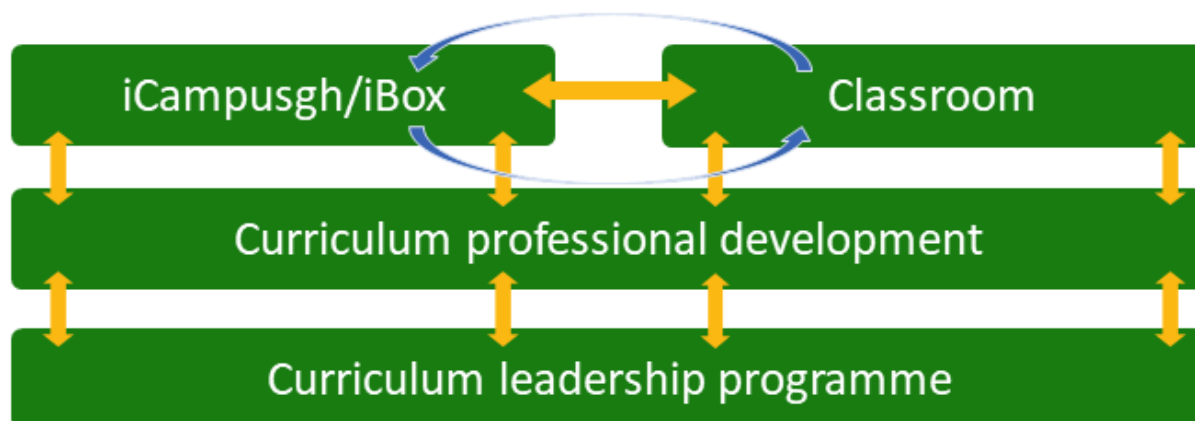
1. **Virtual Lab:** onscreen interactive science instruments using real data and with examples of science lessons, to improve the experiential teaching and learning of science in Senior High Schools, helping develop girls' and boys' practical science study skills, and building on the iCampusgh/iBox model developed by CENDLOS.

Underpinned by:

2. **Continuous Professional Development (CPD) for science teachers:** which develops confidence, skills and strategies to enable improved teaching and learning in the sciences, with a particular focus on ICT-based practical sciences, and which supports them in meeting the aspirations of the SHS elective science curriculum (Physics, Chemistry and Biology).

Embedded in Senior High Schools through:

3. **Curriculum Leadership Programme:** for Heads of Department/Heads of Subject, which enables them to effectively implement short- and long-term strategies to improve teaching and learning in the sciences, with a particular focus on ICT based practical science in their school.



The school-based professional development and leadership programmes will help more teachers use ICT-based science resources more and more effectively, with more learners. The support for school leaders' facilitates the development of a sustainable community of practice in science within the school, led by the Head of Department/Subject Lead and with the support of the Headmaster/Headmistress, in line with National Teaching Council Guidelines.

CPD programme for SHS science teachers

This CPD programme for SHS science teachers is designed by experienced Senior High School science teachers working with Heads of Science and SHS curriculum and Science Resource Centre developers, representing a wide range of Senior High Schools in Ghana. They are working with representatives from the Ministry of Education, from CENDLOS, from the University of Ghana and from The Open University (UK) on OpenSTEM Africa (Ghana).

Improving teaching and learning in the sciences at SHS level is part of the Government of Ghana's *Education Strategic Plan (2018–30)* to enable increasing numbers of SHS students to specialise in the sciences at tertiary level and then move into STEM careers. Government of Ghana policy points to the importance of in-service training for teachers for acquiring new skills and keeping abreast of new developments. The National Teacher Standards for Ghana (MoE/NTC) set out the importance of teachers continuing to learn as they teach and the importance of the school as the location of that learning. Ghanaian research suggests that continuous professional development (CPD) taking place within the school is more motivating, more coherent, more sustainable and likely to be more effective in the long term. This is the “growth approach in which teachers are given the opportunity to try new opinions, gain new perspectives, and extend their professional capabilities in order to understand and find solutions to problems in their individual schools” (Asare et al., 2012).

SHS science teachers, particularly those specialising in the elective sciences are already experts in their field. This programme is to enable them to work directly with their Head of Science, or Heads of Physics/Biology/Chemistry alongside their departmental colleagues to further develop the expertise of the whole department in teaching SHS sciences, with a particular focus on ICT-based teaching and learning and to help build a community of practice among science teachers in the school.

Using feedback and feedforward to improve learning

Introduction

The Government of Ghana's *Education Strategic Plan* (MoE, 2018) includes specific objectives for STEM subjects in Senior High Schools.

These include objectives to:

- introduce in-school remedial tuition/support, particularly for SHS1, to improve learning outcomes and reduce repetition
- invest in improving learning outcomes for girls in all subjects, especially STEM
- strengthen assessment to inform instructional interventions
- strengthen supervision and management of teaching and learning in SHS
- invest in STEM materials and facilities to ensure SHS graduates are adequately prepared for tertiary institutions and the world of work.

Feedback to support and develop learning can take many forms. It can be:

- oral or written
- provided by teachers for students
- given by students to other students
- provided by mentors observing teaching or HoDs commenting on lesson plans
- provided by teachers to each other if they are writing and sharing TLMs.

This unit focuses on the many ways you as a teacher can use feedback to improve learning – your own as well as the learning of your students.

By the end of this unit you will have:

- identified examples of good practice in giving feedback to students, including helpful feedback for struggling students and supportive feedback for girl students
- considered how you might support strategies in your department for types of feedback which will improve students' performance.



Reflection point

- Think about your own experiences of receiving feedback on your work when you yourself were studying. Did you have numerical marks or comments?
- Which would you prefer and why?
- What sort of feedback motivated you to learn?
- Is it best always to give positive feedback or are there times when challenging feedback is more helpful for improvement?

Giving feedback to students

The *National Teachers' Standards for Ghana* state clearly that feedback given to students is expected to be constructive and to develop understanding.

National Teachers' Standards for Ghana

The Teacher:

- listens to learners and gives constructive feedback.

Examples of the Standards in action

The Teacher:

- the teacher gives formative feedback to individual female and male learners
- learners are encouraged to talk or respond without interruption, in extended speech modes in whole class or group scenarios; the teacher listens hard, assesses their understanding, asks for expansion, alternative interpretations or clarification from the same learner or others, and gives constructive feedback to ensure or enhance understanding.

Examples of some indicators of teacher's performance

- evaluations of lessons by mentors, teacher reflective notes, gender responsive scorecard for teachers.

(National Teachers' Standards, 2017)

The SHS Elective Science syllabuses have information about summative assessment, how the marks are distributed between skill areas and teacher assessment. The OpenSTEM Africa CPD unit *Formative assessment* is about the sort of informal monitoring effective teachers do all the time.

The CPD units can be found at: https://www.open.edu/openlearncreate/Teacher_units

Teachers can feed back on their students' work by listening, observing what they do in class, and marking their written work. Commenting in detail on your students' progress is critical because it helps them to:

- be more aware of their performance and more responsible for their learning
- understand how to achieve higher grades
- improve their learning.

Feedback from you as a teacher can be in many forms. It can include:

- a question or a prompt
- praise
- challenge
- suggestions about how to approach a particular task
- clarifications, corrections when mistakes are made or supportive comments encouraging them to try again!

Close observation and monitoring of your class will enable you to give regular feedback, letting your students know – as a whole class and as individual students – the details of what they are doing well and what they need to do to improve.

Listening to and observing students

Most of the time, listening to and observing students is a natural part of teaching. It is a simple monitoring tool. For example, you may:

- listen carefully to how students answer questions and think about what this tells you about their understanding
- listen to discussions in pair or group work, particularly where peer teaching or support is taking place
- observe how girls are treated by their peers within the class, particularly when groups or pairs are mixed. Be prepared to intervene if the girls are being teased or ridiculed.
- observe the body language of groups as they work. Are they all interested and involved? Are any individuals being ignored?
- observe students when they are engaged in learning inside and outside the classroom.

Make sure that the observations you collect are true evidence of student learning or progress. Only document what you can see, hear, justify or count.

As students work, you would naturally want to move around the classroom in order to make observations and, if you need reminders, you might make brief notes. You can use a class list to record which students need more help, and also to note any emerging misunderstandings. You can use these observations and notes to give feedback to the whole class or prompt and encourage groups or individuals. If you have a large class, concentrate on observing a few students over each lesson, and make sure you have observed every individual student during a two-week period.

Giving feedback

There are two aspects to considering feedback – formal and informal:

1. the oral feedback you give to your students on a daily basis during lessons
2. WASSCE assessment frameworks, national policies, school policies and departmental guidelines for marking and feedback.

Your feedback

Feedback is information that you give to a student about how they have performed in relation to a stated unit or lesson objective or expected learning outcome. This will shape the relationship you form with your students, as it is a way of getting to know them better and showing them that you care about their progress.

Effective feedback gives the student:

- information about what happened

- an evaluation of how well the action or task was performed
- guidance as to how they can improve.

The feedback you give to each student will help them to know:

- what they can actually do
- what they cannot do yet
- how they can improve.

It is important to remember that effective feedback helps students. You do not want to inhibit learning because your feedback is unclear or unfair. Effective feedback is:

- **focused** on the task and the learning that the student needs to achieve
- **clear and honest**, telling the student what is good about their learning as well as what requires improvement
- **actionable**, telling the student to do something that they are able to do
- **given in appropriate language** that the student can understand
- **given at the right time** – if feedback is given too soon, the student may think, “I was just going to do that!”; the feedback will have been given too late, and the student’s focus may have moved elsewhere and they might not want to go back and do what is asked in the feedback.

Whether feedback is spoken or written in the students’ workbooks, it becomes more effective if it follows the guidelines given below.

Use praise and positive language when appropriate, and in proportion to the student’s performance

When we are praised and encouraged, we generally feel better than when we are criticised or corrected. Reinforcement and positive language is motivating for the whole class and for individuals of all ages.

Remember that praise must be specific to the work done, rather than about the student themselves; otherwise it will not help the student progress. Also remember that overpraising or giving ‘empty’ praise is not helpful to the student.

Some students also like to be challenged, so be aware of matching your feedback to what you know about the student’s typical responses. You will often be giving feedback when a task is in progress, so you are not only commenting on what has been achieved so far, but also supporting the student in their next steps.

“Well done” is non-specific and backward-looking, so it is better to say one of the following:

“That’s well thought through so far, but why...?”

“Think again ...”

“Explain how you came up with that.”

“I really liked the way you have ... Now, how are you going to ...?”

Use prompting as well as correction

The dialogue you have with your students helps their learning. If you tell them that an answer is incorrect and finish the dialogue there, you miss the opportunity to help them to keep thinking and trying for themselves. If you give students a hint or ask them a further question, you prompt them to think more deeply and encourage them to find their own answers and take responsibility for their own learning. You can encourage a better answer or prompt a different angle on a problem by saying such things as:

“What would make this even better is...”

“You have highlighted two of the important factors – can you think of any more?”

Student feedback

It is also appropriate to encourage students to praise, support, and sometimes critique each other. However, this does need to be organised carefully.

You can do this by asking another student a checking question, such as:

“Was that the answer you got?”

“Did you observe the same as... who just answered?”

Or you can ask the whole class:

“Did anyone have a different answer?”

It can also be appropriate and helpful to have detailed student-to-student feedback in a group or project activities, where the feedback is not targeted at an individual student but at another group.



Classroom example 1: Group feedback

Mr Kofi was teaching his students how to prepare carbon dioxide gas (Chemistry, SHS 1 Section 5 Unit 2)

First, he wrote the steps on how to prepare the gas but jumbled the steps.

Then he put the students into mixed male and female groups, making sure that there was a gender balance and that there was equality in terms of male and female group leaders.

He used a series of quick quiz questions to check all the groups' understanding of the safety procedures needed, with each group channeling their responses through their student leader and Kofi providing feedback to the group via its leader.

He provided all the groups with marble chips, dilute hydrochloric acid, two test tubes, lime water, cork and a delivery tube. He then drew a simple diagram of the preparation of carbon dioxide and how it is tested in the laboratory on the board.

He went around to assist those who had challenges in putting the apparatus together, giving them supportive feedback on their efforts so far.

Once the groups began the experiment, Mr Kofi moved continually around the laboratory, monitoring and giving feedback to each group.

When they had finished the practical lesson, Mr Kofi asked them to stay in their groups and wrote the following questions on the board, explaining that they should answer them as a group and that he would be calling on the student leaders for particular answers.

1. What gas have you just prepared?
2. What are the right steps for the laboratory preparation of the gas?
3. What did you observe when you added the hydrochloric acid?
4. How is the gas tested in the laboratory?

When asking the group leaders for their answers to the questions, Kofi made sure that he:

- looked equally to groups with female leaders as male leaders for the answers
- allowed each student leader time to explain in detail the response of their group
- asked a checking question to another group for each response (“Was that the answer your group decided on?”, “Did your group observe the same as the group which just answered?”)
- gave the correct response to each question to the whole class before moving onto the next
- praised the whole class for their responsible attitude to the practical lesson
- gave feedback to the whole class on the accuracy of their answers and made suggestions for ways of improving the next practical lesson based on the experience of this one.

Did you notice...

By having the group leaders take responsibility for providing the group's answers, and giving feedback to the groups, Kofi was able to ensure that no individual student was the target because of being mistaken or wrong in their answers.



Activity 1: Feedback strategies

Focus on **three** students in one of the science classes that you teach.

1. In your notebook write down everything you know about their achievements in your subject.
 - What do they find difficult?
 - What do they find straightforward?
 - What are they interested in?
 - Who do they prefer to work with?
 - Who do they work well with?
 - What are their long-term aspirations?
2. Now think about how each one responds to various types of feedback.
 - Does one of them enjoy praise in front of the whole class?
 - Does one of them prefer to be talked to individually or quietly?
 - Do any of them like challenging feedback to improve their performance (e.g. of the kind that is considered quite usual in sports)?
 - Do any of them get upset if they are told they have made a mistake?
 - Are any of them competitive with their feedback (e.g. the “Am I better than...” type of question)?
3. Now think about how you know that information and how you tailor your feedback to the particular individual. Of course, if a student does well in a task they should be congratulated, and if a student makes a mistake, they need to understand it, but there can be variations in the way that feedback is given. It is also important that you do not assume that the quiet student does not like to be praised publicly or that girls deserve more or less feedback than males.
4. Now write down the names of three more students that you would like to know more about. Look at your lesson plans for next week and plan some opportunities to observe these students and give them feedback, looking to understand whether they have particular preferences.
5. Compare your strategies with a colleague and work with your Head of Department to devise a list of effective monitoring strategies that could be displayed in the staffroom.

As students move through Senior High School, they do need to become more independent learners, especially if they plan to progress into tertiary education as young adults. So increasingly then, they do need to be encouraged to understand their own learning objectives. However, students (especially struggling ones), are not accustomed to having ownership of their own learning. You can help all your students to do this through the feedback that you give so that they understand their learning objectives and what they need to do to achieve them. Good feedback will help them achieve their goals. For example, for a project you could plan out their work and set deadlines the first time and then have them practise the process. This will serve them well in school and throughout their lives. But it may take time for them to make the mental shift from the idea that you as the teacher are responsible for their learning, to the realisation that they can make a positive contribution. Feedback continues to be important even for adult learners and in professional life.



Reflection point

Think about some recent feedback that you have received in your professional life as a science teacher. Was it unusual to be praised? Did you find it difficult to be challenged over some aspect of something you had done – or not done?



Classroom example 2: Using student feedback

Mrs Dufie is teaching her third year Biology class and the students are looking at DNA structure, replication and RNA transcription (Biology SHS 3, Section 2 Unit 2).

She puts the students into pairs to consider:

- What is DNA replication?
- Outline the process of DNA replication.

She asks each pair to produce an A3 drawing (two pieces of A4 stuck together) to summarise the process. She tells the class that the drawings will be displayed in the classroom.

Once the posters are finished and put up on the walls, she gives the students time to walk around and look at each other's. Then she gathers the class together and asks for positive comments on any of the posters that they think are particularly good ones. She emphasises that, when giving feedback, the students must explain in detail why they think a particular poster is a good example.

Finally, having had the chance to observe and comment on others, she gives all the pairs time to revise their own posters.



Activity 2: Creative feedback

It is encouraging to students if when they produce some creative work, they are given creative feedback.

Chemistry students study the Chemistry of carbon compounds (Chemistry SHS 2 Section 6) and in particular the uses of organic chemicals. The compounds of carbon have many uses and this is covered across all the units in this section.

- Divide your class into groups and give each group one group of organic chemicals
- – alkanes, alkenes, alcohols, esters, etc.
- Ask them to prepare a 15-minute presentation to the class on the different uses of the group of chemicals they have been assigned. They should all include a final section on the implications if oil runs out or needs to be replaced by alternative raw materials.
- Encourage them to use their imagination. They could do it as a radio news report, a presentation, present their work in the form of a TV documentary, appear as the Board of a large Ghanaian oil company, etc.

You could have one session for all the presentations or set up the activity at the start of the topic and have each presentation as you reach that part of the syllabus.

This kind of creative work is likely to happen only occasionally, but it can generate real

enthusiasm. Feedback from you could focus on the impact of their presentation and how convincing they were in promoting their group of organic chemicals. If possible and if you run the presentations in one session you could invite a fellow science teacher or the Head of Department/Head of Subject in to judge. There could even be a token prize!

Departmental approaches to feedback

Your science department is a community of practice and as the NTC 2017 Teachers' Standards state, "you are a teacher who 'engages positively with colleagues... as part of a community of practice'". Many of your students will be taking more than one of the elective sciences, and of course, all students will be taking Integrated Science as a core subject. This means that the learning of your students is shared with many of your colleagues in your department. Taking a departmental approach to how you give student feedback, along with subject- and department-wide discussions about how science students respond to particular types of feedback will develop a consistency of approach.

The professional sharing of information about students is a valuable practice and one which would be guided by your Head of Department/Head of Subject. This will include sharing concerns about an individual student, about particular difficulties they are having in your subject or about how they respond to particular types of comment or feedback. It will, of course, also be important to share information about student success in your subject and about how well particular students have responded to specific tasks or challenges.

One very valuable aspect of this concerns students who are shy or withdrawn in your class, as it can be difficult to know how they are responding to comments, praise or challenges. It may also be that you find it harder to give feedback to students who are struggling in your subject, as you may be concerned about being overcritical of their efforts. Again, sharing any concerns at subject and departmental level can provide helpful information about how the particular student responds in other classes, which will enable you to tailor your feedback to the student's specific needs.

Generally, where there is formal assessment then feedback is given. Knowing what they did well and how they accomplished it is extremely important to students in shaping the next steps in their studies. As you know, the WASSCE framework covers both external and internal assessment, and the school-based assessment carries a significant weight in students' final marks.

Distribution of WASSCE examination paper weights and marks

The following section is taken from the SHS syllabus.

Dimensions	Paper 2		Paper 2b	School-based assessment	Total marks	% weight of dimension
	2a	2b				
Knowledge and understanding	-	40	20	30	90	40
Applying knowledge	-	10	40	19	69	30
Practical and experimental skills	50	-	-	19	69	30
Total marks	50	50	60	68	228	-
% age contribution	2	22	26	30	-	100

School-based Assessment

New School-based Assessment (SBA) is designed to provide schools with an internal assessment system that will help them to achieve the following purposes:

- Standardise the practice of internal school-based assessment in all Senior High Schools in the country.
- Provide reduced assessment tasks for subjects studied at SHS.
- Provide teachers with guidelines for constructing assessment items/questions and other assessment tasks.
- Introduce standards of achievement in each subject and in each SHS class.
- Provide guidance for marking and grading test items/questions and other assessment tasks.
- Introduce a system of moderation that will ensure accuracy and reliability of teachers' marks.
- Provide teachers with advice on how to conduct remedial instruction on difficult areas of the syllabus to improve class performance.

(WASSCE table and SBA information above taken from the SHS syllabuses)



Activity 3: Feedback on school-based assessment

Working with your HoD/HoS and colleagues, use departmental meetings to work through the following questions:

As the science department you know that SBA includes laboratory work, projects/field work and group exercises alongside mid-term and end-of-term examinations. Consider the following and make notes in your notebook:

- Do you have a subject-wide or department-wide approach to feedback on laboratory work, project or field work or group exercises?
- Are there ways in which feedback to students on this type of work could be improved?
- In your subject and/or across the sciences, do you give students oral or written feedback on their mid-term or end-of-term examinations?
- Do you think there are ways in which feedback on school examinations could be improved to improve student performance and enable more students to achieve all the learning outcomes in your subject?

Using ICT to transform learning

National Teachers' Standards for Ghana

Examples of the Standards in action

All teachers have good technological pedagogical knowledge, knowing how to incorporate ICT into their practice to support learning.

(National Teachers' Standards, 2017)

Lesson planning using ICT

Activities 4, 5 and 6 will help you to think about the effective use of technology and how to make it transformational. Information and communication technology (ICT) provides a great opportunity to make lessons and learning more interactive, and at the same time help students to engage in 21st century skills that are relevant for their studies and future professional lives. Selecting and integrating a range of ICTs in your lesson requires careful consideration and thought.



Activity 4: Using ICT to transform learning

Think of a science topic that you will be teaching next week.

Imagine that you and your students could have access to any technology that you wished.

1. How could you use the technology to support how you would normally teach this topic?
2. How could you use technology to achieve the same learning but in different ways?
3. How could you use technology to provide learning opportunities that would otherwise not be available?

As a subject or departmental group and under the guidance and support of your Head of Department, collect all your ideas for points 1–3 on to a flip chart and keep it as a resource to support future planning or to inform the individual coaching sessions you will be having with your HoD.

OpenSTEM Africa Virtual Laboratory Applications

Practical science

The practical science applications in the OpenSTEM Africa Virtual Lab such as the electrical circuits application being introduced are designed to help you to teach your students practical science in the absence of other reliable equipment.

With each instrument there is an example lesson plan, demonstrating how it might be used to support science learning.

The instruments could be used to:

- introduce a topic
- deliver the main content of a lesson
- consolidate key concepts and ideas
- teach practical skills
- help students solve problems you have posed
- encourage critical thinking
- relate science to everyday life.

Working with your Head of Department, take a look at one of the science apps and its related exemplar lessons. Consider:

- what practical skills the students will learn
- how the engagement is being used
- alternative ways in which the engagement could be used.

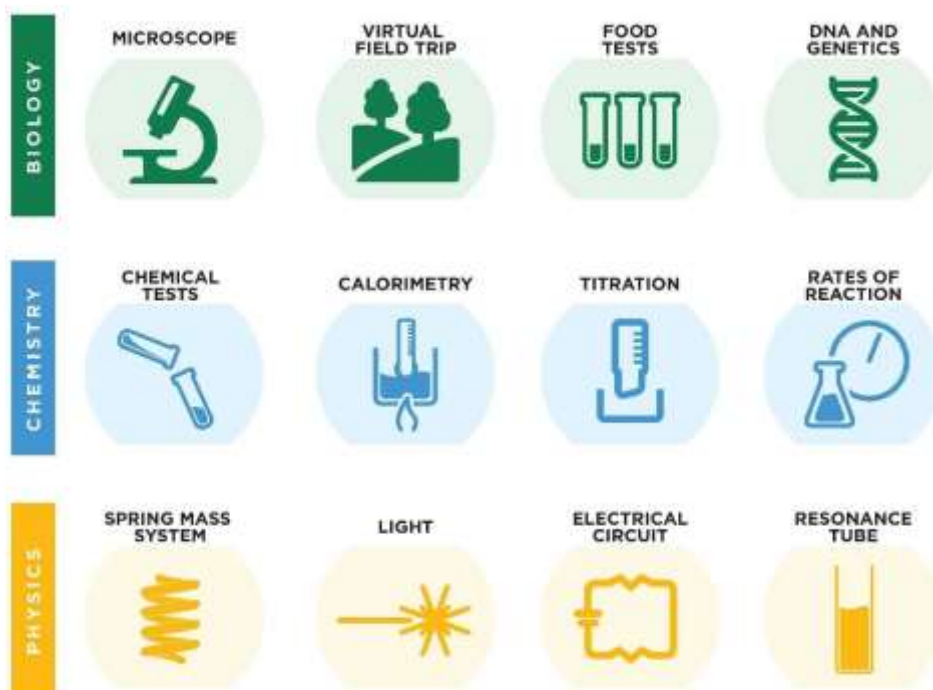
As more apps in the Virtual Lab become available, work with your Head of Department and colleagues to develop more example lesson plans.



Activity 5: Planning to use the OpenSTEM Africa Science applications

Work with your HoD to plan activities across the whole department for using the Science apps. For example, you might work with a colleague to choose one of the apps to investigate, work through the exemplar lesson and discuss how it would work best in your school with your students.

OpenSTEM Africa Virtual Lab



The OpenSTEM Science apps in the Virtual Lab have been developed collaboratively by CENDLOS, GES and a group of SHS teachers in Ghana and The Open University (UK). They cover a range of experiments highlighted in the SHS elective science syllabuses. Students can interact with the experiment individually at home if the internet is available, or at school if enough computers are available. They might benefit more from the experience if they work in twos or threes, so they can discuss the issues and work together to solve problems.

With each Science app there is at least one possible exemplar lesson. These are intended to highlight the possibilities for teaching a lesson rather than anything prescriptive. It is expected that at first you might follow the example as suggested, but you could move towards developing your own plans as you become more familiar with the apps. They have all been designed to be relevant at various points in the syllabus, or over a few weeks of work, so that there is extended opportunity for students to interact with the materials.

Lesson planning using iCampusgh and the iBox

Activity 6 will help you think about the effective use of technology and how to make it transformational.



Activity 6: Examples of using the iBox and iCampusgh

Teachers in Ghana are using the iCampusgh and the iBox, which have been developed by CENDLOS, in a number of ways:

1. **Catch up** – students who have missed lessons are able to access the material in the ICT lab and go through what they have missed.
2. Using the **video** lesson interactively – the teacher plays the video lesson to the class but stops the video periodically to ask questions or to set up a short discussion between the students about one of the issues raised.
3. **Flipping** – students work through the lesson on the iBox, in advance of the classroom lesson. The teacher then organises a series of activities in groups or pairs designed to probe students' understanding. Through careful questioning, peer-support groups can be established and the teacher can focus on those who need the most help.
4. **Note-taking** – the teacher displays the notes **and** students work in pairs or groups to convert the notes into alternative formats such as a poster, a mind- map or a concept map. While they work the teacher walks around asking questions and checking individuals' understanding
5. **Teacher absence** – the teacher knows that they will be absent on a particular day so arranges for the class to access the lab and work through a designated lesson.

Classify each of the above as:

1. supporting learning as usual
2. extending learning
3. transforming learning.



Reflection point

Reflect on some of the things that you have learnt and some of the things that you would like to get better at. You should raise these with your Head of Department, who will be able to help you to think more deeply about your lessons and how they may be further improved step by step.

Summary

This unit has focused on both oral and written feedback, and the ways that good feedback can encourage and develop learning. Most of the unit has focused on you as the teacher in your individual classroom, but you have also been invited to consider how feedback is naturally discussed and shared among colleagues in the science department and how a departmental approach to giving feedback can be developed under the guidance of your Head of Department/Head of Subject.

A full list of the OpenSTEM Africa CPD units can be found at:

https://www.open.edu/openlearncreate/Teacher_units

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