OpenSTEM Africa

# APPROACHES TO ACTIVE NOTE-TAKING

# Acknowledgements

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**Ministry of Education**

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Ghana Education Service, and the expert SHS science teachers, for their expertise in producing materials that are rooted in the Ghanaian school context, accessible and useful to learners and teachers.

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

OPITO for their generous support, which has made OpenSTEM Africa and the development of the Virtual Laboratory and these materials possible.

# Contents

# 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 iCampus/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.
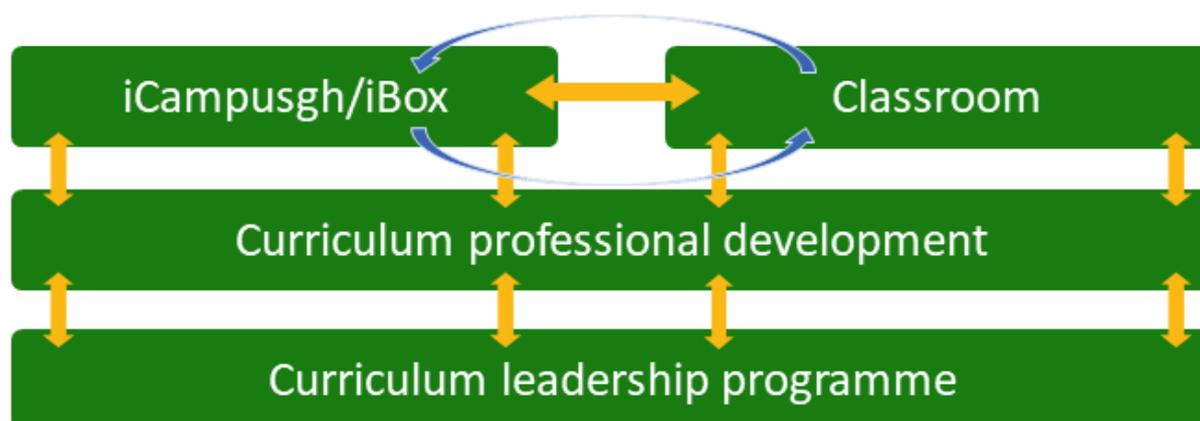


The school-based professional development and leadership programmes will help more teachers use ICT-based science resources more and more effectively, with more learners. The support for school leaders' facilitates the development of a sustainable community of practice in science within the school, led 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, CENDLOS, GES, 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.

# Approaches to active note-taking

## Introduction

Science students in Senior High Schools in Ghana have extensive material to learn and assimilate. They need to record all the new ideas, facts and explanations that they learn, so that they can revise effectively for the examinations that they will sit at the end of Senior High School and so they are under considerable pressure (Buabeng et al., 2014). Good note-taking is key to their learning.

By the end of this unit you will have:

- better appreciated the benefits of ensuring that students' writing is an active process which helps them to engage with the knowledge and understanding, and the application of knowledge in your SHS science subject
- understood better the strategies at the core of the SHS syllabus for your science subject and be more confident in using them for your own teaching
- made links between the ideas in this unit and some of the other CPD units, particularly the units on *Formative assessment*, *Effective questioning*, *Collaborative learning* and *Involving all*
- continued to develop your skills in using ICT in teaching and learning, via the final section of this unit.

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

## Note-taking

As well as explaining new ideas, you have to help students record their work in such a way that they will have a clear, coherent and detailed record that will form the basis of their assessment as well as their revision. For example, as you know, a student needs to create clear and accurate records in their laboratory notebook – which you will assess as part of their School-Based Assessment. For some students, perhaps particularly in rural Ghana, these notes in a laboratory notebook may be the only detailed account of the practical or experiment that they have, given that according to the Government of Ghana (MoE 2018) students are sharing textbooks in some SHSs.

Supporting students in making notes often involves copying from the whiteboard or dictating to them. Both of these can be passive activities. This unit encourages you to try some alternative approaches to students' note-taking and writing – approaches that will help them to actively engage with the ideas and develop their understanding.

**Discussion**

It is likely that copying or dictating was boring, but at least you felt confident that you had a 'good set of notes' to revise from. Making your own notes was possibly daunting – how could you know that you included all the important information? It is also possible if you copied or wrote notes from long periods of dictation, that you had little memory of actually making the notes, and that you didn't really come to understand the material until you started to revise.

Active note-taking with your students enables them to better engage with the four profile dimensions of the SHS syllabuses – "knowledge", understanding", "application" and "process" – in moving the student through understanding of the lesson taught to a position where they can start to create, innovate or synthesise knowledge and apply that knowledge to problem-solving

Drawing for example, appeals to visual memory and can be a shorthand to understanding or memorising. Discussion and dialogue can help every student with their own understanding and retention of facts and ideas.

👨‍🏫 **Classroom example 1**

When Lamisi Jebuni was at school, she remembers spending a lot of time, copying notes or taking down dictation. Her Biology teacher was the most difficult to follow – she spoke too fast so Lamisi had to concentrate on her writing rather than on what the teacher was actually saying. When she revised her Biology she had no memory of writing the pages and pages of neat notes! When she started to revise, she realised that remembering was such a problem that she had difficulty in understanding (and even more difficulty in applying) this knowledge, so she just learnt it the best she could and did well enough in the WASSCE exams to go to university. She found her first year very difficult as she could not really remember much from school.

**Did you notice…**

- Dictation prevented Lamisi from asking questions.
- Not understanding the work made it more difficult to remember – and to synthesise or apply that knowledge – and meant that she did not retain the ideas when she left school. University lecturers often complain that students do not know as much as they expected.

# Activities related to note-taking

The activities described below will all help your students to think about what they are writing. They promote the understanding and knowledge outlined in the SHS syllabus, moving away from the rote memorisation which is inherent in copying or dictating, while still ensuring that students have a good record of the knowledge and ideas that they need.

## Completing text

Activities could include:

- leaving gaps in a paragraph for students to add key words
- completing a table
- compiling a table from words, phrases or sentences
- labelling a diagram
- writing the first half of four or five sentences on one side of the board and the second half of each sentence on the other side. Students have to match the halves to make complete sentences which they copy down.

## Classroom example 2

- Mr. Mensah was teaching adaptations of organisms to their habitat Biology SHS 1 Section 3 Unit 7. He wrote a paragraph about the Tilapia fish on the chalkboard, but he left out some of the key words. He made a list of the key words underneath and as they copied the students had to put the right words in the right spaces, so that the paragraph made sense.
- Mrs Nortey wrote a paragraph on the board about the properties of the particles that make up an atom. Instead of copying it down, she asked her students to present the information in a table, as that would be easier to follow. They worked in pairs to work out how to do this.
- Miss Tagoe was teaching her students about the mass spectrometer Physics SHS 2 Section 5 Unit 3. She decided to use a strategy called 'think-pair-share'. She drew a diagram on the board and used it to explain the steps. When she had finished talking, she wrote the steps on the whiteboard, but put them in the wrong order. She numbered the steps. Working on their own, students had to work out the correct order by jotting the numbers on a piece of paper. Then each compared with their neighbour (think). If they did not agree, they had to explain their reasoning and agree the correct order (pair). Then they had to share with another pair and discuss the problem until they all agreed (share). Once everyone had agreed the correct order, students copied the sequence into their notebooks.

### Did you notice…

- Both Mr. Mensah and Miss Tagoe structured 'gap' activities to enable the students in the class to reflect on knowledge and apply their understanding.
- Miss Tagoe incorporated dialogue between the students to develop understanding. This peer sharing and peer teaching among students is helpful to all the students in your classes.

### Activity 1: Planning active writing activities

Suggest to your HoD that the active note-taking is a teaching skill which you would like developed across the whole science department.

Working with your HoD and perhaps a group of colleagues teaching the same elective science, think about what you will be teaching in the next few weeks and draw on some of the writing activities in the Teaching and Learning activities in the syllabus that will engage your students and encourage them to think more closely about how developing the dimension of 'Remembering' which leads to 'Understanding' and how this in turn leads to developing 'Knowledge Application'.

## Key words and definitions

### Activity 2: Focus on key terms

Working with a colleague or with your Head of Subject for example in the elective science which you teach, agree a list of 'key words'. These should include required definitions and key terms from the syllabus, or words which, based on your experience, you know students will find confusing.

There are many examples from the syllabuses – e.g. population density, microbe (Biology), refraction, terminal velocity (Physics), hybridisation, cell potential (Chemistry).

If you have a laboratory or a classroom, make – or ask your students to make – a drawing for each topic. Alternatively create a 'word wall' and stick up the key words for the topic you are studying.

One of the challenges for science students is that they will come across new scientific words and have to learn the definitions. Some of those words will have special meanings in science and a different meaning in everyday life! As you know, to a chemist 'reduction' doesn't mean 'get smaller'. It means 'to remove oxygen from a chemical compound'. See Chemistry SHS2 Section 5 which focuses on oxidation reduction.

There are many ways of consolidating understanding of key terms. Here are a few:

- Write each key term on a separate piece of card. Write the definitions on different cards. Give each group of students a set of 'term' cards and 'definition' cards and ask them to match the term with the definition.
- Put the 'key term' cards in a bag and ask a student to pick one out. They should then nominate someone to give the definition. If you are concerned that some students will lack confidence, let them work in pairs to support each other.
- Write a list of 'terms' on the left-hand side of the whiteboard and definitions on the right-hand side. Invite students to the front to draw a line connecting the 'term' and the definition.

# Brainstorming and Mind mapping

## Brainstorming

Brainstorming is a way to encourage creativity, as it encourages free thinking. It can also help revise previous work with a class and can encourage discussion and thinking in groups. Brainstorming a topic is a group activity and is a visual exercise where once given the topic, students are encouraged to generate terms, facts or ideas very quickly. As you will know brainstorming is a teaching and learning activity used across the SHS sciences. You will find examples in every year of every syllabus.

### How to brainstorm

Once given the topic, group members call out one word or a short phrase and one person writes each of them quickly and randomly onto a flip chart or a whiteboard. All words/phrases are written up – nothing is rejected. Brainstorming is a short activity and fast paced. The students are encouraged not to think for too long or to worry whether their word or phrase is appropriate. If it helps to encourage them count from five down to one each time something is written on the board, to encourage the next idea to be shouted as soon as possible – and before you reach one!

### Mind mapping

Mind mapping is a next phase activity connected to brainstorming, a way to represent key aspects of a central topic or concept and how they link together. Mind maps are visual tools which help students to structure and organise their own thinking. A mind map reduces a large amount of information in to an easy-to-understand diagram that shows the relationships between different aspects of the topic and any patterns that there are.

A mind map is useful when trying to solve a problem as a mind map helps to highlight the aspects of the problem and how they relate to one another.

## How to make a mind map

- ask students in pairs or groups to draw a box in the centre of a blank sheet of paper and write the name of the topic in the box
- identify four of five main sub-headings (or sub-themes) and make a branch for each one
- around each sub-heading or sub-theme, make more branches or record the key facts or ideas.

You may need to give an example of a mind map to help students understand the process. The process of brainstorming and making a mind map is just as helpful as the finished product. For example, you could brainstorm to:

- come out with the meaning of 'force' for SHS Physics Yr 1 Section 2 Unit 2
- come out with the meaning of the terms 'chemical industry' and 'chemical plant' for SHS Chemistry Yr 2 Section 1 Unit 1
- come up with the meaning of the terms 'health', 'hygiene' and 'sanitation' for SHS Biology Yr2 Section 3 Unit 4.

You and your students may come up with a very complicated mind map network – like the example below:
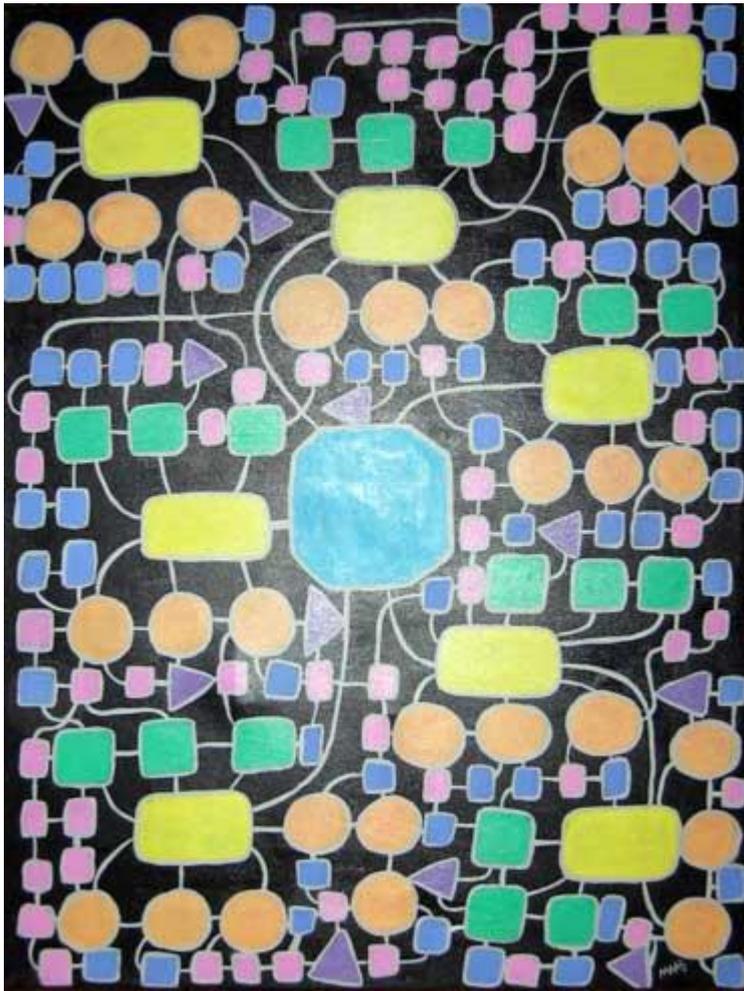


*Mind map* by Mary-Ann Alberga is licensed under CC BY-NC-ND 2.0

# 📝 Classroom example 3

Mr Appiah was teaching Chemistry to SHS 2 and it was time to revise for the end of term exam. The topic for revision was 'Acids, Bases and Salts' which they had studied at the start of term.

He gathered the class around the front and asked them what they could remember about the topic – some key terms, important facts or key ideas. He wrote everything they said on the whiteboard and it was not long before the board was covered. At first, the ideas came slowly, but as the task progressed they seemed to remember more and more.

Then they went back to their places and he explained what is meant by a mind map. Working in pairs, he asked them to identify four or five sub-headings or themes. Then, each pair made a mind map. They used the information on the whiteboard as a prompt but organised it into their chosen themes. He collected the mind maps and stuck them on the wall. The students walked around and looked at each other's work. Finally, they were given five minutes to add anything they wanted to their own mind map.

### Did you notice…

- By having the brainstorm first, students were reminded of the topic they had already covered.
- The students could see all the ideas on the whiteboard. The mind mapping exercise required them to sort the information. This exercise was suitable for all levels of attainment.
- Brainstorming followed by mind mapping gives students the chance to be creative and express themselves in different ways.

Take some time to look at the three examples. There is no 'perfect' mind map and different people will appreciate aspects of them. The key question is 'is this way of representing what I need to know about this topic, useful to me?' This will vary for different people. In order to be able to support your students in drawing mind maps, you need to be able to do it yourself.

## Activity 3: Brainstorming and making a mind map

Working with your HoD and/or with colleagues in pairs or small groups, choose a topic you enjoy teaching, or one where you feel that you would all benefit from revising the key ideas. Brainstorm, and then make a mind map summarising the key ideas and facts for that topic.

- Discuss your mind map. Highlight what you like about the mind map you created and anything which could be improved.
- In your group and with your HoD devise a list of criteria for deciding what makes a 'good' brainstorming and mind mapping exercise. This could include things like layout, use of colours, level of detail, relevance to the examination, how the information is structured.
- As a department, select what you collectively consider to be the 'best' two and put them on the wall so teachers and students can see them.

# Writing for different audiences

Writing for a different audience will encourage students who find science difficult to research key concepts and definitions. It will also provide some variety and keep your students engaged. Instead of writing formal notes, you could get your students to:

- Produce an information leaflet e.g. on the topic of using seatbelts in Physics SHS 1 Section 2 Unit 1 that could be used by parents to encourage road safety.
- Make a poster on a topic such as careers in chemistry from Chemistry SHS 1 Section 1 Unit 1 'How to become a…' illustrating key ideas and main facts.
- Extend the idea of using newspaper articles from Integrated Science SHS 1 Section 2 Unit 1 'Expressing a point of view' to write a newspaper article e.g. on the importance of the salt industry to Ghana (from Chemistry SHS Year 2 Section 4 Unit 7) or its potential environmental impact.
- Write a story (using 'and then' to describe each stage in the narrative. For example, use the teaching and learning activity in Biology SHS 1 Section 4 Unit 2. Describe, from this activity, the process of digestion in humans after taking a meal of boiled rice and meat stew and fresh orange as desert, writing it as a story focusing on enzyme activity at each stage.

## Reflection point

Think about the topics you are teaching this year. Could you use one of these suggestions?

# Writing to support active learning and teaching

Apart from the benefits for students that will come from having the opportunity to think as they write, the suggestions in this unit will give you the chance to learn more about your students. By watching and listening when they talk about their idea for brainstorming and mind mapping, or matching words and definitions, you will be learning who needs more of a challenge and who needs more support. You will also give your students the opportunity to ask questions which will help them to learn, and it will help you to understand what help they need.

By setting open-ended tasks – such as brainstorming, or creating a mind map, a poster or an information leaflet – students with different attainment levels will have the opportunity to demonstrate what they can do.

The activities related to text in this unit – filling gaps, completing sentences and labelling diagrams – provide opportunities for questioning to probe understanding and will help you to work out how best to support individual students.

In this way, adopting more active approaches to note-taking will provide opportunities for formative assessment, opportunities for questioning to support thinking, tasks suitable for all attainment levels and opportunities for discussion.

## Activity 4: Learning from each other

As a departmental group and under the guidance of your HoD, agree a time-frame for trying one or more of the ideas in this unit with your class. Remember that these suggestions for teaching and learning activities – along with many more – are all in the SHS syllabuses.

At break (over tea or lunch) share your experiences, highlighting the positive benefits of working in this way and sharing some of the things you have learnt about your students.

- Is there anything you will try and do more of in the future?
- Did you encounter any challenges?

Sometimes, teachers report that it takes students a while to get used to working in this way. If they are used to copying and being dictated to – both relatively passive, easy activities from their point of view – they might need time to get used to your different expectations. Think about how you could perhaps use a reward system to encourage them.

# Using ICT to transform learning

Here are some strategies where you could use ICT to to encourage your students in new ways of working

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## 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)

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# Lesson planning using ICT

Activities 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 engage in 21st century skills that are relevant for their studies and future professional lives. Selecting and integrating a range of ICT in your lesson requires careful consideration and thought.

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## Activity 5: 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.

- How could you use the technology to support how you would normally teach this topic?
- How could you use technology to achieve the same learning but in different ways?
- 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 the points above 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.

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# OpenSTEM Africa Virtual Lab Applications

## Lesson planning using ICT

> ### 🧠 Activity 6: Using ICT in note-taking
>
> It is only a short step from writing notes by hand in a notebook to typing them on a PC or laptop. This may be something you already do and if so, you will already understand the advantages of this – e.g. that you can store large amounts of notes digitally and access them easily (using a search facility) when you need them. If you are already using PowerPoint presentations with your science classes, you may already be adding notes to those (e.g. under each slide), or you would perhaps have sets of notes which you store in the same folder that you have created for presentations.
>
> Your students are asked to make presentations in SHS elective sciences and in Integrated Science (e.g. Int Science SHS1 Section 2 Unit 1 where they are asked to carry out a project:
>
> #### Project
>
> *Students in groups of two or three use search engines from the internet, local newspapers or international news stations to gather information and write a report on storms around the world, forecasting procedures, early warning signs etc. Students make a presentation of report in class for discussion and award of marks.*
>
> Using the example of the project above, then besides the suggestion that the students use the internet (!) it would also benefit each student to type their notes so that they can share them easily across the group, and to construct their presentation as a Word or PowerPoint file so that again, they can do this more easily as a group. Remind them that this way, they can share drafts of the presentation with each other to create the finished piece of work – and after the presentation they can send it to you by email for your marking.

Information and communication technologies (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.

## Practical science

The practical science applications such as the mass spring system being introduced by OpenSTEM Africa 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 the mass spring system and the lesson plan. 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 applications in the Virtual Lab become available, work with your Head of Department and colleagues to develop more example lesson plans.

## Lesson planning using the iCampusgh and the iBox

Activity 7 will help you to think about the effective use of technology and how to make it transformational.

### Activity 7: Examples of using the iCampusgh and the iBox

Teachers in Ghana are using the iBox and iCampusgh, 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 at home or 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 though the lesson on iCampusgh at home 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 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

Helping students to build a personal record of their learning so that they have a good basis for their revision is an important part of your role as a science teacher. Besides their lab notebooks, reports, diagrams and group projects, there are additional ways of actively engaging them in the process. By using all possible methods of active engagement, they will learn more and you will have the opportunity to better understand them and their individual strengths and weaknesses.

A full list of the OpenSTEM Africa CPD units can be found at:
https://www.open.edu/openlearncreate/CPD_units

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