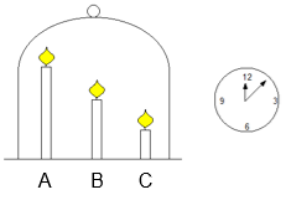
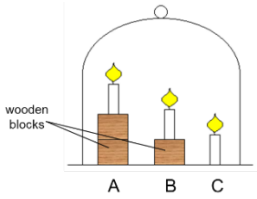
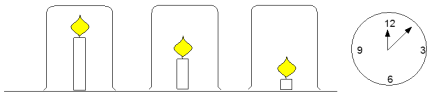
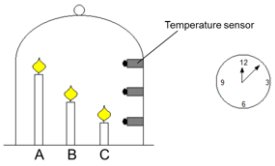
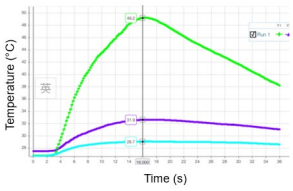
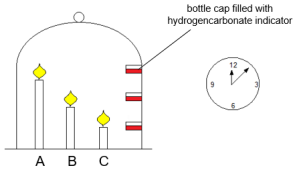
Gifted Education School Network 2021/22

STEAM Education

Acknowledgements: This lesson example was adapted/adopted from the tryout by Ms HO Ka-yee of Homantin Government Secondary School

Level	Secondary 4	
Topic	Unit 2: Atmosphere	
Lesson Duration	1 hour (a double lesson)	
Class size	32 students	
Learning Objectives	Knowledge • To apply factors affecting the combustion of candle wax in an unfamiliar condition. Skill • To analyse and interpret experimental data and form a justified claim. • To evaluate and revise hypotheses based on new empirical findings. Values and attitude • To appreciate the nature of scientific inquiry and discovery.	
Prior knowledge of students	• Composition of air • Tests for oxygen and carbon dioxide	• Conditions required for burning • Word equation of burning fuel
Highlights of this exemplar	This lesson is designed to exemplify the use of a jigsaw cooperative learning strategy using a prediction-observation-explanation (POE) inquiry model. When candles of different lengths are ignited under a closed system, the longest candle will go out first. It is because the hot carbon dioxide rises and accumulates near the longest candle. The experimental result may contradict students' predictions as they may think that the burning time depends solely on the amount of fuel. This lesson allows students to discuss what they think will happen in the closed system. They are arranged in expert groups to collect new evidence in 4 learning stations. Finally, students are arranged in jigsaw groups to share their empirical findings and write an explanation for what they have seen. The lesson design helps nurture creativity and higher-order thinking skills among gifted/ more able students.	
Differentiation Strategies employed	• Jigsaw cooperative learning strategy • Learning stations • Tiered assignments	

Activities	Rationales for Implementation
1. Introduction (5 mins) Teacher asks students to recall the fire triangle and chemical tests for oxygen and carbon dioxide.	Teacher can check students' understanding of basic knowledge of the topic.
2. Setting the scene (10 mins) Teacher introduces the practical of igniting candles of different lengths in a closed system. Students discuss and write down their *predictions* about the candle that would go out first. They then observe the experimental result to see if it matches their prediction.  (Fig. 1)	Teacher should be open to students' ideas and he/ she should not judge the correctness of students' predictions at this stage. Teacher can ask students to use scientific ideas to explain their predictions. Scientifically gifted/ more able students can be invited to comment on ideas made by their classmates. It is anticipated that most students will be surprised by the experimental result. This can enhance students' **curiosity** to investigate the phenomenon.
3. Development (20 mins) Students are divided into groups of four students. Each student in a group is assigned a worksheet of different learning stations. Each group has one student responsible for a learning station. This forms a jigsaw group. Students read and study the worksheets individually. After each student has studied his or her worksheet independently, they gather with other students who have been assigned to the same learning station. This forms an expert group. In each expert group, students work together to collect new evidence about the candle investigation. Students are reminded of wearing safety goggles during the lesson. Learning tasks in each learning station are described below:	Students are assigned to different expert groups based on students' readiness. Learning stations A and B are more appropriate for the average students, whereas learning stations C and D are more appropriate for the scientifically gifted/ more able students. The learning stations provide students with different learning experiences such as hands-on activity, graphical analysis, and quantitative observation. It can facilitate the development of **multiple intelligences** among gifted/ more able students. The activity in each learning station is **cognitively demanding**. Students need to work closely in each expert group in order to make sense of the experimental findings. It helps nurture **creativity** and **higher-order**

Learning Station A (2 small groups): To investigate the relationship between the height of candles and the burning time of candles  (Fig. 2) *Learning Station B (2 small groups):* To investigate the relationship between the length of candles and the burning time when the candles are burnt individually.  (Fig. 3) *Learning Station C (2 small groups):* To investigate the change of temperature at different heights during the candle experiment.  (Fig. 4)  (Fig. 5) *Learning Station D (2 small groups):* To investigate the change of concentration of carbon dioxide at different heights during the candle experiment.  (Fig. 6)	**thinking skills** among gifted/ more able students.
4. Development (15 mins) Students return to the jigsaw groups. They share empirical findings in each learning station. They discuss and use the new evidence to construct a	*For scientifically gifted/ more able students*, the discussion process can their development of **collaboration skills** and **communication skills**.

scientific explanation of why the longest candle goes out first. Teacher walks around and facilitates group interactions in each jigsaw group.	
5. Conclusion (10 mins) Teacher invites students to share their explanations and evaluate their responses.	Students are encouraged to exchange their ideas with different groups and evaluate explanations made by other jigsaw groups.
Materials	
Worksheets for each learning station	
References	
Cheng, M. W. (2006). Learning from students' performance in chemistry-related questions. In B. H. W. Yung (Ed.), Learning from TIMSS: Implications for teaching and learning science at the junior secondary level (pp. 51–74). Hong Kong: Education and Manpower Bureau. Jolliff, T. (2007). *Chemistry for the gifted and talented*. Royal Society of Chemistry.	