Interactive STEM lesson in Teaching Primary Astronomy

--Reasons for Seasons

以互動STEM 課堂教授小學天文學: 地球與四季

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Shaukiwan Tsung Tsin School 筲箕灣崇真學校

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Which of the following is the correct reason of seasonal changes?

A. Earth receives vertical sun rays is summer. Earth receives oblique rays is winter.
B. Earth closer to Sun is summer. Earth further away from Sun is winter.
C. Earth facing to Sun is summer. Earth facing away from Sun is winter.
D. Strong sunlight is summer. Weak sunlight is winter.

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Background

Most widespread astronomy misconceptions at all educational levels (Trumper, 2006)

Most widespread astronomy misconceptions by groups (in percentages)

Subject	Misconception	Junior High School	Senior High School	Future Primary Teachers	Future High School Teachers	Non Science University
Day–night cycle	Earth moves around the Sun	36	30	51	37	34
Moon's phases	Moon moves into Earth's shadow	19	27	16	25	29
	Moon moves into Sun's shadow	25	17	29	23	16
Reason for seasons	Earth closer to Sun in summer	45	33	37	32	32
Reason for it being hotter in summer than in winter	Earth closer to Sun in summer	36	28	20	19	22
	Earth's rotational axis flips back and forth	20	23	31	29	23
Sun overhead at noon	Everyday	35	36	48	44	42
Moon's phase in solar eclipse	Full phase	74	77	71	75	70
Moon's rotation—same side visible	Moon does not rotate on its axis	54	57	51	47	50

Journal of Research in Science Teaching. DOI 10.1002/tea

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45%

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Background

5E Instructional Model (Bybee & Landes, 1990)

1. Engagement

Promote curiosity and elicit prior knowledge

2. Exploration

Conduct activities that build basic concept or do a preliminary investigation

3. Explanation

Focus students' attention and guide students toward a deeper understanding

4. Elaboration

Through new experiences, students develop deeper and broader understanding

5. Evaluation

Assess students' understanding

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Lesson

- **Background**
  - Grade 5 General Studies
  - Reason of Seasons
  - Whole-class gifted enrichment

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1. Engagement

Promote **curiosity** and elicit **prior knowledge**

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Mr Chan

Mrs Chan

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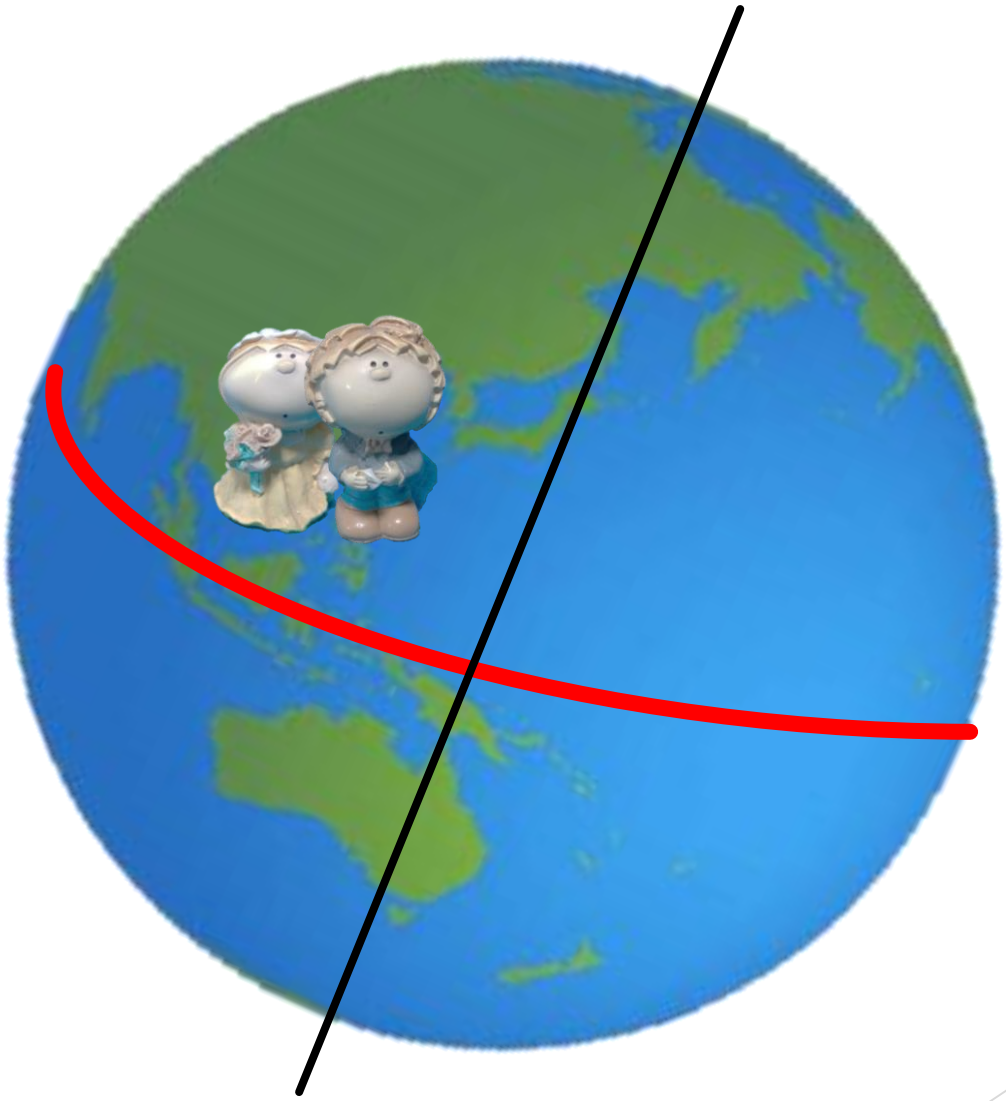
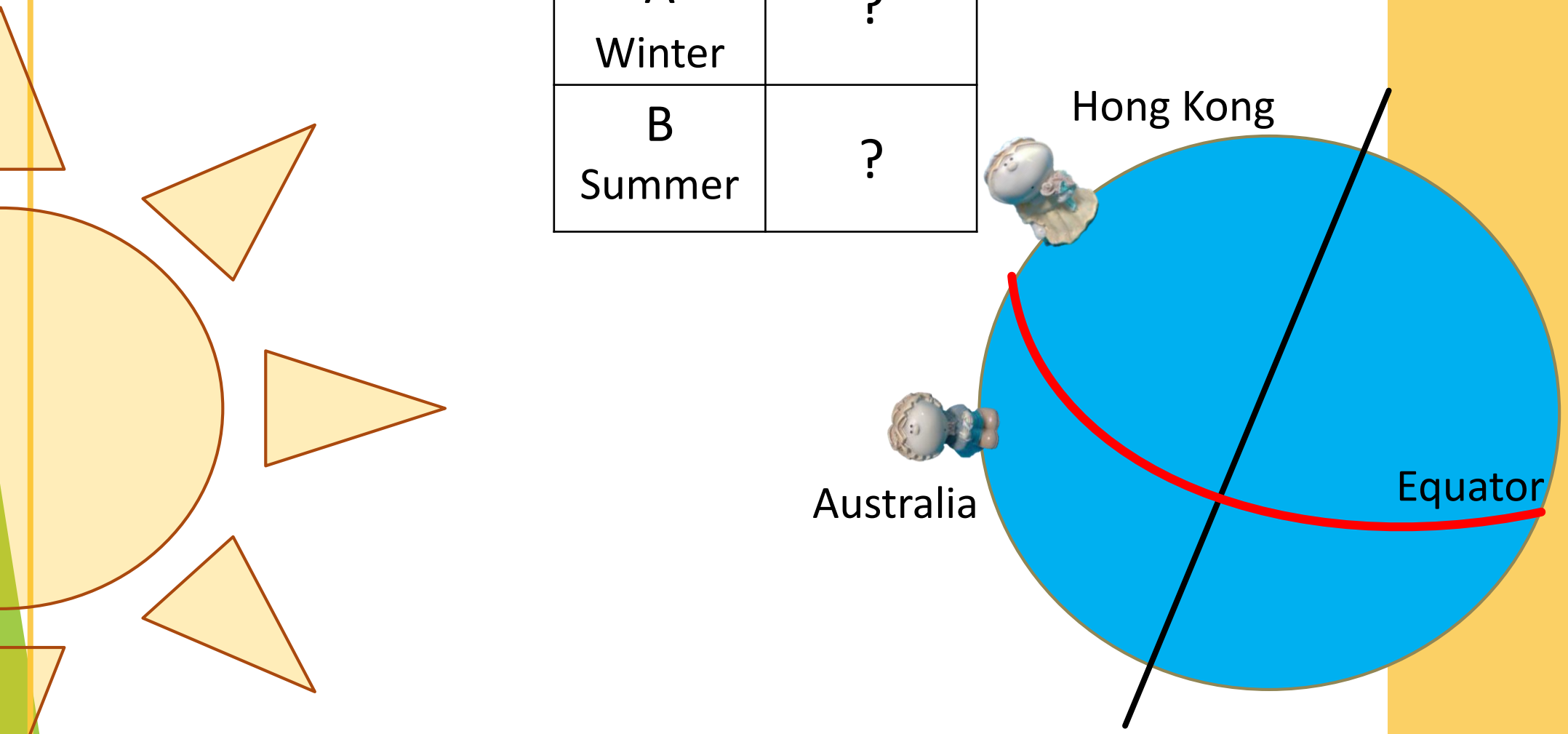


Equator

A Winter	?
B Summer	?



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2. Exploration

Conduct activities that **build basic concept** or do a preliminary **investigation**

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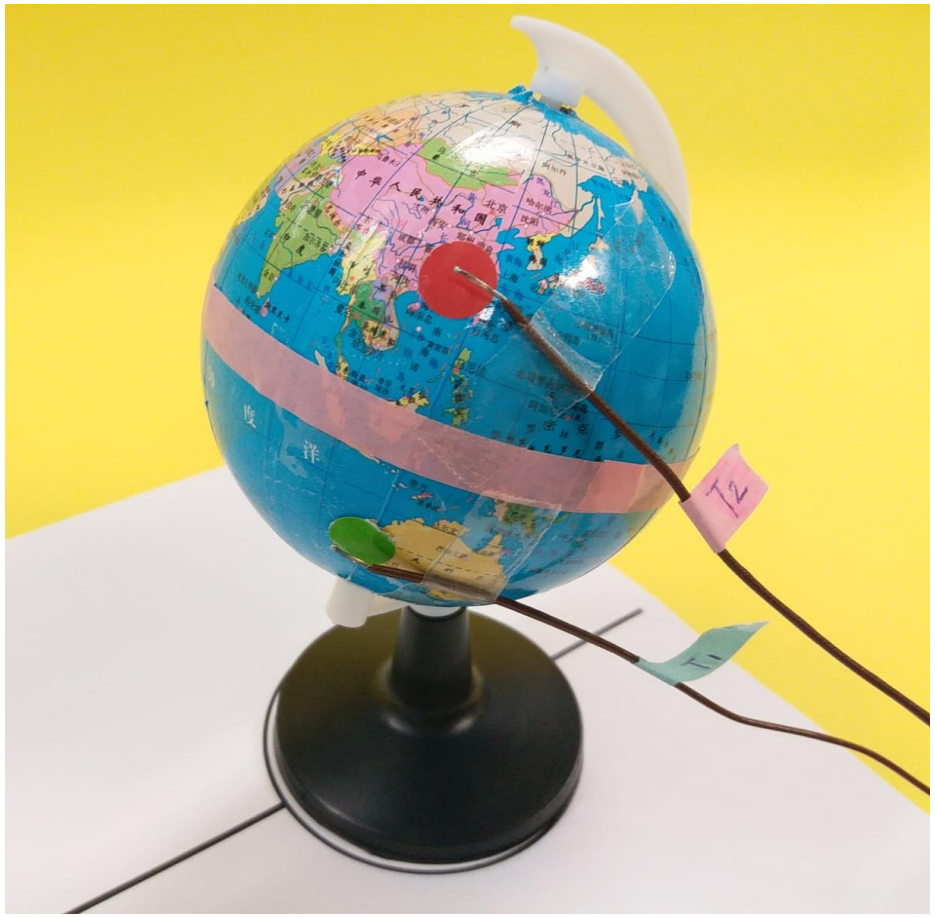

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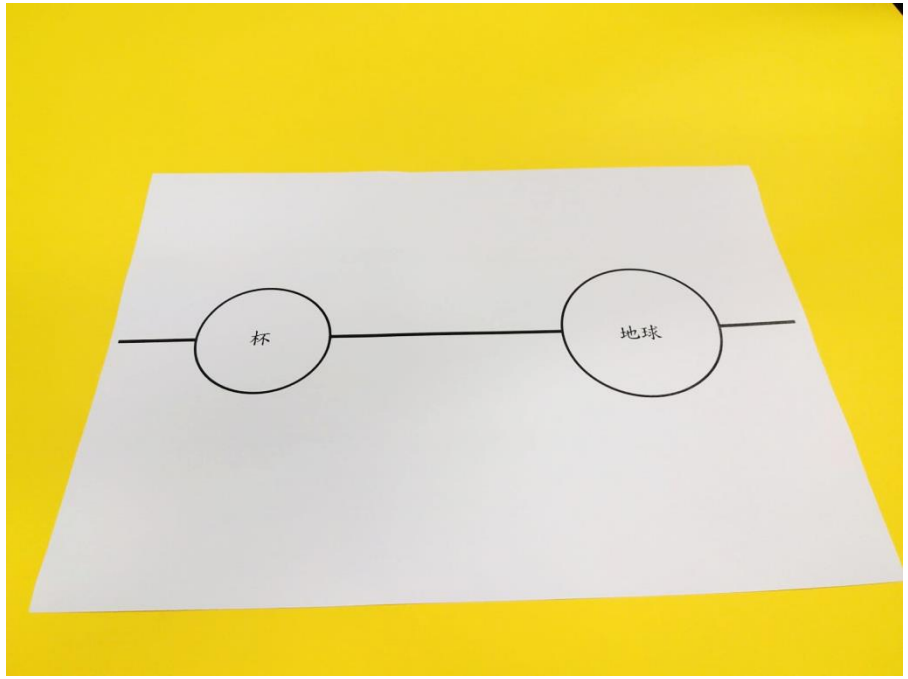

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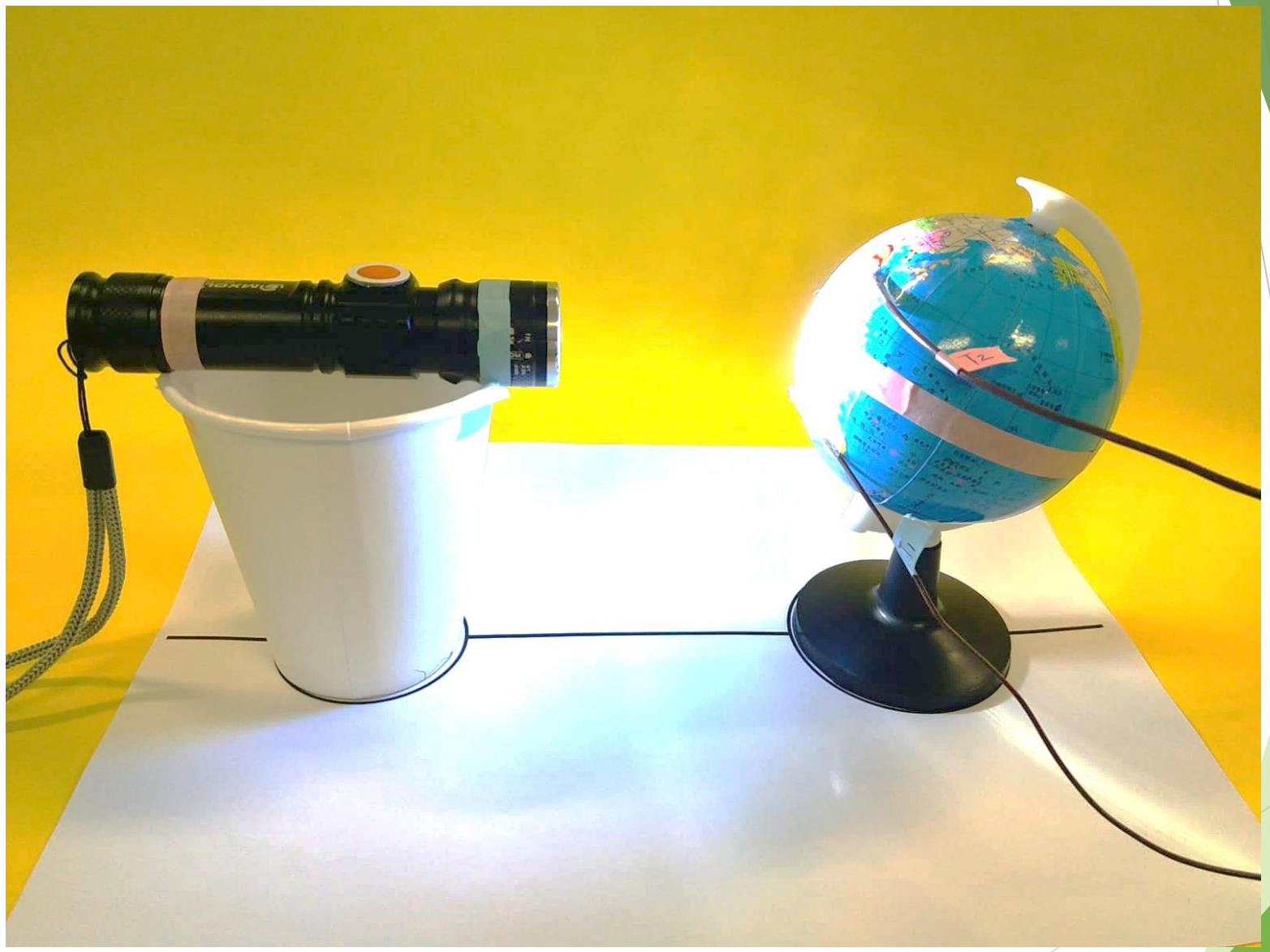

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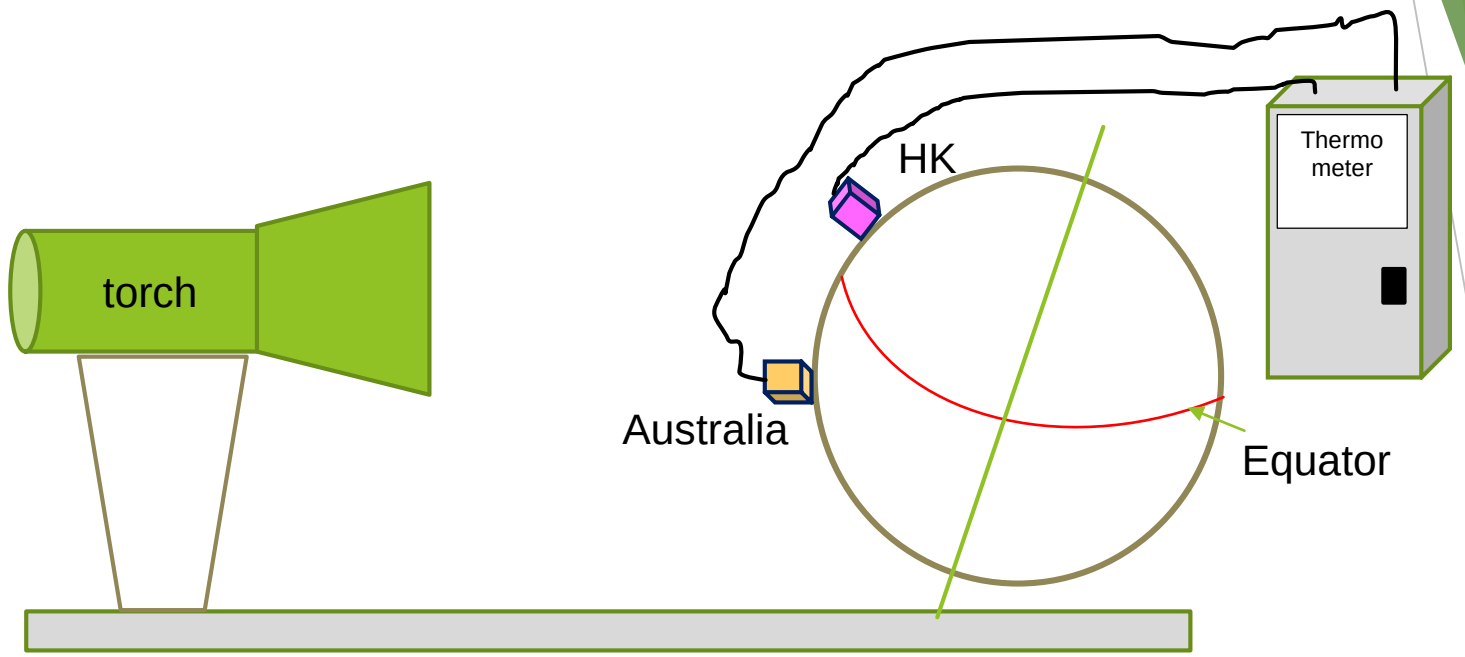
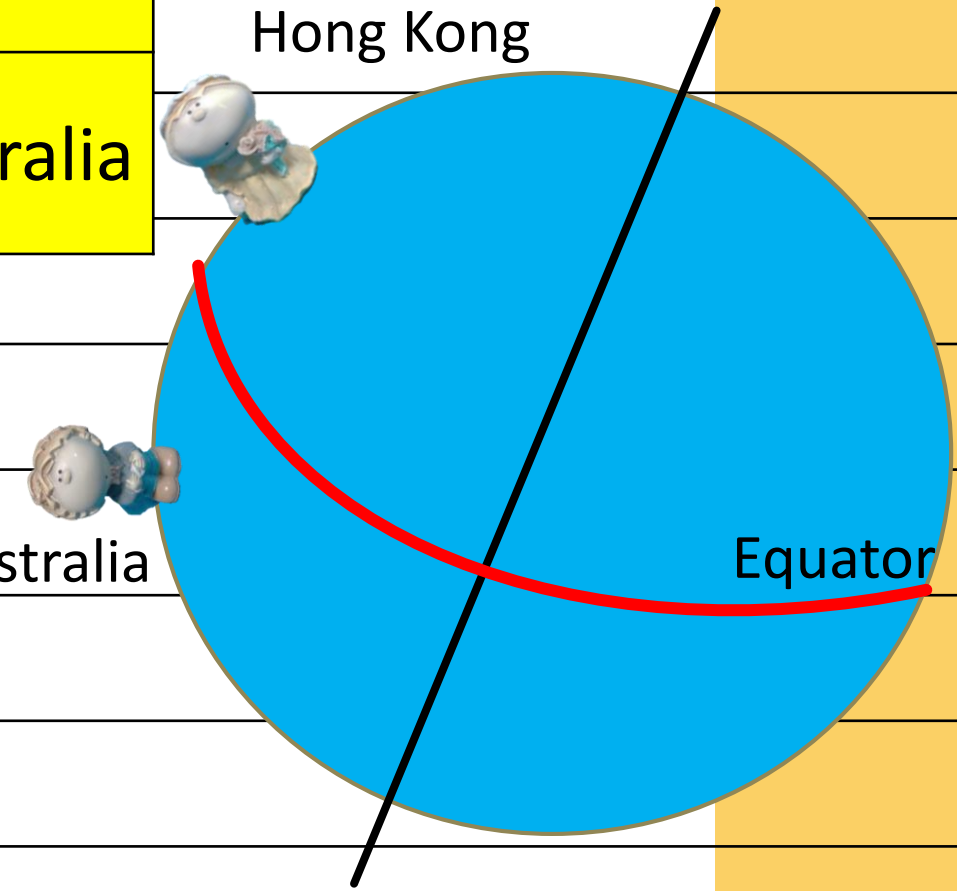


	Australia	**Hong Kong**
Measured Temperature (°C)	T1:	T2:
Temperature	high / low	high / low
Season shown	summer	winter

Winter	HK
Summer	Australia



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3. Explanation

Focuses students' attention and teacher guides students toward a **deeper understanding**

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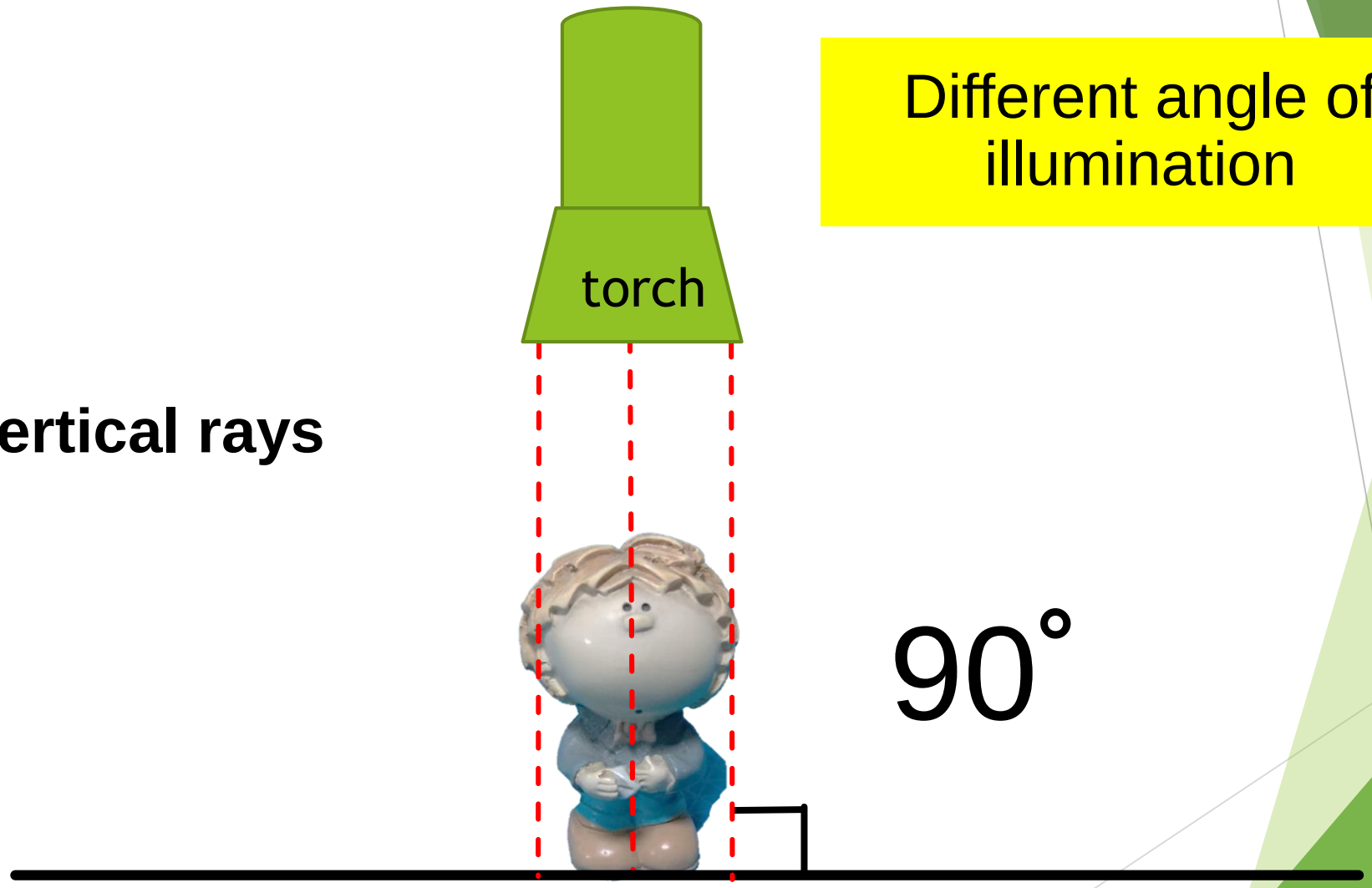
Different angle of illumination

Vertical rays



90°

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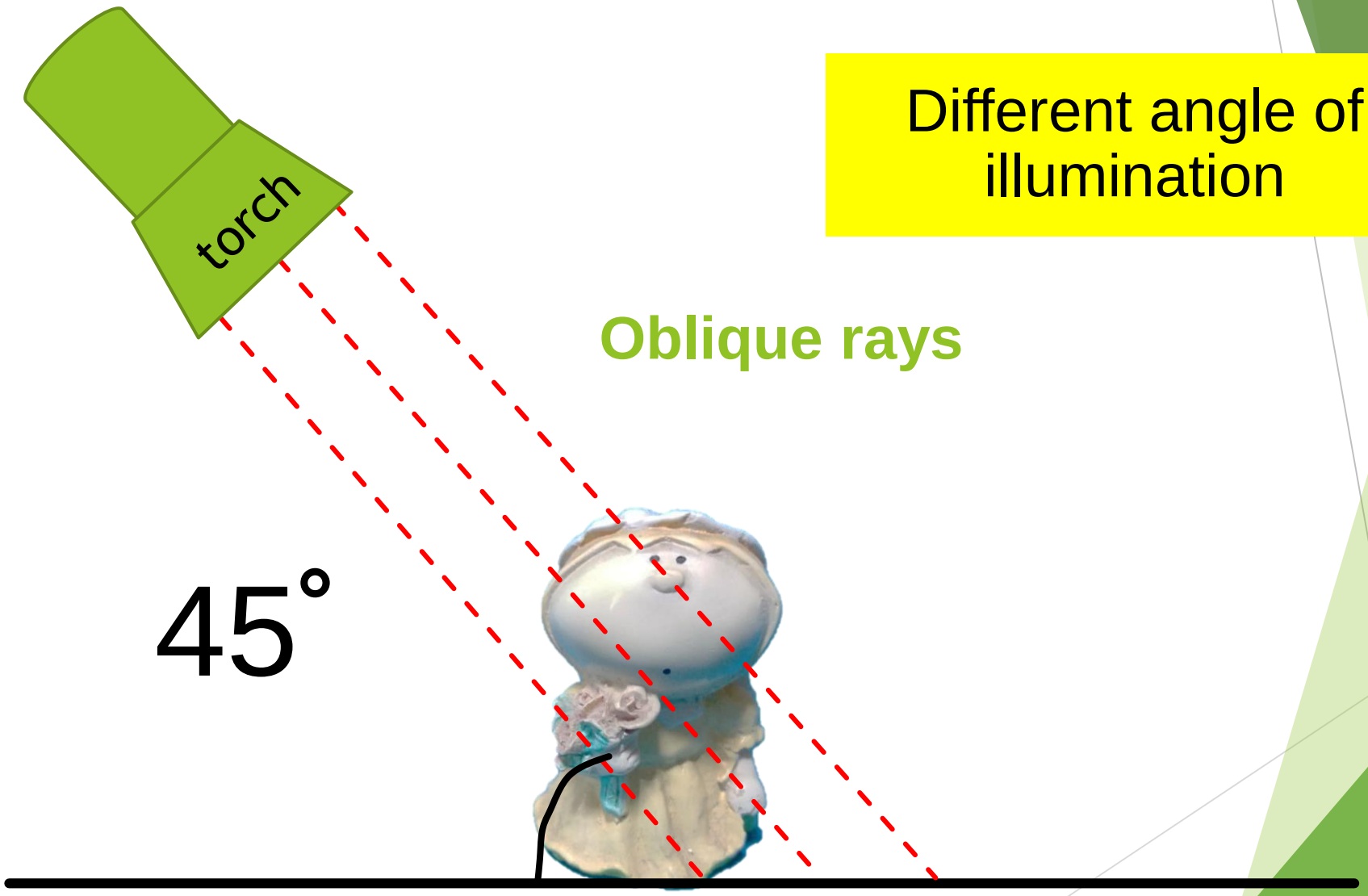
Different angle of illumination



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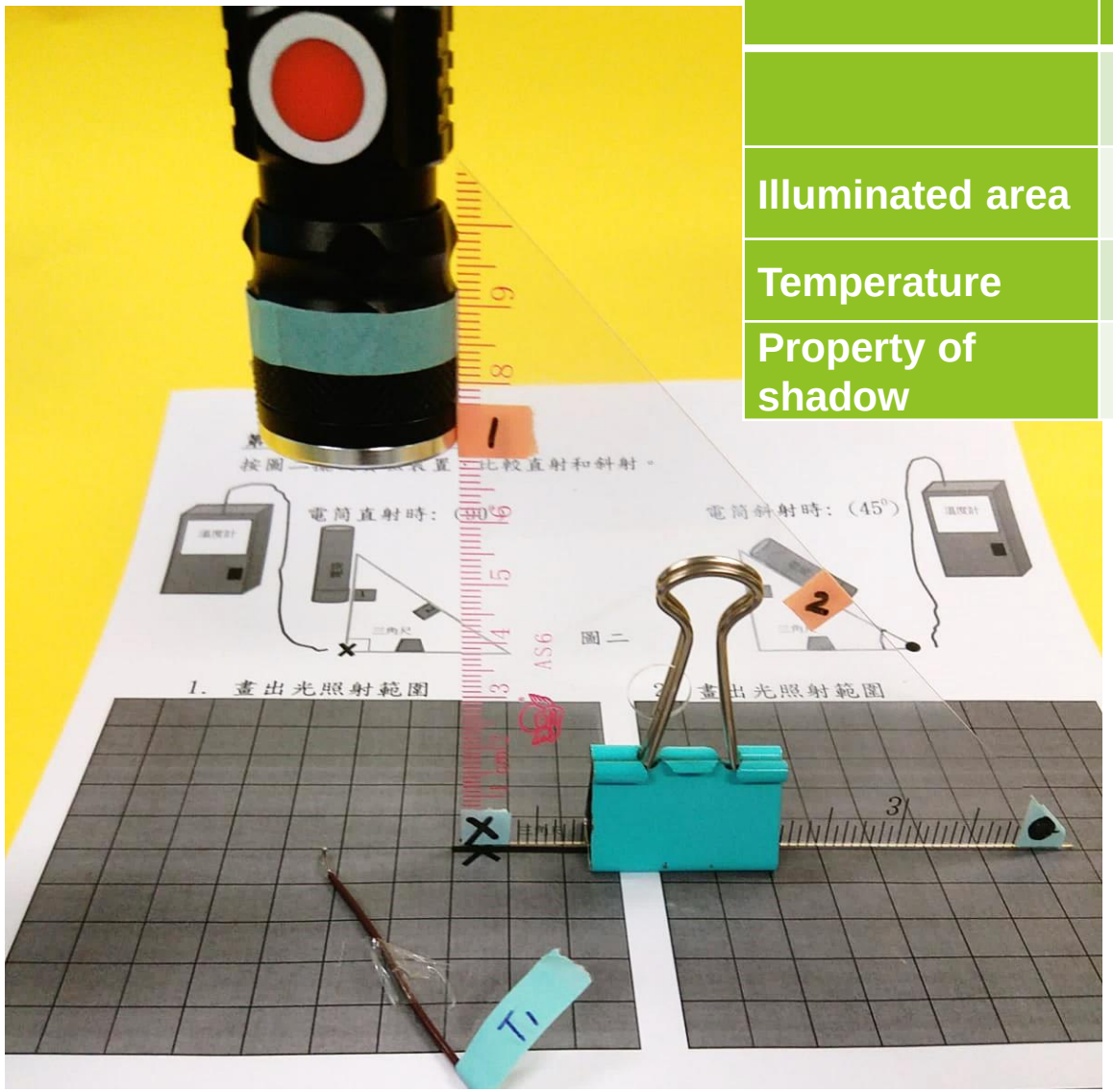

	1. Vertical rays (90°)		
	Prediction	Result	Prediction (✓/ ×)
Illuminated area	big / small		
Temperature	high / low	°C	
Property of shadow	long / short	cm	

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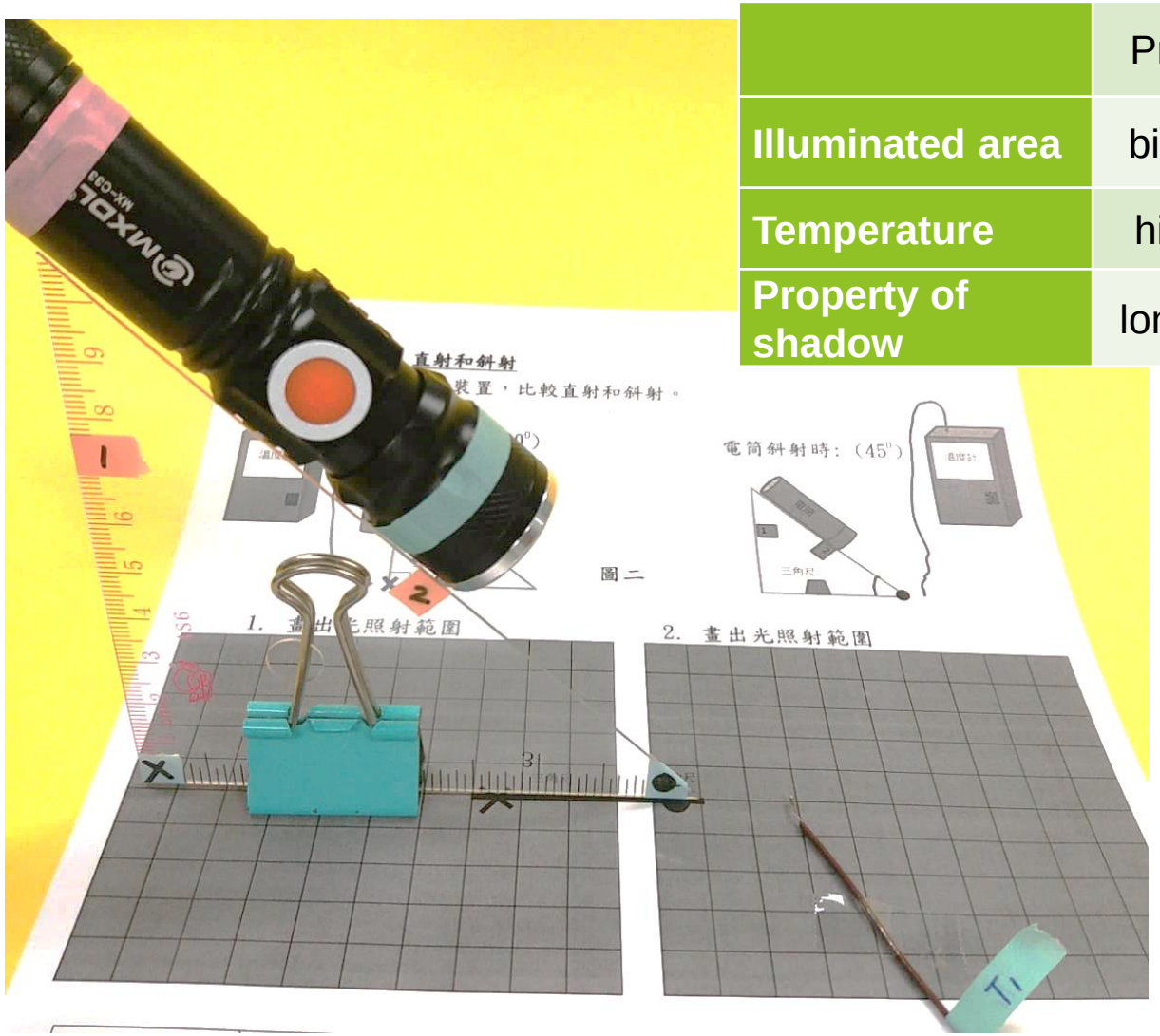

	2. Oblique rays (45°)		
	Prediction	Result	Prediction (✓/ ×)
Illuminated area	big / small		
Temperature	high / low	°C	
Property of shadow	long / short	cm	

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	3. Oblique rays (30°)		
	Prediction	Result	Prediction (✓/ ✗)
Illuminated area	big / small		
Temperature	high / low	°C	
Property of shadow	long / short	cm	

Conclusion

1. Under vertical rays, temperature is higher.
   That is summer. Smaller area receives a greater concentration of insolation.

2. Under oblique rays, temperature is lower.
   That is winter. Bigger area receives a less concentration of insolation.

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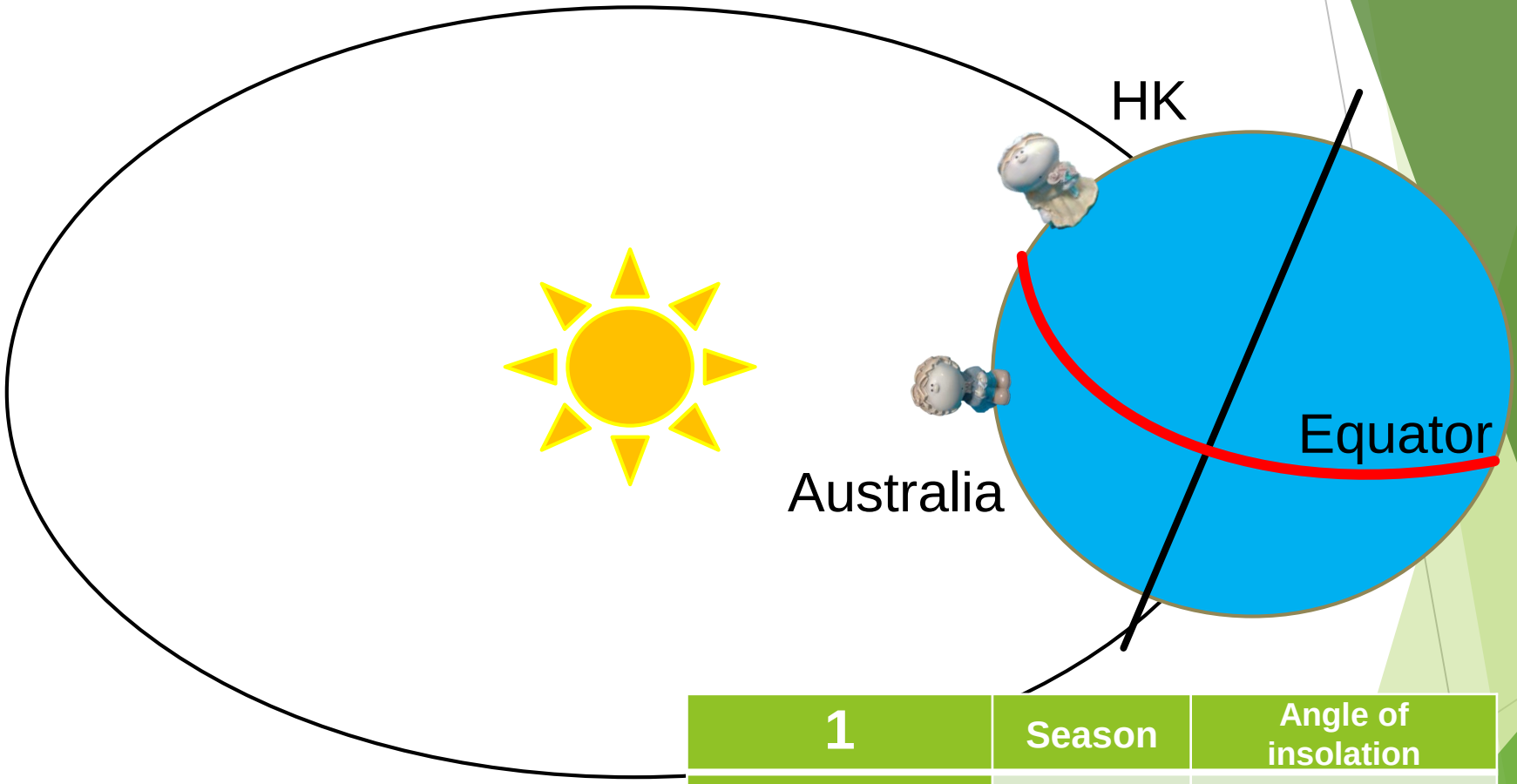

1	Season	Angle of insolation
a. North hemisphere	Winter	Oblique rays
b. South hemisphere	Summer	Vertical rays
Month	December	

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4. Elaboration

Through new experiences, students develop **deeper and broader understanding**

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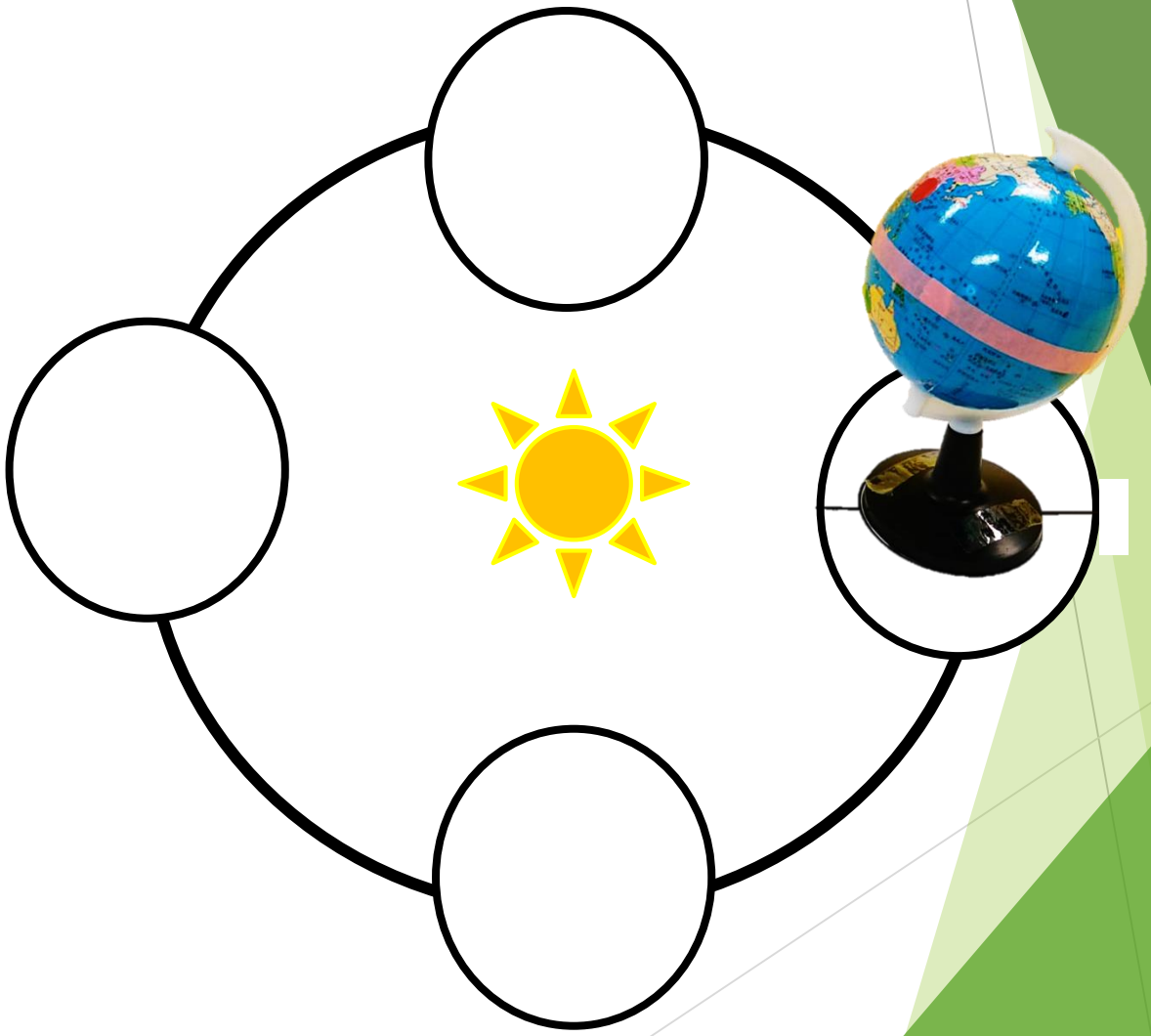

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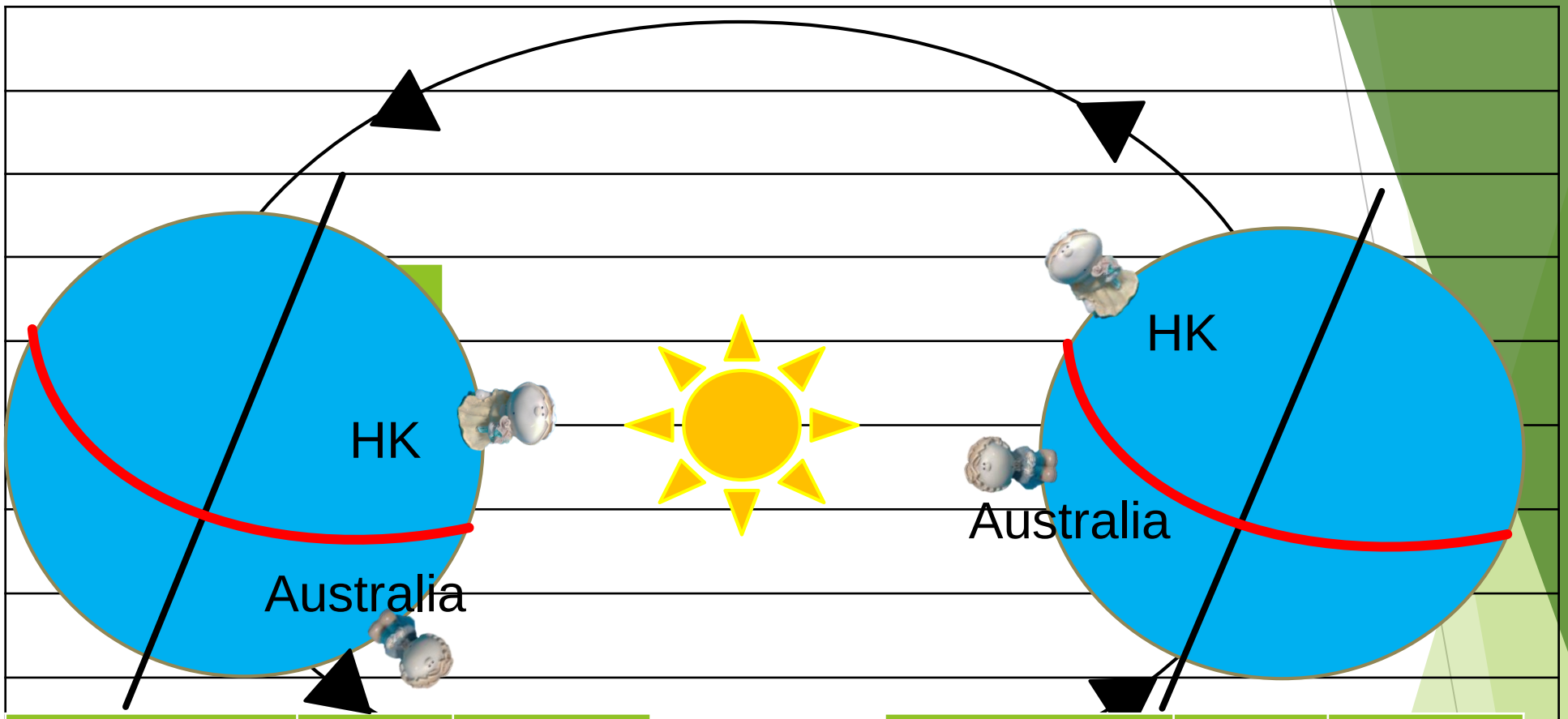

2	Season	Angle of insolation
a. North hemisphere		
b. South hemisphere		
Month		

1	Season	Angle of insolation
a. North hemisphere	Winter	Oblique rays
b. South hemisphere	Summer	Vertical rays
Month	December	

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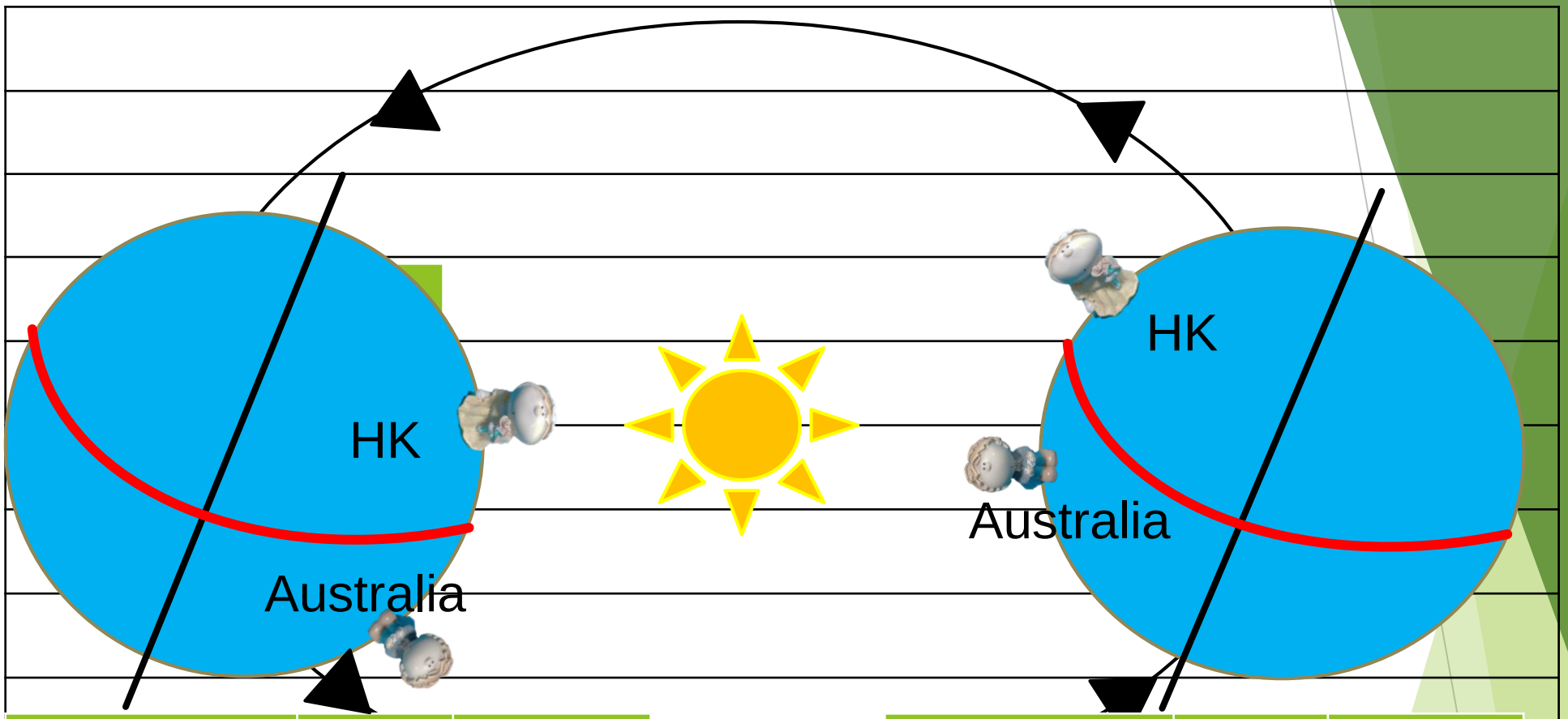

2	Season	Angle of insolation
a. North hemisphere	Summer	Vertical rays
b. South hemisphere	Winter	Oblique rays
Month	June	

1	Season	Angle of insolation
a. North hemisphere	Winter	Oblique rays
b. South hemisphere	Summer	Vertical rays
Month	December	

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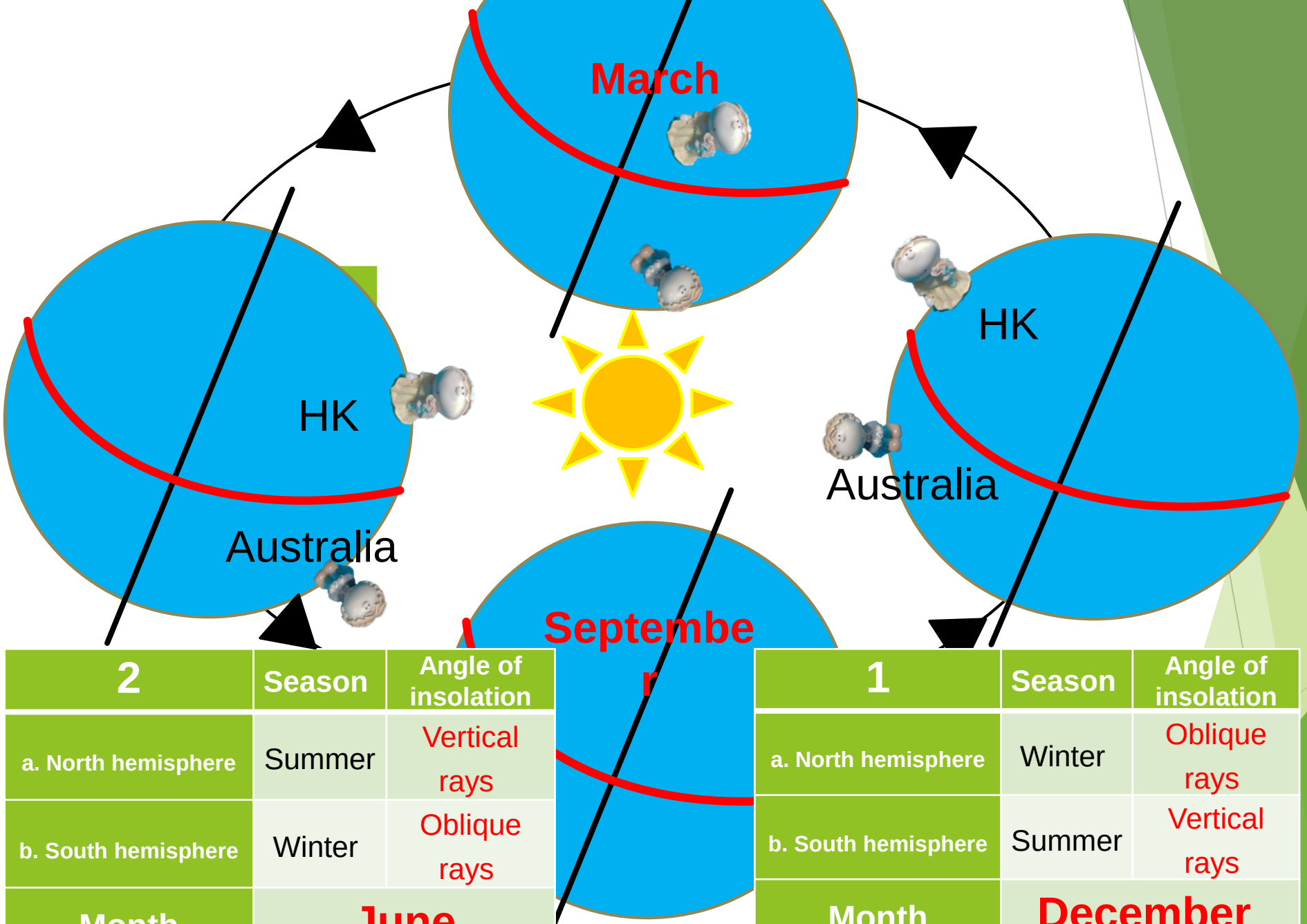

2	Season	Angle of insolation
a. North hemisphere	Summer	Vertical rays
b. South hemisphere	Winter	Oblique rays
Month	June	

1	Season	Angle of insolation
a. North hemisphere	Winter	Oblique rays
b. South hemisphere	Summer	Vertical rays
Month	December	

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5. Evaluation

Assess students' understanding

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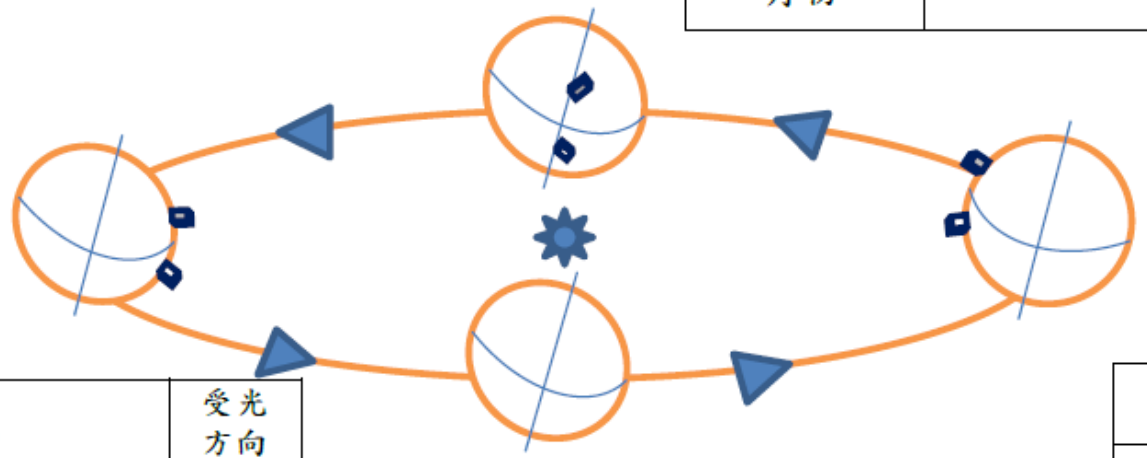
2		受光方向
a. 北半球		
b. 南半球		
月份		



3		受光方向
a. 北半球		
b. 南半球		
月份		

4		受光方向
a. 北半球		
b. 南半球		
月份		

1		受光方向
a. 北半球		
b. 南半球		
月份		

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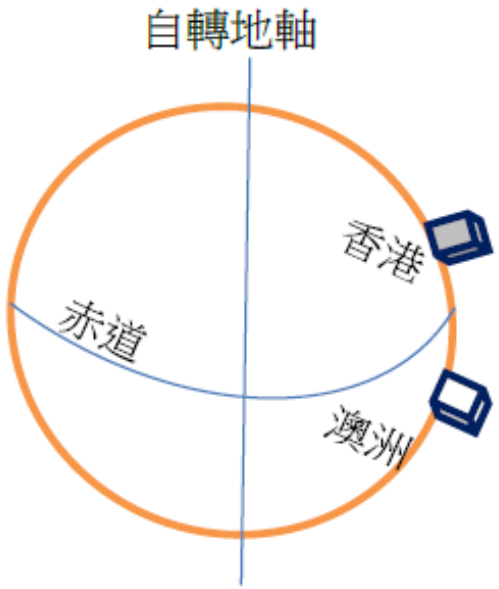
思考問題



如果地球自轉地軸沒有傾斜，地球將有什麼改變?

What would happened if the Earth's axis were not tilted?

_____

_____

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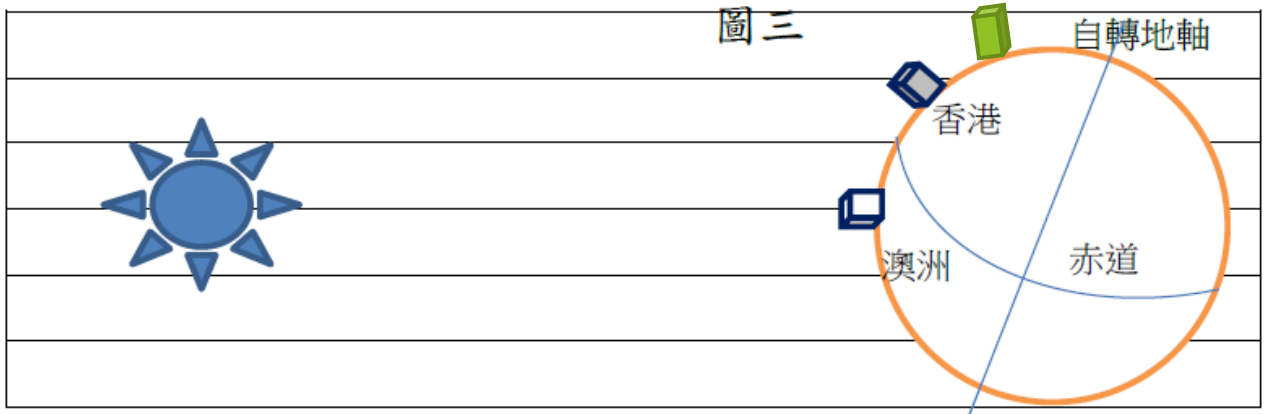
當陽光直射南半球，如圖三：



觀察在地球儀上香港和澳洲在電筒照射下受光角度。

	澳洲	香港	北京
受光角度	直射 / 斜射	直射 / 斜射	
受光面積	大 / 小	大 / 小	
溫度	高 / 低	高 / 低	
影子	長 / 短	長 / 短	
季節	夏 / 冬	夏 / 冬	
月分	6月 / 12月	6月 / 12月	
原因： 陽光照射	能量集中 / 能量分散	能量集中 / 能量分散	

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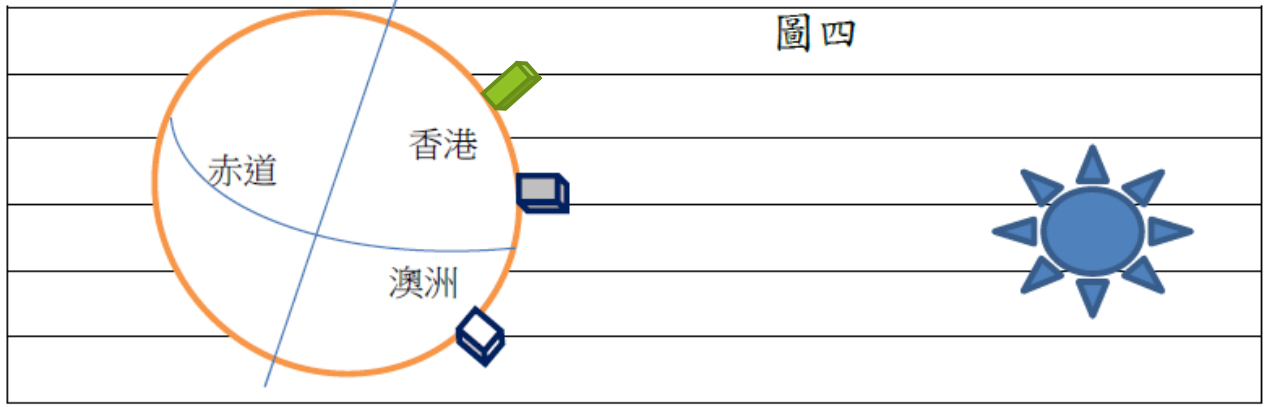
地球圍繞太陽公轉，轉到相反方向時，因為地軸傾斜，陽光直射方向改變，陽光直射北半球，如圖四。

圖四



觀察在地球儀上香港和澳洲在電筒照射下受光角度。

	澳洲	香港	北京
受光角度	直射 / 斜射	直射 / 斜射	
受光面積	大 / 小	大 / 小	
溫度	高 / 低	高 / 低	
影子	長 / 短	長 / 短	
季節	夏 / 冬	夏 / 冬	
月分	6月 / 12月	6月 / 12月	
原因： 陽光照射	能量集中 / 能量分散	能量集中 / 能量分散	

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Which of the following is the correct reason of seasonal changes?

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C. Earth facing to Sun is summer. Earth facing away from Sun is winter.
D. Strong sunlight is summer. Weak sunlight is winter.

79.2%

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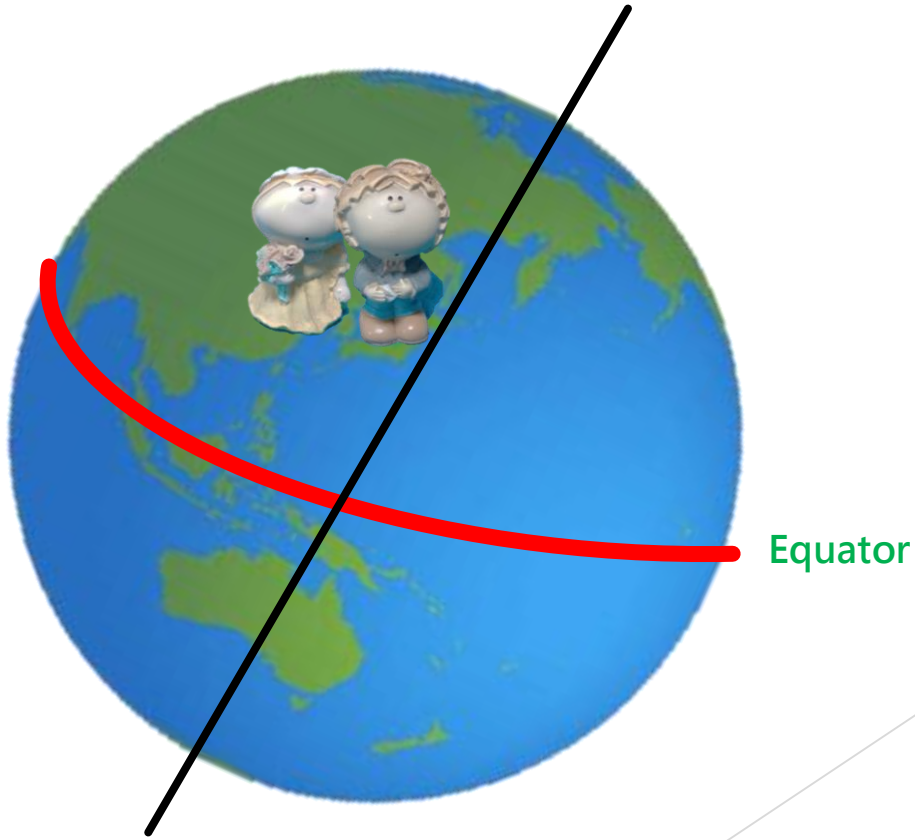
Discussion

1. **Concrete setting** makes the abstract idea more understandable and interesting for young kids.



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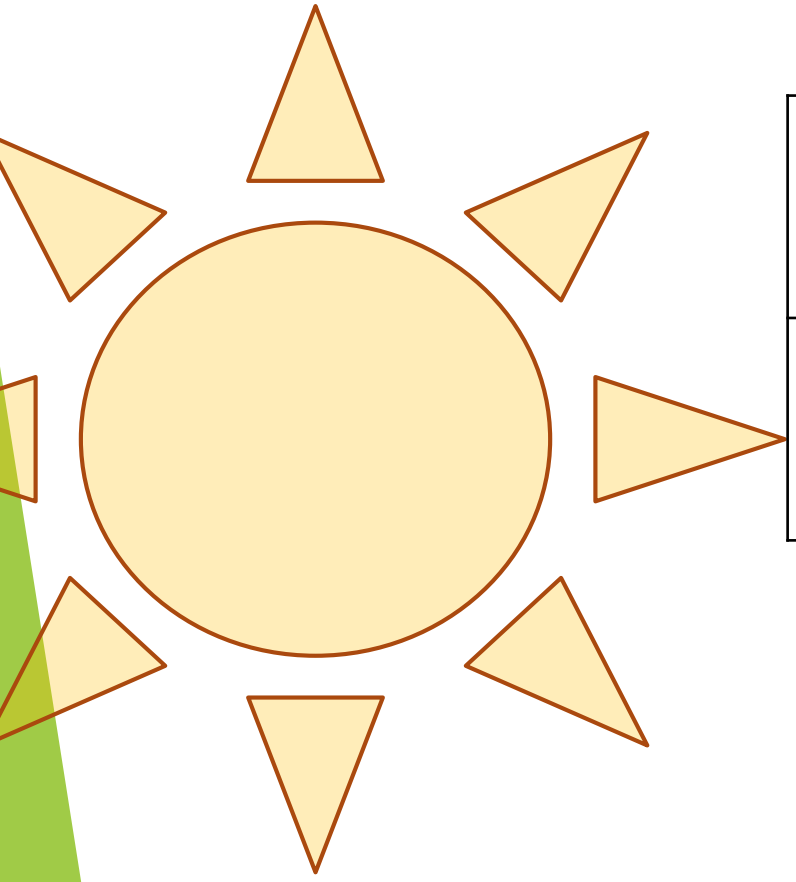
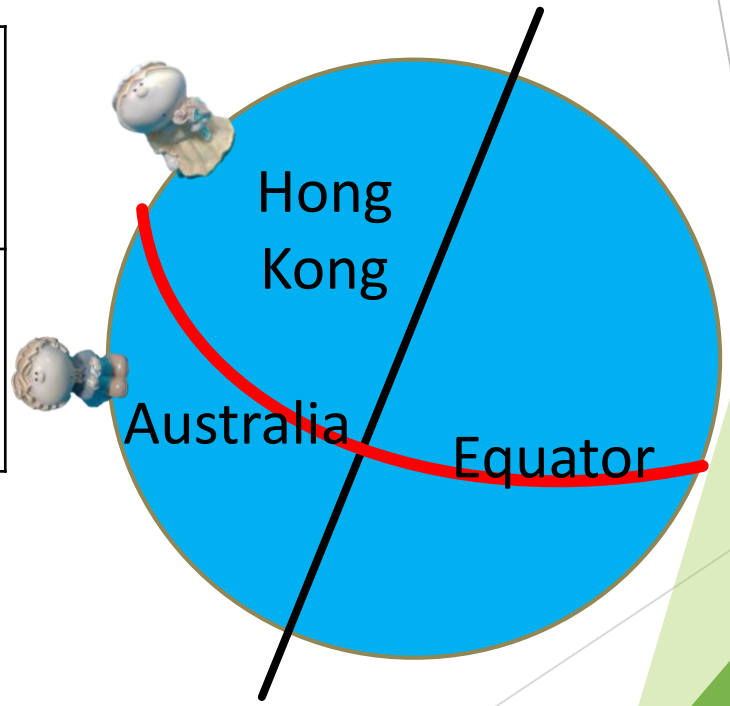
Discussion

2. **Curiosity** - a question/ a riddle for students to find the answer themselves.



A Winter	?
B Summer	?



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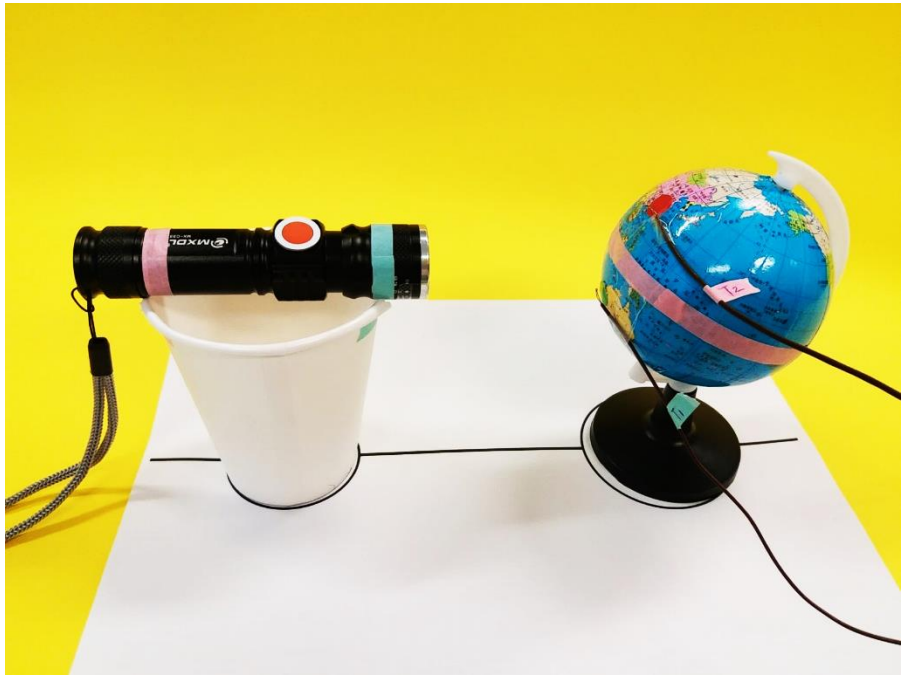
Discussion

3. **E-thermometer** allows precise measurement of temperature.



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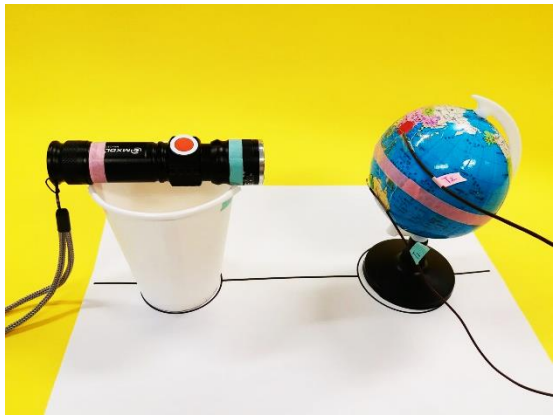
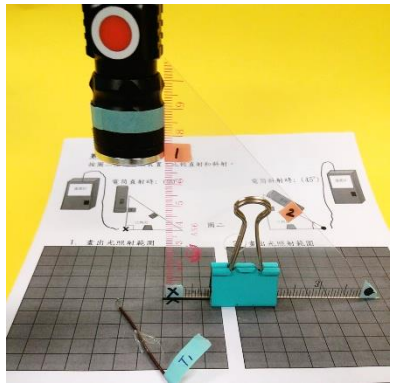
Discussion

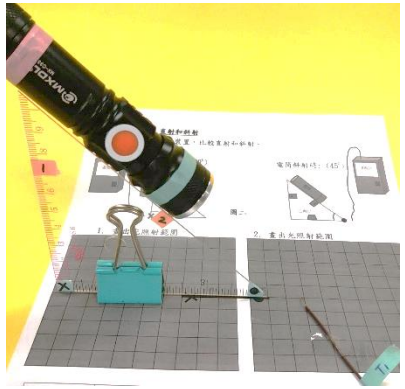
4. **Challenging but well structured**

Activity 1:

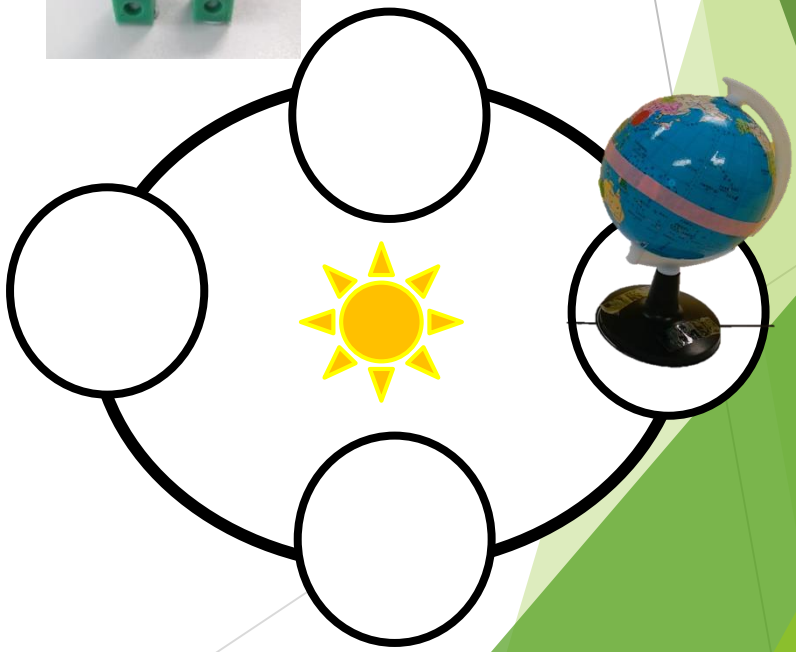


Activity 2:





Activity 3:



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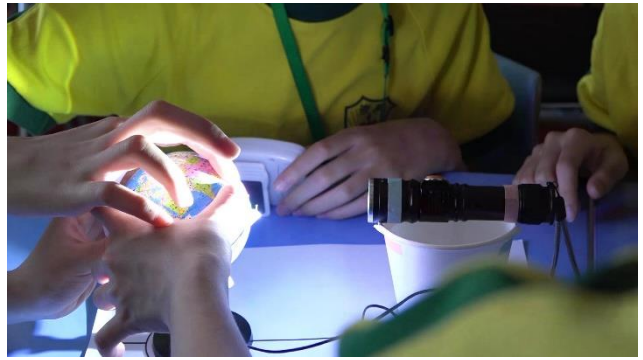
Discussion

5. **Co-operative learning** with different roles in the group work allows every student participates.



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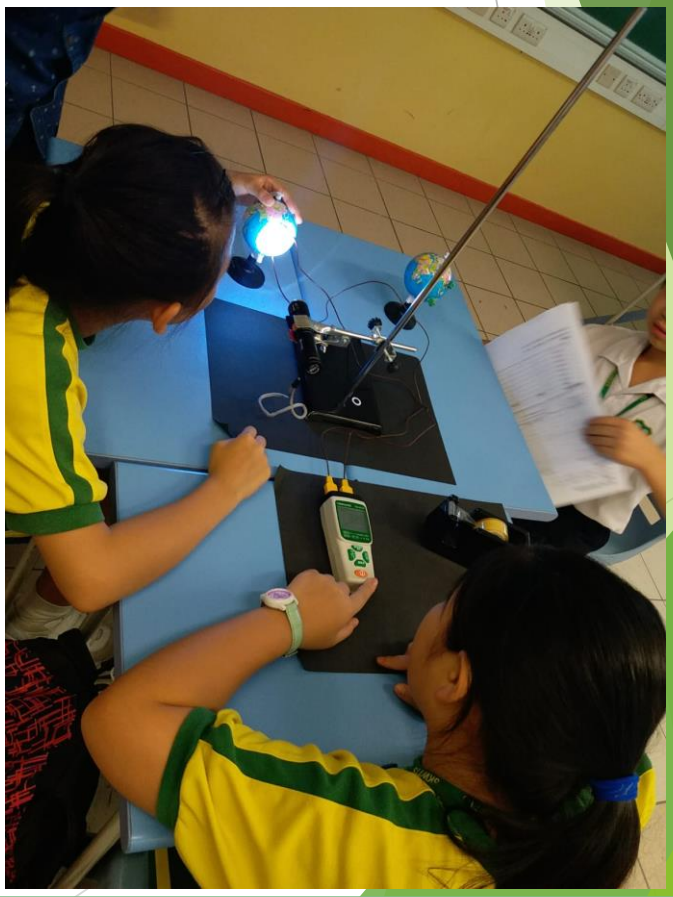
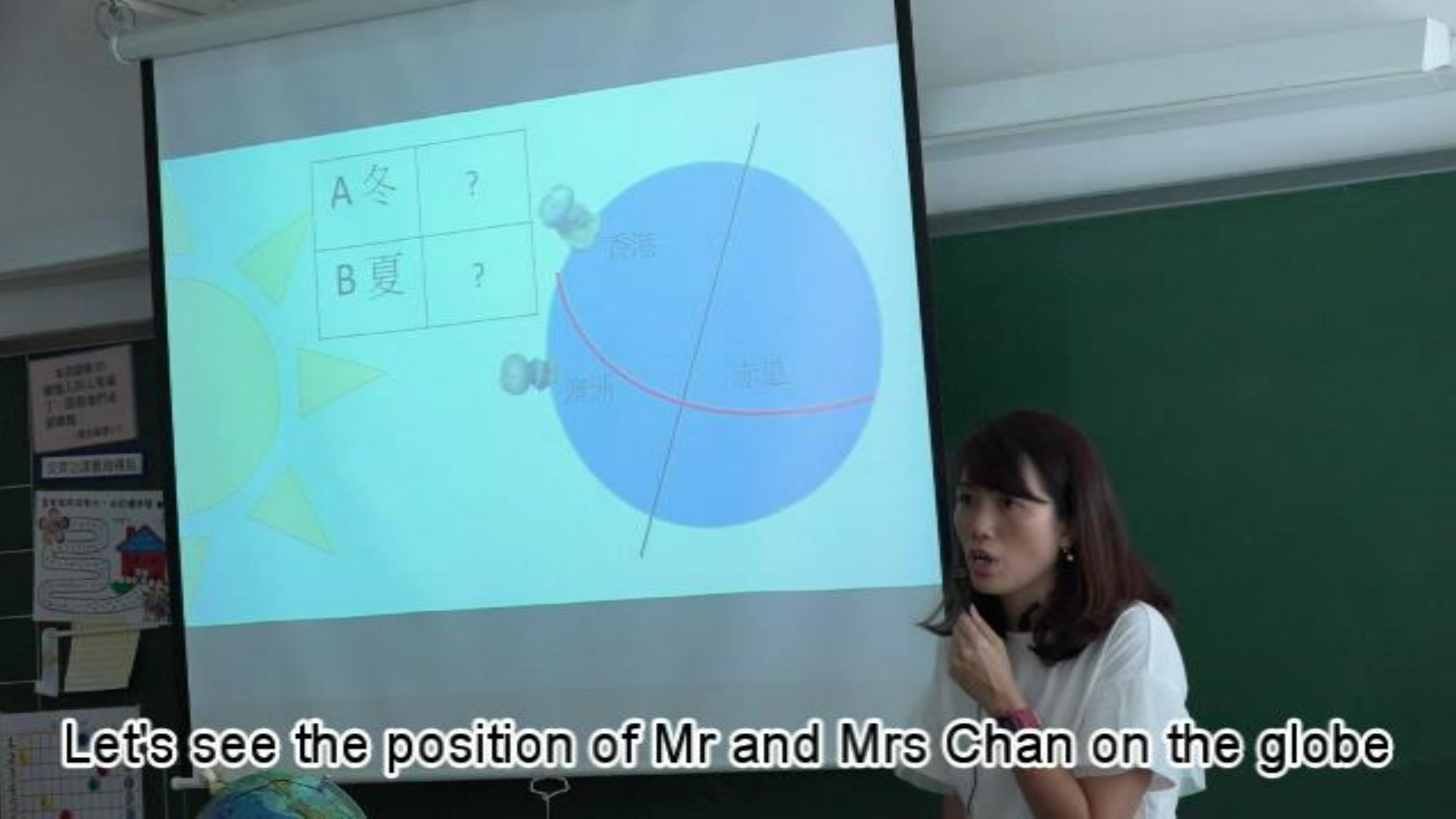
Discussion

6. **Hands-on experiment** is always a good idea.




A 冬 ?
B 夏 ?
Let's see the position of Mr and Mrs Chan on the globe

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Conclusion

There may be gifted students in every classroom. Some of them like morning stars in the sky but some of them like pearls in deep ocean.

- Some unexpected bright answers are found in average or underperforming students.
- Almost every student is aroused during the lesson.
- I see a lot of bright stars in class.

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