

Learning Critical Thinking Through Astronomy:
Extreme Shadows

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STUDENT NOTE

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Contents

Questions	2
Materials Needed	2
Points To Remember	2
1 Extreme Shadows	2
2 Inquiry	2
2.1 Vanishing Noon Shadows	2
2.2 Extremely Long Noon Shadows	4
2.3 Extremely Short Noon Shadows	5
3 Feedback	9

Questions

What are the dates of extreme length and direction of a stick's shadows at various locations?

Materials Needed

For this activity, you will need the following materials:

- a simulation of a stick's shadow
- a ruler
- a pencil (do not use ink)
- the ability to read and follow directions
- you must have previously completed either Activity0201 or Activity0202 (but you need not have completed both) and Activity0203.

Points To Remember

Instructions in this activity are open-ended compared to instructions in previous activities. That is because by now, you should be familiar with how to plan a procedure to answer a question that has been asked of you. You will likely be frustrated by this activity, but the experience is very important.

1 Extreme Shadows

We define an *extreme shadow* as one that vanishes, one that has a nonzero minimum length, or one that has a maximum length. For this activity, we are concerned with the lengths of noon shadows. We could also consider a sunrise or sunset shadow's extreme directions, maximum angle north of east for example, but we will not do so in this activity.

2 Inquiry

2.1 Vanishing Noon Shadows

1. Set the location to Quito (which also selects a few other places). Determine the date(s) on which a stick's **noon** shadow vanishes and record the date(s). Recall from a previous activity that *noon* has nothing to do with the reading on a clock. If there are no dates on which this happens, explicitly say so.

2. Are there any special days you may have previously heard about on or near the date(s) you found? If so, what days?

3. By trial and error, determine the **maximum** distance north (if you are on the northern hemisphere) or south (if you are on the southern hemisphere) of the location for which a stick's **noon** shadow vanishes on any date and record that location. It may help to bracket your search between a location for which the noon shadow vanishes and a location for which it does not vanish.

4. Does the location(s) you just determined look or sound familiar to you? Is it close to something that you may have previously heard about? If so, what and where?

5. At the location you just found, determine the date(s) on which a stick's noon shadow vanishes and record the date(s).

2.2 Extremely Long Noon Shadows

6. Set the location to Quito again. Determine the date(s) on which a stick's **noon** shadow's length is a maximum and record the date(s). Recall from a previous activity that *noon* has nothing to do with the reading on a clock.

7. Are there any special days you may have previously heard about on or near the date(s) you found? If so, what days?

8. Set the location to the extreme location you found earlier. Determine the date(s) on which a stick's **noon** shadow's length is a maximum and record the date(s).

9. Are there any special days you may have previously heard about on or near the date(s) you found? If so, what days?

10. Set the location to where you are right now (or the closest choice you have). Determine the date(s) on which a stick's **noon** shadow's length is a maximum and record the date(s).

11. Are there any special days you may have previously heard about on or near the date(s) you found? If so, what days?

12. Make a prediction about the date(s) on which a stick's **noon** shadow's length is a maximum regardless of location.

2.3 Extremely Short Noon Shadows

13. Set the location to Quito yet again. Determine the date(s) on which a stick's **noon** shadow's length is a minimum and record the date(s). Recall from a previous activity that *noon* has nothing to do with the reading on a clock.

14. Are there any special days you may have previously heard about on or near the date(s) you found? If so, what days?

15. Set the location to the new extreme location you just found. Determine the date(s) on which a stick's **noon** shadow's length is a minimum and record the date(s).

16. Are there any special days you may have previously heard about on or near the date(s) you found? If so, what days?

17. Set the location to your current location again. Determine the date(s) on which a stick's **noon** shadow's length is a minimum and record the date(s).

18. Are there any special days you may have previously heard about on or near the date(s) you found? If so, what days?

19. Make a prediction about the date(s) on which a stick's **noon** shadow's length is a minimum regardless of location.

20. What are the dates of extreme length and direction of a stick's shadows at various locations, regardless of location?

———— CHECKPOINT ————

21. Map this activity into as many of the elements of thought as you can.

22. Every activity will have at least one standard associated with it.

STANDARD

I can create a framework for describing the behavior of a stick's extreme shadows (shadows are of maximum or minimum length).

3 Feedback

What could be done to make this activity more interesting? Please be honest.