THE LAWN-CHAIR SCIENTIST: TEACHER GUIDE

Subject: Earth Science
Grade Level: Middle School
Last Updated: November 5, 2008

Case Summary

A miscalculation turns a backyard experiment into the talk of the town! Local news picks up a story about a 13-year old boy whose sister has accidentally sent him up into commercial flight paths in a balloon-covered lawn chair. The boy's misadventure includes a run in with a low-pressure system, exposure to the effects of extreme altitude, and local infamy as yet another individual who shuts down a nearby international airport.

Credits

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Learning Objectives

1. Identify the layers of the atmosphere, their altitude and characteristics.
2. Explain the relationship between wind and weather in the lower layers of the atmosphere.
3. Explain the role of air masses and water in weather systems.
4. Explain the effects of different altitudes on the human body.
5. Diagram and label atmospheric layers.
6. Describe major features of weather systems and what causes them.
7. Explain the physiological risks of ascending to extreme altitude.

Georgia Performance Standards

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science. (NSES Content Standard A)

S6E3. Students will recognize the significant role of water in earth processes. (NSES Content Standard D)

b. Relate various atmospheric conditions to stages of the water cycle.

Assessment

Students will produce a poster that tracks Marcus's journey, mapping him in the atmosphere, across metro Atlanta and in terms of his overall health.

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While the students will receive group grades, the teacher will include facilitator observations and student evaluations of their group members' participation and effort in her/his assessments. *See the **Self Evaluation Worksheet** in the Student Materials document*.

Implementation Strategy

This case is designed to take place over one 60-minute class session and four 90-minute class sessions. It has three scripted scenes, the third of which is mostly an epilogue. Students work in groups of 4-5 individuals. This case can be facilitated by one or two facilitators, because rather than placing a facilitator with every group, the students spend time brainstorming with their group and then as a whole class.

The brainstorming session described below involves students reading, discussing and taking notes in their groups in 10 minute blocks (totaling about 25 minutes per scene), then reconvening as a whole class to volunteer their observations, questions, hypotheses and learning issues (learning issues are things that students say they need to know or look up to define unknown terms, answer their questions, and/or test their hypotheses) at the end of every 10-minute block. During the group brainstorming, the teacher/facilitators float from group to group, checking progress and helping students with any stumbling blocks they may have. During the whole-class volunteering time, the teacher/one of the facilitators takes notes on an overhead or with a Smart Board. In this way, students can learn to work as a team while still benefiting from sharing their information as a whole class or even competing with other groups for volunteering, while the teacher can make sure that all students are at the same point in the case at each step.

This case was designed for approximately five days of implementation. This assumes a block schedule, where Tuesday-through-Friday classes are given ninety minutes, while the first day of the case (Monday) runs for sixty-minutes.

Day 1 – Read scene 1; fill out box chart, brainstorm and strategize.
Homework: Research scene 1 learning issues in textbook or online.

Day 2 – Discuss learning issues with group, share ideas and insights from homework (~20 min.). Computer Lab: explore PRISM-Columbia Middle webpage with useful links (~45 minutes). Read Scene 2 and start filling out box chart (~25 min.).
Homework: Finish scene 2 box chart; research learning issues in textbook, online and other resources of choice.

Day 3 – Compile research findings and discuss in groups (~45 min.)
In class **Activity**:

1. Fill 10-12 balloons with approximately the same amount of helium. Using water displacement in a large bucket, calculate the volume of helium in each balloon.
2. Tie 1g weights from a triple beam balance with string to enough helium balloons to lift the weight off the ground. Record the total He volume.

3. Multiply that volume by 3900 to calculate how much He would be required to lift Marcus off the ground (i.e., the *minimum* He needed), *then* multiply by 8500 to calculate how much He *actually* lifted him in Scene 1.

Day 4 – Work on poster (allow the group members to divide up tasks based on their individual strengths, i.e. artistic ability, writing skills).

Day 5 – Finish posters (~30 min.). Set up posters for group viewing (~20 min.); Read Scene 3 (~30 min.) group evaluation, case wrap-up (~20 minutes).

Case Notes

What Went Well:

1. The storyline – The students thought this was one of the dumbest ideas they'd ever read, which was great because they saw the humor in it right away and had a lot of fun acting out the scenes. The fact that it took place in Decatur and Atlanta also meant that they could intuit the direction of Marcus' flight with less difficulty than if it was in a place that was less familiar.
2. The DVD – Unbeknownst to us when we wrote this case, there is an independent film from New Zealand, available at most video stores, called *Danny Deckchair (2003),* about a man who conducts the same misguided lawn chair experiment and ends up halfway across his province. To provide a fun visual component of what we had written, we screened the scenes of Danny's lawn chair voyage in class using an LCD projector hooked up to a classroom computer. The students *really* enjoyed it, and it provided a perfect visual representation of what we had originally envisioned. Some of the students liked it so much they actually rented it on their own time (It's rated PG and was pre-screened in its entirety just to be safe)
3. The Web page: With links to the movie trailer as well as a multitude of Web resources (see **Resources**), the Web page provided fun and informative links and structured the students' research in a productive, portable way (i.e. anyone can access the Web site using any Web browser).

What Could Have Gone Better

1. Product-making – Perhaps because the storyline was a lot of fun and humorous and had the movie component to it, it was harder to keep the students on task towards the end of the case and during their poster construction, even though they seemed to be absorbing the material. While we wouldn't recommend making the case less fun, it's good to recognize this potential in advance.
2. Sadly, there was not enough time for the second activity because of unexpected changes in the standardized testing schedule. The second activity involved bringing the weighted balloons from their first activity outside and measuring the balloons' paths (tethered) with a homemade altimeter (See **Resources**) after monitoring weather patterns for several days prior and hypothesizing the altitude and trajectory).

Facilitator Guide

Sample Box Charts with Key Concepts Included:

Scene 1 Facilitator Box Chart

FACTS

1. Keisha is Marcus's sister
2. Marcus is held by a rope to a ketchup-stained lawn chair
3. 80 oversize balloons w/He are tied to the chair
4. Marcus weighs 39 kg, chair weighs 1 kg
5. Marcus has Keisha's BB gun
6. Keisha is planning for Marcus to go around the neighborhood
7. Marcus wants his notebook for LA homework
8. Keisha ties things to his chair
9. Keisha's friends are holding the chair down
10. Marcus takes off, wind blows him SW?
11. Sky is cloudless
12. At 12:30 pm, FAA announces unauthorized aircraft at 5km altitude is messing up flights
13. At 12:30 pm, Marcus' condition unknown
14. Marcus's mom thinks he's in the stratosphere
15. Marcus's dad thinks he's in the thermosphere
16. Keisha though Marcus weighs 85kg
17. Keisha's mom says she used the wrong unit

HYPOTHESES

1. Marcus and Keisha are just having fun
2. 80 balloons is necessary for Marcus's liftoff
3. Marcus is headed to south Atlanta
4. Helium is an elemental gas
5. Marcus is in the troposphere
6. Keisha used too much He by accident

QUESTIONS

1. Why are they doing this?
2. How many lbs is 39 kg? 1kg?
3. Why so many balloons?
4. Where is Marcus headed?
5. Why did he take off so fast?
6. How high is 5 km of altitude?
7. What is Helium? It's density?
8. Why did her friends need to hold down the chair?
9. What would happen if he shot the balloons?
10. What is the FAA?
11. What could be wrong with Marcus's condition?
12. What is the stratosphere? Is it cold? Does it have air? What altitude?
13. What is the thermosphere?

LEARNING ISSUES

1. Helium, Density of Helium
2. Stratosphere
3. Thermosphere
4. FAA
5. Units, conversions for lbs to kg.
6. Wind directionality
7. Amount of He needed to lift 40kg
8. Air temperature at 5 km
9. Can Marcus breathe/see clearly
10. Altitude
11. Homeland Security

Scene 2 Facilitator's Box Chart

FACTS

1. At 2:30 pm, chair is 20K ft. over H-J Intl. airport
2. At 2:30 pm, Marcus is unconscious
3. Marcus may be suffering from:
 - hypoxia - dehydration - vertigo
 - hypothermia - burst ear drum
4. At 3:30 pm, warm humid air from the gulf of Mexico ran into cooler westerly air from the Plains creating large thunderstorms
5. Severe storm warning issued; should stay inside and look for anvil-shaped clouds if outside

HYPOTHESES

1. Marcus is unconscious because there is not enough oxygen in the air at that altitude?
2. Marcus is unconscious because he's afraid

QUESTIONS

1. How many km is 20,000 ft?
2. Why is Marcus unconscious?
3. What is:
- hypoxia? - dehydration? - vertigo?
- hypothermia - burst ear drum?
4. How do air masses create thunderstorms?
5. What are air masses?
6. Where are the Great Plains?
7. What are westerly air masses?
8. What kind of storm is a category of severe?
9. What are anvil-shaped clouds?
10. What is an anvil?
11. Why would Marcus's eardrums burst?

LEARNING ISSUES

1. Converting feet to kilometers
2. Hypoxia, hypothermia, vertigo
3. Dehydration, burst eardrum
4. Air masses, westerly air masses
5. How thunderstorms form
6. Categories of storms
7. Anvils, anvil-shaped clouds
8. Central Plains

Scene 3 Facilitator Box Chart

FACTS

1. At 5:22pm, Marcus lands in downtown Macon
2. Several balloons pooped on their own @ 20K ft because of the low air pressure descended to 16K ft then regained consciousness, shot out more balloons
4. Marcus was airlifted to Grady Hospital
5. Marcus is in critical condition
6. Keisha was taken into custody
7. Marcus had the notebook, pen, BB gun

QUESTIONS

1. Where is Macon? How far away is it from Atlanta and/or Decatur?
2. Why did only some of the balloons 3. Marcus burst?
3. Why did Marcus regain consciousness?
4. Why did he need to be airlifted?
5. What is "critical condition?"
6. Why was Keisha arrested?

HYPOTHESES

1. The balloons that were filled to bursting burst because the gas in them expanded @ 20K ft
2. Macon is in Georgia
3. Marcus regained consciousness because there was more oxygen in the air at 16K ft vs. 20K ft.
4. Keisha was arrested because H-J Intl. had to ground all of its flights.

LEARNING ISSUES

1. Air pressure at different altitudes
2. Oxygen levels at different altitudes
3. Location of Macon

Resources

We found that assembling the most useful of the following online sources as links on a Web site that the students can access in the computer lab or at home is a very efficient way to structure group or independent research. Also, the students should be encouraged to utilize their textbooks or other resources. These are some helpful resources; a selection of these was included on the "Lawn Chair Scientist" page of the PRISM website under 8th grade Cases (www.prism.emory.edu/columbia).

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