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EDCI 54900 – Assessments in STEM

Research into Practice Project Final Paper

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The student I chose to observe is a 13-year-old homeschooled male, I will call Nathan. Nathan is in the 7th grade and has been homeschooled since the 3rd grade. Prior to homeschooling, he had tested into the Gifted and Talented (GT) program at his school (his twin brother also tested into the GT program and is currently in the GT program in the 7th grade in a public school). Nathan also has Attention Deficit Hypoactive Disorder (ADHD) and Oppositional Defiant Disorder (ODD). His ADHD has been factored into the curriculum his mom has chosen for him as well as the assessment I drafted for use later in this project.

The reason I chose him was due to time constraints and requirements for this assignment. The program I manage happened to be on a break, and finding students to work with was not a possibility. I have known Nathan for a long time, I even taught him in Sunday school when he was little, so this was a unique opportunity to see how he has grown over the years.

The unit Nathan was learning about had to do with water content in the air. It's a food science curriculum so there are also elements of cooking practices in with the science unit. For this lesson, Nathan was to complete 3 activities – boil plain water, documenting results; boil sugar water, documenting results; boil cornstarch water, documenting results. Unfortunately, due to an equipment malfunction, he was only able to complete the plain water and sugar water tests.

The curriculum was chosen by Nathan's mother who is also his teacher (Cox, 2019). We discussed what unit he was in, so I chose which assessment I wanted to observe as well as designing an assessment for him. The primary assessment strategies I used were informal, formative verbal discussions. Having worked with Nathan before, and having discussions with his mother on previous occasions, I knew writing was a struggle for him. From my observations, by the time he would start writing his thoughts down, the thought would sometimes disappear, which is frustrating to him. I did assessment of learning more than assessment for learning which Remsal (2011) describes as "a device

capable of promoting reflection and change in education by monitoring both, teaching and learning" (p. 473). Because I was not the teacher, there wouldn't have been follow up sessions in which to adapt based on information on the assessment from learning.

From my observations, Nathan is a student that needs to be actively doing something to keep his attention. When it came to setting everything up, he would sometimes be involved, and other times he would just look around in the kitchen. His mother was the one setting things up, the most he did was adding water when asked. However, when it came to taking the recordings of the temperature, he was diligent in recording his findings, engaged in watching the numbers rise. To keep him engaged, and to prevent long discussions, I would ask questions while his mom would reset the experiment. In fairness, this experiment did involve a hot pan.

I can say that Nathan does understand the concepts of humidity in the air and dew point. He was able to articulate several different ways to describe moisture in the air, even if it took a few tries to convey what he was thinking. One observation Nathan had during the boiling water test was that he saw heat coming from the pan. When I asked him about it at the time, he said it was hot air, not water vapor. During the interview, I asked him to clarify. "When I think of steam, I think of a cloud. When I put my hand over and I don't feel wet, it's a dry steam." He went on to describe a cloud in a chamber he felt at a science museum, when the air was cooler and wet. He also did note as the water started to boil, he saw steam coming from the pan.

While his answer wasn't fully elaborated or articulated, I believe this to be evidence that he has understood how air sometimes can have varying amounts of water content. He understands that as the water heated, it did eventually release steam. I believe what he was seeing as the "dry steam" was actually just heat waves coming from the pan. This interview worked as a formative assessment. "For an assessment to be considered formative, it must be used to make decisions about next steps, to plan

instruction, and to help learners reflect upon their thinking" (Tugel, n.d., p. 2). Through this interview, I was able to help him process what he meant with his comments about water vapor and steam, helping to bring together what he knows with what he can see and feel.

For his second assessment, he collected temperature, dew point, and humidity readings for where he lives, predictions for where he was travelling to during his Thanksgiving break, and then was asked to use the data to make a prediction. He was then to record the actual values where he was at. This exercise showed he was able to analyze the data to make an educated prediction.

The main activity I ended up using as the basis for the final feedback discussion was for him to give an example and teach me about humidity or dew point. Lalley and Miller (2007) explain that when students engage in peer tutoring, or teaching what they have learned, "it provides opportunities to overlearn the material and engage in higher levels of thinking, and/or develop certain social skills" (p. 75). Through this activity, Nathan was able to describe several ways to explain humidity in the air. This allowed me to ask pointed follow up questions to ascertain whether he understood what he was talking about. For example, he mentioned how a cold glass of water can get condensation on the outside, so I asked what in the environment would have to change for a cold glass not to have condensation. It took a while, with him thinking and asking clarifying questions for him to go on explaining how if the air temperature is colder like in a freezer, or if there's less humidity in the air, then there would be less condensation. Being able to synthesize these concepts is important, because "…any STEM competency construct must go beyond the recall of isolated, factual knowledge or procedures" (Douglas et al, 2020, p. 235).

As for feedback, I did it similarly to how I did his assessment, through conversation. We discussed his findings during the first meeting, and I commented then about how he made the appropriate correlations in the data as well as brainstorming other things that could be done to

troubleshoot when the equipment failed. The second round of feedback was conducted over Microsoft Teams, after he turned in his work from Thanksgiving break and taught me about what he knows about humidity. I observed he was more focused on the conversation with the Teams call than when we were in person. Perhaps this was due to the extra stimulation of using technology, or the removal of distractions as it was just him, me, and his mom on the call, or it could have been the promise of seeing around my cubicle when we were done. Regardless, it was a productive discussion.

Given the limited time of this project, there was not much time to demonstrate whether the feedback was helpful. “As feedback, comments are only useful if pupils use them to guide further work…” (Black & Harrison, 2001, p. 59). Additional feedback I would like to give to Nathan would be in writing and ongoing over a longer period of time. “No one approach to assessment can evaluate everything that is important in achieving integrated STEM competence” (Douglas et al, 2020, p. 250).

Regarding assessments with students with ADHD, this can be difficult. Often, accommodations in school will include extra time for testing. This may help for some, but for others that may just prolong the testing period with no benefit. If the test must be a written test, one accommodation could be chunking, where they would do just a small part of the test at a time. This could be accomplished by handing just part of the test out at a time, possibly preventing overwhelming a student who may struggle to start taking a test because the whole test seems like too daunting a task. They may also need a quiet space to work in, although if the space is new, that, too, could be a distraction. Kewley and Taylor (2010) suggest that “possibly the use of a scribe during examinations” or voice dictation software (p. 73). Assessment is a complex topic that needs to factor in the reason for the assessment as well as the student themselves.

References

Black, P., & Harrison, C. (2001). Feedback in questioning and marking: the science teacher's role in formative assessment. *School Science Review, 82*(301), 55-61. Black Harrison - Science 2001.pdf

Cox, D. (2019). *Introduction to food science: Water workbook* (2nd edition). Beakers & Bricks, LLC.

Douglas, K. A., Gane, B. D., Neumann, K., & Pellegrino, J. W. (2020). Contemporary methods of assessing integrated STEM competencies. In C. C. Johnson, M. J. Mohr-Schroeder, T. J. Moore, & L. D. English, *Handbook of research on STEM education* (pp. 234-254).

Kewley, G., & Taylor, &. F. (2010). *Attention deficit hyperactivity disorder: What can teachers do?.* Taylor & Francis Group.

Lalley, J. P., & Miller, R. H. (2007). The learning pyramid: does it point teachers in the right direction? *Education, 128*(1), 64+. https://link-gale-com.ezproxy.lib.purdue.edu/apps/doc/A169960867/AONE?u=purdue_main&sid=bookmark-AONE&xid=b9377f95

Remesal, A. (2011). Primary and secondary teachers' conceptions of assessment: A qualitative study. *Teaching and Teacher Education, 27*(2), 472-482. https://doi.org/10.1016/j.tate.2010.09.017

Tugel, J. (n.d.). *Using formative assessment to uncover how students think about science (white paper).* https://www.mheducation.com/unitas/school/explore/sites/inspire-science/formative-assessment-ngss-white-paper.pdf

Appendix

Quotes from November 17, 2023 meeting

Hypothesis for sugar water – “will boil at a higher temperature because the sugar molecules are part of the water, and it will take longer to get to 200 degrees”

Observations – “it’s going more slowly, maybe the water is evaporating”

“the bubbles look like google eyes” – he noted the difference in size in the bubbles as the temperature increases

“the sugar water was more gradual”

“it took longer to get to the boiling point with sugar”

Why would water be gone by 400 degrees? “It would evaporate”

What is coming off the pot? “heated air, not water vapor”

What is the difference between heated air and steam?

“When I think of steam, I think of a cloud. When I put my hand over, I don’t feel wet. It’s dry steam. But in this cloud chamber at the museum, I could put my hand in a cloud and it felt wet.”

Quotes from November 30, 2023 meeting

0:2:15.280 --> 0:2:26.900
Vandergraff, Mary Jean
So alright, so the one thing I wanted to talk about today while we are here is you came up with, I gave you an assignment of looking at different I see him.

0:2:28.910 --> 0:2:29.170
Nathan
I'll just.

0:2:29.10 --> 0:2:38.860
Vandergraff, Mary Jean
Looking at different ways to explain dew point and humidity, and I saw for Mom's paper you came up with a bunch of them.

0:2:38.910 --> 0:2:41.330
Vandergraff, Mary Jean
So that's awesome because there are lots of different ways.

0:2:40.930 --> 0:2:44.530
Nathan
By the way, the little cloud maker or thing that I was talking about.

0:2:44.960 --> 0:2:45.180
Vandergraff, Mary Jean
Yeah.

0:2:50.210 --> 0:2:50.430
Vandergraff, Mary Jean
Mm-hmm.

0:2:46.340 --> 0:2:53.460
Nathan
Over at the UM Houston Museum of Natural Science, they have a little bit on.

0:2:55.310 --> 0:3:2.70
Nathan
They have a little station where it's like you can actually learn how clouds are made.

0:3:11.910 --> 0:3:12.140
Vandergraff, Mary Jean
Mm-hmm.

0:3:18.690 --> 0:3:19.10
Vandergraff, Mary Jean
OK.

0:3:3.860 --> 0:3:20.60
Nathan
I just a little old thingy and then it shows below that if you press the button the little thing it will start running and it'll start making a little steam cloud and it's actually wet and you can actually see the cloud.

0:3:20.790 --> 0:3:22.270
Vandergraff, Mary Jean
Can you put your hand in the cloud or?

0:3:22.900 --> 0:3:23.40
Nathan
Yes.

0:3:24.50 --> 0:3:25.810
Vandergraff, Mary Jean
OK, very cool.

0:3:26.190 --> 0:3:27.60
Vandergraff, Mary Jean
So what did they say?

0:3:27.70 --> 0:3:29.270
Vandergraff, Mary Jean
How did how did clouds get made?

0:3:30.130 --> 0:3:31.50
Vandergraff, Mary Jean
Do you remember what they said?

0:3:33.850 --> 0:3:36.120
Nathan
Have me doesn't have a mean.

0:3:36.130 --> 0:3:38.800
Nathan
Doesn't actually read the stuff, it actually.

0:3:39.190 --> 0:3:45.970
Nathan
Basically, usually I don't even really read the stuff I usually just hit the button I like to hit the button first.

0:3:47.290 --> 0:3:50.250
Vandergraff, Mary Jean
That would be called an observational assessment.

0:3:50.370 --> 0:3:51.870
Nathan
What I am not?

0:3:51.500 --> 0:3:55.830
Vandergraff, Mary Jean
You are observing and observing what happens.

0:3:57.450 --> 0:3:57.840
Nathan
Yeah.

0:3:56.20 --> 0:3:59.250
Vandergraff, Mary Jean
That is totally cool and I tend to be that.

0:3:57.850 --> 0:4:0.260
Nathan
No, I'm a total bookworm ohm.

0:4:0.930 --> 0:4:3.410
Nathan
Basically, you know, I'm pretty much a total bookworm.

0:4:6.890 --> 0:4:12.340
Nathan
I like to see things happen in better than reading about them.

0:4:13.10 --> 0:4:15.130
Nathan
At least first because.

0:4:18.210 --> 0:4:18.570
Nathan
Well.

0:4:21.380 --> 0:4:22.930
Nathan
Ask the people in the world old.

0:4:22.940 --> 0:4:25.400
Nathan
I've definitely heard of the saying.

0:4:27.480 --> 0:4:29.410
Nathan
A picture is worth 1000 words.

0:4:29.900 --> 0:4:30.130
Vandergraff, Mary Jean
Mm-hmm.

0:4:29.840 --> 0:4:33.0
Nathan
It's like I like seeing things.

0:5:52.10 --> 0:5:53.880
Vandergraff, Mary Jean
What you pick to demonstrate?

0:5:54.150 --> 0:5:57.190
Vandergraff, Mary Jean
How does that explain anything about dew point?

0:5:59.130 --> 0:6:0.910
Nathan
So you explained it to me when we wrote.

0:6:0.920 --> 0:6:5.280
Nathan
It doesn't really explain it that much, I I I.

0:6:5.930 --> 0:6:6.790
Vandergraff, Mary Jean
Or demonstrate it.

0:6:8.50 --> 0:6:8.510
Nathan
Well, it's.

0:6:12.360 --> 0:6:12.990
Nathan
Well, you.

0:6:15.650 --> 0:6:19.120
Nathan
You saw the part about how I wrote down hot shower, right?

0:6:19.710 --> 0:6:19.990
Vandergraff, Mary Jean
Mm-hmm.

0:6:21.320 --> 0:6:22.910
Nathan
Yeah, it it.

0:6:22.920 --> 0:6:29.130
Nathan
Basically, it raises the humidity in the room when I do the hot.

0:6:29.170 --> 0:6:30.440
Nathan
When I make when I.

0:6:32.430 --> 0:6:38.440
Nathan
When I take a hot shower, it definitely humidifies up the room.

0:6:39.270 --> 0:6:39.510
Vandergraff, Mary Jean
Yep.

0:6:40.100 --> 0:6:41.990
Nathan
It's like my window gets blurry.

0:6:42.0 --> 0:6:43.330
Nathan
My mirror gets blurry.

0:6:44.460 --> 0:6:49.300
Nathan
Things get sorry, man. Like.

0:6:48.490 --> 0:6:50.880
Vandergraff, Mary Jean
OK, what do you what do you mean by blurry?

0:6:52.250 --> 0:6:52.730
Nathan
Well.

0:6:55.330 --> 0:6:57.150
Nathan
Water condenses on them and they.

0:7:1.130 --> 0:7:3.540
Nathan
Well, it's water on a window.

0:7:9.650 --> 0:7:10.150
Vandergraff, Mary Jean
Very true.

0:7:3.550 --> 0:7:10.210
Nathan
You can't see that well when it's on window and making it sort of fog too kind of thing.

0:7:10.690 --> 0:7:11.770
Nathan
Yeah, condensation.

0:7:12.420 --> 0:7:15.120
Vandergraff, Mary Jean
Yep, very true. Yep.

0:7:16.910 --> 0:7:17.290
Vandergraff, Mary Jean
OK.

0:7:18.520 --> 0:7:19.600
Vandergraff, Mary Jean
Well, that's a good example.

0:7:19.610 --> 0:7:30.500
Vandergraff, Mary Jean
Yeah, because as you explained, it's that once the humidity starts going up, that affects the dew point and then you know the condensation comes in.

0:8:0.770 --> 0:8:2.980
Nathan
I've seen it like when my UM.

0:8:5.480 --> 0:8:7.810
Nathan
I see it in action with my color changing.

0:8:7.820 --> 0:8:9.180
Nathan
What water cups?

0:8:9.190 --> 0:8:12.380
Nathan
I mean it or drink cabs.

0:8:18.920 --> 0:8:19.180
Vandergraff, Mary Jean
OK.

0:8:12.390 --> 0:8:21.70
Nathan
It's like you just you just pour the stuff in and it changes color right there because it changes color with the cold.

0:8:22.290 --> 0:8:22.930
Nathan
It's a lot of good.

0:8:22.730 --> 0:8:23.460
Vandergraff, Mary Jean
Very true.

0:8:23.770 --> 0:8:26.80
Vandergraff, Mary Jean
So that's that would be the temperature.

0:8:26.710 --> 0:8:26.990
Nathan
Mm-hmm.

0:8:26.570 --> 0:8:34.40
Vandergraff, Mary Jean
So is it possible then for stuff to be cold and not have condensation on the outside?

0:8:36.410 --> 0:8:36.550
Nathan
Yes.

0:8:38.350 --> 0:8:39.450
Vandergraff, Mary Jean
Can you think of an example?

0:8:42.990 --> 0:8:43.450
Nathan
Umm.

0:8:51.210 --> 0:8:53.690
Nathan
Sometimes cold metal basically.

0:8:56.280 --> 0:8:56.560
Vandergraff, Mary Jean
Umm.

0:8:57.700 --> 0:8:58.720
Nathan
This is it's just.

0:9:2.180 --> 0:9:2.890
Vandergraff, Mary Jean
So what?

0:9:2.900 --> 0:9:8.730
Vandergraff, Mary Jean
What would have to be around the cold metal for it not to be condensed to not have condensation?

0:9:9.380 --> 0:9:11.40
Vandergraff, Mary Jean
What would be the environment be like?

0:9:11.730 --> 0:9:12.250
Nathan
Well.

0:9:14.830 --> 0:9:17.890
Nathan
Basically it's like I remember that it's basically like.

0:9:20.70 --> 0:9:21.710
Nathan
If you put something in a freezer.

0:9:24.250 --> 0:9:25.980
Nathan
It's not gonna come and sit.

0:9:26.30 --> 0:9:29.610
Nathan
It's not gonna condensate because the water molecules.

0:9:31.810 --> 0:9:36.590
Nathan
In the air are two frozen and move on to the on to the thing.

0:9:39.540 --> 0:9:41.930
Nathan
Plus. Umm.

0:9:45.470 --> 0:9:45.870
Nathan
Well.

0:9:48.810 --> 0:10:1.720
Nathan
All the water in the air in a freezer, it just goes down to the ground and just should there, as ice usually sometimes do.

0:10:1.790 --> 0:10:5.320
Nathan
Do you remember about the inside versus the outside?

0:10:6.870 --> 0:10:10.160
Nathan
Ohh, I'd like the glass or of the container.

0:10:11.530 --> 0:10:13.130
Nathan
What do they have to be in order?

0:10:14.690 --> 0:10:16.920
Nathan
So then do not contain condensed.

0:10:17.220 --> 0:10:17.880
Nathan
That's a weird word.

0:10:18.520 --> 0:10:19.210
Vandergraff, Mary Jean
Yeah.

0:10:19.520 --> 0:10:22.620
Vandergraff, Mary Jean
In order for condensation not to occur, how about that?

0:10:22.970 --> 0:10:23.470
Nathan
There you go.

0:10:25.540 --> 0:10:27.640
Nathan
What was the poll question?

0:10:27.750 --> 0:10:33.780
Nathan
So like when you had something cold like you're cold glass of water or cold something, it's cold substance.

0:10:34.330 --> 0:10:39.480
Nathan
What have the inside the, the glass or the inside of the glass and the outside of the glass?

0:10:39.490 --> 0:10:45.470
Nathan
What do they both have to be in order for it to not condensate condensation?

0:10:45.480 --> 0:10:47.460
Nathan
To not occur the same temperature.

0:10:50.510 --> 0:10:50.750
Vandergraff, Mary Jean
Yeah.

0:10:49.680 --> 0:10:54.880
Nathan
Or it can be a little colder than the actual average temperature and not condensate.

0:10:58.260 --> 0:10:59.520
Vandergraff, Mary Jean
What else might be a factor then?

0:11:2.670 --> 0:11:6.180
Vandergraff, Mary Jean
If the temperature is slightly different but there isn't condensation.

0:11:21.300 --> 0:11:23.0
Nathan
Ah.

0:11:23.90 --> 0:11:26.230
Vandergraff, Mary Jean
It's kind of another backwards way of just asking kind of the same questions.

0:11:28.910 --> 0:11:33.800
Vandergraff, Mary Jean
So if you think about it, when things condensate, that's because there's what in the air.

0:11:35.140 --> 0:11:35.400
Nathan
Water.

0:11:36.180 --> 0:11:36.460
Vandergraff, Mary Jean
Yep.

0:12:49.240 --> 0:12:55.980
Vandergraff, Mary Jean
If you think about it, you were talking about that there could be a slight temperature difference and still not have condensation.

0:12:55.990 --> 0:13:4.400
Vandergraff, Mary Jean
And that's true if you think if there isn't that humidity in the air, then that would be another reason why why we wouldn't have condensation.

0:13:5.240 --> 0:13:10.810
Nathan
Also wanted on something cool that I that I get it cool that I've done before.

0:13:11.940 --> 0:13:12.110
Vandergraff, Mary Jean
What?

0:13:11.840 --> 0:13:12.310
Nathan
Umm.

0:13:12.420 --> 0:13:13.650
Nathan
Basically, UM.

0:13:14.850 --> 0:13:21.30
Nathan
I had uh, basically, sometimes I well.

0:13:24.490 --> 0:13:26.950
Nathan
When there's like cold water and a little water bottle.

0:13:27.700 --> 0:13:27.950
Vandergraff, Mary Jean
Umm.

0:13:31.320 --> 0:13:33.330
Nathan
And the CAP is off sometimes.

0:13:33.170 --> 0:13:33.460
Vandergraff, Mary Jean
Umm.

0:13:43.780 --> 0:13:44.50
Vandergraff, Mary Jean
Umm.

0:13:35.40 --> 0:13:46.60
Nathan
Sometimes if I actually like blow into the water bottle like like a slow like that thing. UM.

0:13:48.250 --> 0:14:0.140
Nathan
Steam could actually come out because it because the water is so cold and my breath is warm, it acts just like it does on a winter day.

0:14:0.150 --> 0:14:3.910
Nathan
It sort of condensates in the air.

0:14:11.780 --> 0:14:20.160
Vandergraff, Mary Jean
You gave me a lot of great examples and part of the reason that we were just this is more just a conversation rather than giving a formal presentation.

0:14:28.110 --> 0:14:28.370
Nathan
And.

0:14:21.910 --> 0:14:35.860
Vandergraff, Mary Jean
Just so that you know, we can talk it out and you know just to hear you explain it, cause there is the thought that if you can explain it to somebody, then you really understand the material.

0:14:37.450 --> 0:14:44.460
Vandergraff, Mary Jean
So you know, it's one thing to read it in a book and remember it, but if you can, then explain it to somebody, you have a really good understanding of it.

0:14:45.90 --> 0:14:45.290
Nathan
Yeah.

Pages from "*Introduction to food science: Water workbook*" (Cox, 2019)

EXPERIMENTS: LET'S MAKE A MESS!

Boiling #1: Boiling Point and Water Solutions

Background

Some molecules affect the colligative properties of water, while others don't. In this experiment, you'll see examples of both.

Items Needed

- 1 candy thermometer with a pan clip
- 1 cup sucrose (normal white table sugar)
- 2 tablespoons cornstarch
- Water
- Small saucepan
- Spoon
- Graph paper and a pen or pencil

Procedures

Note: If you completed Stuff in Water Experiment #2, *you can use your data for Parts A and B from that experiment, and skip to Part C.*

Part A

1. Add 1 cup of water to the saucepan.
2. Clip the candy thermometer to the pan's side.
3. Record the beginning water temperature.
4. Place the pan on the stove and begin heating on medium heat.
5. Record the temperature every 60 seconds (every minute).

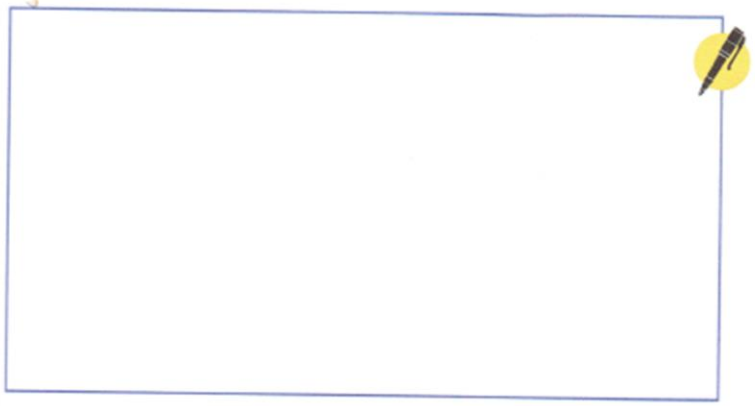
6. Once the water begins to boil, continue to record the temperature every 30 seconds for an additional 4 minutes.
7. Turn off the heat and let the water stand until it is cool enough to safely dump down the drain, around 100°F.
8. Discard the water and let the pan cool in preparation for Part B
9. Record any observations you haven't already written down.

10. Create a graph with temperature on the y-axis and time on the x-axis.

Part B

1. Add sugar and water to the saucepan.
2. Clip the candy thermometer to the pan's side, with the tip in water and sugar, but not touching the pan bottom.
3. Record the beginning temperature.

4. Place the pan on the stove and begin heating on medium heat.
5. While heating, record the temperature every 60 seconds.
6. Make a note on your data sheet when the mixture begins to boil.
7. Continue recording the temperature until the mixture reaches 250°F.
8. Turn off the heat and let the contents cool to 150°F. At this point you can wash what's left down the sink, or use it as a syrup. To make candy, you'd need to continue heating and evaporating off more water, and add flavoring.
9. Record any observations you haven't already.



10. Create a graph with temperature on the y-axis and time on the x-axis.

Part C

1. Add 2 cups of cold water in the saucepan.
2. Stir in 2 tablespoons of cornstarch.
3. Picture: 66, Raw cornstarch
4. Clip the thermometer to the pan's side.
5. Record the starting temperature, and begin heating on medium heat, recording the temperature approximately every 60 seconds.

Boiling #1 Discussion: Boiling Point and Water Solutions

Part A

Your graph for water should show the temperature rising steadily until it approaches boiling (at or near 212°F, depending on your altitude), at which point the temperature levels off and no longer rises. This remains the case until all the water has been boiled off, phase changing into steam, which we didn't do in this experiment.

Convection currents: Natural currents in substances associated with gravity and density. Portions of a substance that are warmer than other portions are less dense and tend to rise, if conditions allow it, promoting convective mixing.

Part B

This graph is very different than the one created in Part A, with boiling not occurring until the temperature was higher than 212°F, rising steadily as water flashed off through evaporation, which you'll recall from Chapter 2. Sucrose does not evaporate, only water does, so the solution becomes more concentrated. These charted differences are additional evidences of the boiling point elevation rule. Note: From the observed boiling point, you can calculate the sucrose syrup's concentration.

Part C

This graph should be similar to the graph in Part A, but might become variable once the product began to boil. You may have seen temperatures fluctuating or changing. An explanation is that as the starch gelatinizes and causes the dispersion to become thick, *convection currents* are hindered, creating hot and cold spots in the mixture.

Since cornstarch in water is a colloidal dispersion and not a true solution, the colligative properties, including the boiling point, aren't affected.

Thick things burn: lack of convection currents allows localized areas to move past 212°F to temperatures that will scorch and burn the product even though there's water a very short distance away.

NOTE: Be extremely careful as you proceed! When the mixture beings to boil, it tends to foam and boil over. If this starts to happen, reduce the heat or slide it off the burner temporarily, or both.

6. Continue heating and recording your observations for 3 minutes after the mixture starts to boil.

7. Remove the pan from the heat and let it cool while you record your observations.

8. Create a graph with temperature on the y-axis and time on the x-axis.

Examples of Nathan's work

Dew Point, Humidity, and Temperature - What's the Point?

Since you are going to be traveling where you may experience different weather, I want you to gather some information before you leave and while you are on your trip.

Before you leave...

Date	11/21/23
Current temperature where you live	57°F
Current humidity where you live	66%
Current dew point where you live	45°
What date will you observe the weather on vacation?	11/22/23
What is the predicted temperature?	50-60
What is the predicted humidity?	same
What is the predicted dew point?	same
Based on the information you know, do you think it will rain?	no
Why or why not?	no rain in sight + too cold

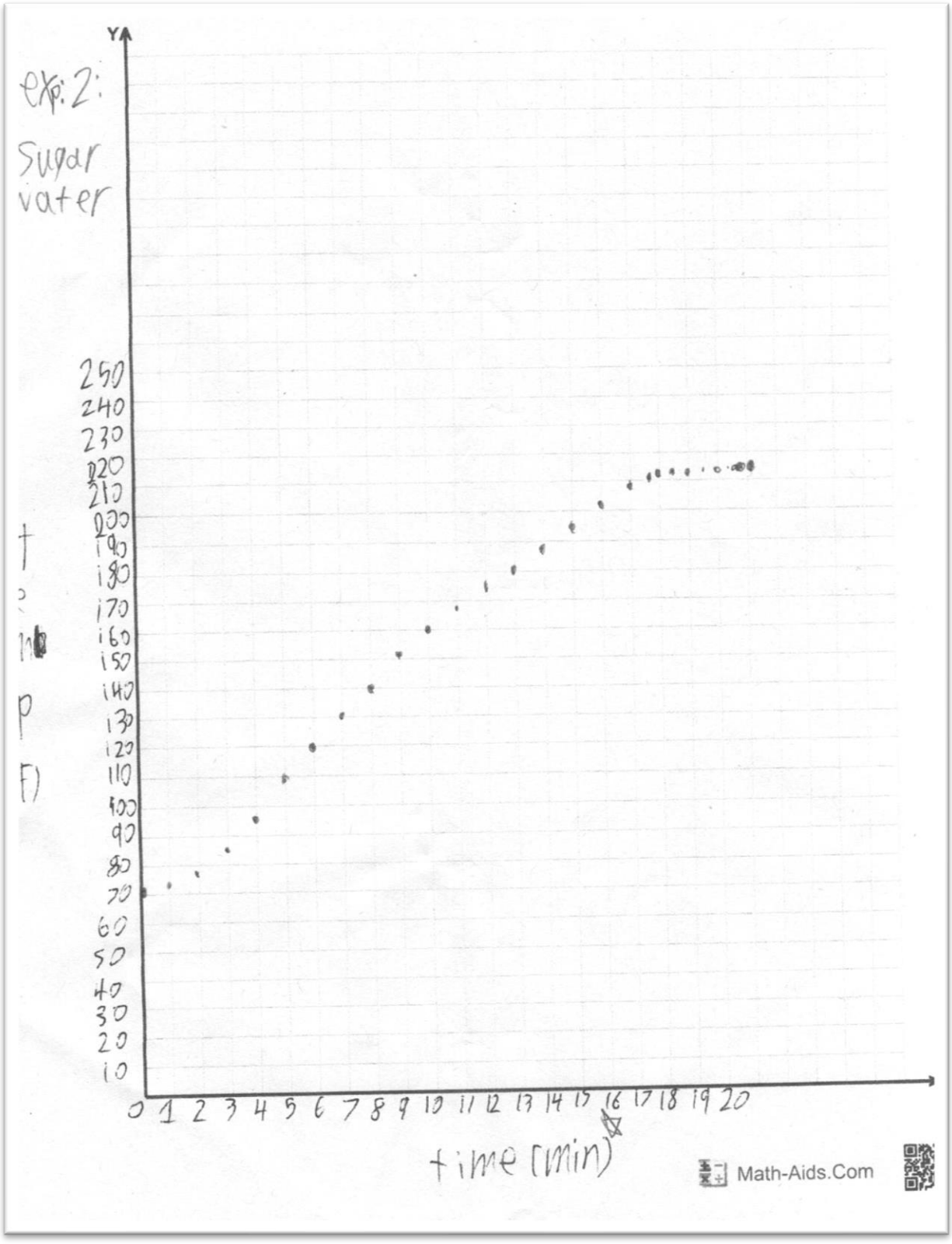
On your observation day...

Date	11/22/23
Current temperature where you live	37°F
Current humidity where you live	74%
Current dew point where you live	29°
What was your prediction about rain?	no rain
Were you correct?	yes

Before we meet again...

If you were to explain what dew point, humidity, and temperature is, what activity or activities would you do to explain it? Just jot down your ideas, you don't have to write them out, we will talk about them when you get back. You can also research ideas.

cloud maker (machine), hot shower condensation on glass, glass, cold water bottles, you name it.


exp. 2:
Sugar
vater
Y
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240
230
220
210
200
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180
170
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130
120
110
100
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70
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50
40
30
20
10
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
time (min)
Math-Aids.Com

exp: 1:

water

(measured using meat thermometer)