**Q405: Saturday Science**

**Lesson Plan 1**

**Lesson Topic: Heat Conductivity**

**Grade level(s): 5th, 6th, and 7th**

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| --- | --- |
| **Desired Results** | |
| **Overarching Focus Question for the Session (***the phenomenon being explored across the 3-weeks***)**   * How can I design a pet house that feels JUST RIGHT ---- not too hot, not too cold? | |
| **Central Focus/Topic for today:**  Students will understand:   * What materials keep the cardboard box at a cool temperature? * Which materials cool or heat the cardboard box?   Therefore, the guiding question for today’s learning is:   * How do different materials vary with heat conductivity? | **Relationship that this central focus has to the overarching big idea/question for the unit**   * The students will be exploring the materials they can use in their design of their elephant house. This will help them decide what materials are the best to use to keep the house at just the right temperature. |
| **Student objectives (outcomes):**  Students will be able to:   * Measure temperature within a cardboard box. * Read a temperature gauge. * Collect data based on their testing. | |
| **Timeline of Activities for the Day** | |
| \**Provide a breakdown of how long each activity will take, who will lead the segments of the activities, when breaks will occur or other transition points, etc.*  *\*Identify by highlighting in blue the portion of the lesson your team wants video-recorded each week. This should be ~45 mins*   1. Beach ball introduction activity (10 mins)- 2. Classroom expectations (10 mins)- 3. Explain dog house problem (5 mins) - 4. Explain how to conduct the data (15 mins) - 5. Explore with materials (30 mins) -All 6. Snack and bathroom break (15 mins, 10:40) -All 7. Finish up exploring with materials (30 mins) -All 8. Share data information with each other as a class (15 mins) - 9. Start planning house for next week (20 mins) | |
| **Learning Plan (First three E’s of the 5E model)**  *Any of these phases can be repeated should you have more than one activity to describe OR a complex activity with multiple iterations of some phases.* | |
| **ENGAGE**  Beach Ball introduction-  Students will be passing the beach ball from person to person and across the tables. When the students pass it, they will say their name and have to spin or turn the ball until they see a question the previous person did not answer.  Classroom Expectations -  As a class we will discuss what expectations and norms should be in place during our classes. On the whiteboard we will be brainstorming any and all ideas that we have. After we finish brainstorming, on the flipchart paper we will condense our expectations into 3-5 good rules. We will keep the sheet of expectations for future classes.  Explain Dog house problem -  In order to frame our problem, we will tell the students a story about the stuffed elephant that they will be tasked to be kept cold on a hot day. The story goes: Elly the Elephant loves living here in Bloomington. But in the summertime, she gets to hot sitting outside in the sun. One day Elly came up to me and asked me if I could make a house for her to keep her cool. I told here that I’m not good at building or designing, but that I did have some friends that were. Can you help me create a house that can comfortably fit my friend Elly that keeps her cool?  **EXPLORE**  Explain how to conduct the data -  We will discuss with students what it means to take good observation. We will ask them for their prior knowledge of observation techniques and fill in the blanks that students do not think of. We will make sure they understand why we are isolating our variables of materials, and discuss why we have the same house for each and the same heat lamp. We will help them understand why we will measure the temperature of the top of the house, the side of the house and the inside in order to get comprehensive data. We will also remind them that they need to be able to use the same box for their experiments, so they will need to make sure they can take the tested materials off without harming the box.  Explore with the materials -  As students begin to explore the materials, we will interact with their explorative process in order to highlight and challenge student thinking. This might be questioning the technique they are using to make the observation and stressing the importance of consistency. We might ask students why they think the materials gave them the result it did. Like why do you think the wool not help keep the inside cool? Or other questions. Based on the reactions of the students, we will challenge their reasoning in order to scaffold there logic and lead into the synthesis at the end.  **EXPLAIN**  Share data information  After the students have collected all of their data from each of the materials, we will come back together as a class and put all of our data together on the board.   * We will draw the data chart on the board that looks like this;  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | |  | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 | | Fabric |  |  |  |  |  |  | | Wool |  |  |  |  |  |  | | Packing Peanuts |  |  |  |  |  |  | | Cotton Balls |  |  |  |  |  |  | | Styrofoam |  |  |  |  |  |  | | Egg cartons |  |  |  |  |  |  | | Tin Foil |  |  |  |  |  |  | | Aluminum Foil |  |  |  |  |  |  |  * First we will ask the students what temperature they got for each material on the top of the box. After they all give us the temperature for the top of the box. I will designate each group a material to calculate the mean of across the 6 groups.   + The first time we calculate the mean we will explain the students how to do this.     - You will add up all of the 6 groups temperature and then divide that number by 6.     - G1 + G2 + G3 + G4 + G5 + G6 = Total temp of all groups     - Total temp of all groups/6 = temperature mean * Once the students calculate the mean of the top temperature we will write that over to the side and erase the temperatures within the chart. * Second, once the temperatures from the top are erased we will gather the temperatures from each group they collected on the sides of the box. Once the chart is filled out with the temperature we will conduct the mean of each material again,using the inside and the side and write that off to the side. Then we will erase the temperatures in the chart one last time. * Finally, once the temperatures from the sides are erased we will gather the temperatures from each group they collected on the inside of the box. Once the chart is filled out with the temperature we will conduct the mean of each material again, and write that off to the side. * Off to the side we should now have a conductive list for the means of each material for the inside, side, and top of the box. * The students will then write down the final mean temperatures on page two of the observation worksheet.   **ELABORATING/EXTENDING Understanding**  Start planning for next week  After we calculate the mean temperatures as a class and the students write them down on the observation worksheet, the students will start discussing with their groups what materials they are thinking about using. They should use the data collected to justify their decision to choose certain materials. They will write down their materials on the observation worksheet under the “design for next week materials” and plan out what they are going to be using.  If time permits the students will be allowed to draw out their design and thinking about how they want to consruct their house during next weeks session. They will plan until the end of class. | |
| **Assessment Evidence (\*This is the Evaluation Phase of the 5E approach)** | |
| **Performance Task(s):**   * For our performance task assessment we will be assessing whether the students can correctly record the temperature inside and outside the box. * We will also be assessing whether students can read the temperature probe correctly and record the temperature down on the data sheet. * We will also be assessing the students on if they are able to compare and contrast their data with other groups and use multiple forms of data to come up with their final conclusion. | **Other Evidence:**   * During our discussion on how to conduct the data and sharing data with other groups, we will be assessing their understanding with the topic based on their participation and explanation on how they conduct and got their data. |
| **Materials + Quantity:**     * **6 more 12 can soda boxes** * **6 temperature probes- surface** * **3 labquest computers** * **6 rolls masking tape** * **A lot of Fabric- box** * **Wool- as much as we can get** * **Cotton balls- 4 bags** * **18 Egg cartons** * **Styrofoam- as much as you want to give us** * **Scissors- 12 pairs** * **Pencils- 20** * **Flipchart paper- 1 piece** * **Beach Ball with questions on it- 1** * **Stuffed elephant (Ellie)- 1** * **Rulers- 6** * **Packing peanuts- the bag** * **Heat lamps- 6 (or as many as we can get)** * **Markers for chart paper- 4** * **Calculators- 20 (At most 20, but whatever you can get is fine!)** * **Aluminum foil- 3 rolls** * **Tin foil- 3 rolls** | |
| **Required Accommodations/Modifications:**   * The students will be working in groups which will allow them to work together and figure out each of their individual strengths and how they will be able to best contribute to their group. | |
| **Additional Modifications for Individual Students:**   * **N/A** | |

Wood, fabric, styrofoam, cardboard, glue guns, packing peanuts,

Finger joints?

Materials:

1. Week 1, 2, 3:
   1. 10 Cereal boxes of the same size
   2. 3 rolls of tin foil
   3. 3 rolls of aluminum foil
   4. Packing peanuts
   5. 6 rolls of Scotch tape
   6. A lot of Fabric
   7. Wool
   8. Cotton balls
   9. Egg cartons
   10. Styrofoam
   11. Sponges
   12. Wood
   13. Insulation
   14. 18 Scissors
   15. 6 Exacto knives
   16. 6 surface temperature probes
   17. 18 printed out observation worksheets
   18. Stuffed Elephant
   19. Markers for chart paper
   20. 6 glue guns
   21. 3 labquest computers

Names:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Insulation Observations: Day 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Material | Temperature(℉):  Top Inside Side | | | Observations: |
| Fabric |  |  |  |  |
| Wool |  |  |  |  |
| Packing Peanuts |  |  |  |  |
| Cotton Balls |  |  |  |  |
| Styrofoam |  |  |  |  |
| Egg Cartons |  |  |  |  |
| Tin Foil |  |  |  |  |
| Aluminum Foil |  |  |  |  |
| Other |  |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| Material | Final Mean Temperature from all groups (℉):  Top Inside Side | | |
| Fabric |  |  |  |
| Wool |  |  |  |
| Packing Peanuts |  |  |  |
| Cotton Balls |  |  |  |
| Styrofoam |  |  |  |
| Egg Cartons |  |  |  |
| Tin Foil |  |  |  |
| Aluminum Foil |  |  |  |
| Other |  |  |  |

Design for next Week:

Materials:

Include the dimensions of your design with the size of the elephant in mind:

**\*\*\*Make sure to label materials and features of the design.**

**Q405: Saturday Science**

**Lesson Plan 2**

**Lesson Topic: Heat Conductivity**

**Grade level(s): 5th, 6th, and 7th**

**Instructor Names: Begle, Dennison, and Hochstetler**

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| --- | --- |
| **Desired: Results** | |
| **Overarching Focus Question for the Session (***the phenomenon being explored across the 3-weeks***)**   * How can I design a pet house that feels JUST RIGHT ---- not too hot, not too cold? | |
| **Central Focus/Topic for today:**  Students will understand:   * Maintaining temperature within the houses constructed.   Therefore, the guiding question for today’s learning is:   * How can temperature be maintained within a building? | **Relationship that this central focus has to the overarching big idea/question for the unit**   * The students will be building a house after analyzing the data from the tested materials last week. This will lead them to decide what materials to use in order to reach a stabilized internal temperature. |
| **Student objectives (outcomes):**  Students will be able to:   * Students will be able to analyze data from last weeks data collection to influence the model they will be creating. * Students will be able to design a model to test a possible solution to the problem. | |
| **Timeline of Activities for the Day** | |
| \**Provide a breakdown of how long each activity will take, who will lead the segments of the activities, when breaks will occur or other transition points, etc.*  *\*Identify by highlighting in blue the portion of the lesson your team wants video-recorded each week. This should be ~45 mins*   1. Finish up data collection/wrap up for week 1 (10 minutes)- 9:30 - 2. Intro video about conduction (5 minutes)- 9:40 - 3. Discussion and connection to the challenge (10 minutes)- 9:45- 4. Explain constraints for challenge (5 minutes)- 9:55 5. Planning phase/sketching (15 minutes)- 10:10- 6. Exploration / building of the houses (45 minutes)- 10:25- 7. Snack break and mid explore discussion (15 minutes)- 11:10 - 8. More house building, testing and iterations (15 minutes)- 11:25 9. End of class discussion [whether complete or not] (15 minutes)- 11:40 | |
| **Learning Plan (First three E’s of the 5E model)**  *Any of these phases can be repeated should you have more than one activity to describe OR a complex activity with multiple iterations of some phases.* | |
| **ENGAGE**  Data and analysis wrap-up from week 1: ( )  To start off our lesson we will be conducting a wrap of of the data collection that was completed in last week’s lesson. We left off at just compiling all of our data together and finding the average of each material based off the temperatures taken within each group. We will revisit this data collection and talk about the patterns within the data;   * Which material kept the box the coolest? * What material let the most heat in? * What materials are the most practical to use?   We will then let the students know that they need to be taking into consideration what materials are going to be the best to use on their house to give them the best possible result. The data collection should be guiding them in the direction they choose to go, so they should be able to explain why they chose certain materials.  Introductory video about conduction: ( )  [Video](https://youtu.be/YK7G6l_K6sA)  To start the discussion about these science terms (Heat conductivity, Heat transfer, and Convection) we want to show a video that shows an application about how these terms relate to the problem they will be trying to solve. By giving a refresher over the terms, it will help with their explanation of why they are choosing to do certain things within their house. Also, last week we just mentioned how materials are going to affect the heat that is let into the house, but also a big part of keeping a building cool is having air flow. This video mentions this idea and explain how air flow helps keep an area cool. This will help the students incorporate this into their house and talk about how it affects heat transfer and why it is important to include. This video will basically be a starting factor for discussions they should be having within their groups. After watching the video, will explain these concepts more in depth.  Connection of video to challenge: ( )  In order to make sure students are using the science concepts they have talked about in the previous week and have seen in the video, we will have a discussion about these terms and how we will apply them. Some of the key terms we want to have them discuss and define are; insulation, air-flow, conduction, and reflection. In this discussion we will let students define these terms themselves and will help them label their science concepts rather than teach them a standard definition. We will bring up examples of how we might use these concepts, asking questions like; how does insulation both keep things cool or hot? How can we make sure our houses have air flow? What materials best conduct heat? Giving students time to discuss and reason with these concepts will help them be more prepared for the planning and sketching part of the day.  Go over building constraints: ( )  There will be a short discussion over what the elephant houses have to include. This means that the students have to include doors, windows, a floor, and an angled roof that will make the box more like a home for Elly. This discussion will also include the reasoning behind why the groups have to include these things. Something that the students will need to think about is how Elly will open the door or windows. They will have to be able to build a house where she can open the door for herself.  **EXPLORE**  Creating a blueprint for the house: ( will explain, all will walk around to help groups)  Going along with the constraints given to the students that their house has to have, now they have to plan on what they’re going to build. They will have to collaborate as a group to come up with an idea that their whole group agrees with. After each group thinks they’re done, their plans have to be approved by one of the three teachers to ensure that they have all the necessary components. It will also be discussed that the houses they build will be tested in the back of the room. The students will have to place their house under the heat lamps for 5 minutes before they record their temperatures. The temperatures recorded will be included within their packets used in the previous week with a paper added.  Exploration and building the houses: ( will explain, all will walk around to help groups)  Before the students begin building their elephant houses, it will be discussed that there is access to a hot glue gun station, cricut station and all of the materials used in the previous week at the front table. The glue guns and the cricut will be kept in the areas in which they are placed in order to prevent any mishaps. The three teachers will be talking to various groups to facilitate discussions and check for understanding.  **EXPLAIN**  Mid-class discussion: ( )  While students are having a snack, we will discuss what is working and what is not. This part is placed in the Explain section out of chronological order because it better fits in the explain category and having two different discussions will help students be able to think about iterations during the middle of the lesson, then discuss at the end sharing what they will need to do for next time. In this discussion we will have students share with each other the strategies they are using and the results they have found. This discussion will also be used to promote iterations in their creations. As they are informed and inspired by the success and struggles of their classmates they will be given time to think of how to improve their house. Since students will be promoted to explain why they received the results that they have gotten, students will also get practice using science concepts to explain their observations and data.  End of class discussion: ( )  Similar to the mid-class discussion, we will let students explain using scientific terms how and why their houses work or didn’t work in a sort of “science show and tell”. After this we will lead them to extend their observation to think of what they need to do to create a better house for next week.  **ELABORATING/EXTENDING Understanding**  Discussion of what they would change: (All)  Students will be prompted now in addition to a discussion on what went well and why, they will now be asked to use all of the data they have collected, including data from other groups, and use predict ways that they can create an even better house than the one they have created. We will be pushing their logic by asking how their predictions would better better insulated, or reflect more heat, or create better air-flow, as well as other questions that will illuminate the science-based decision making process they have used. This will help us lead into the last week by promoting more iterations, considerations and concepts they will need to better create a house next week. | |
| **Assessment Evidence (\*This is the Evaluation Phase of the 5E approach)** | |
| **Performance Task(s):**   * Students will construct a house that will be able to maintain its temperature. | **Other Evidence:**   * Students will use their scientific conceptions about heat and heat transfer to inform their building decisions. |
| **Materials + Quantity:**     * **Thin cardboard (cereal boxes, cracker boxes, and other thin cardboard) (as much as possible)** * **Other types of cardboard as well (as much as possible)** * **6 temperature probes- surface** * **3 labquest computers** * **6 rolls masking tape** * **A lot of Fabric- box** * **Cotton balls- 4 bags** * **18 Egg cartons** * **Styrofoam- as much as you want to give us** * **Scissors- 12 pairs** * **Pencils- 20** * **Stuffed elephant (Ellie)- 1** * **Rulers- 6** * **Packing peanuts- the bag** * **Heat lamps- 6 (or as many as we can get)** * **Dry Erase markers** * **Calculators- 20 (At most 20, but whatever you can get is fine!)** * **Aluminum foil- 3 rolls** * **Tin foil- 3 rolls** * **6 rules/tape measures** * **6 exacto-knives** * **Cricut** * **Hot glue guns** | |

**Concepts we might talk about**

**- Insulation**

**- Air flow**

**- Reflection (of heat/cold)**

**- Heat as energy/waves**

**- Electrons and temperature?**

**- Conduction (physical objects), convection(through air/water) and radiation(heat lamp)**

**- Volume/space and temperature**

|  |  |
| --- | --- |
|  | **Temperature of the inside of the house:** |
| **Test 1:** |  |
| **Test 2:** |  |
| **Test 3:** |  |

**Modification 1:**

What are you changing?

Why are you making these changes?

**Modification 2:**

What are you changing?

Why are you making these changes?

**Modification 3:**

What are you changing?

Why are you making these changes?

**Q405: Saturday Science**

**Lesson Plan 3**

**Lesson Topic: Heat Conductivity**

**Grade level(s): 5th, 6th, and 7th**

**Instructor Names: Begle, Dennison, and Hochstetler**

|  |  |
| --- | --- |
| **Desired: Results** | |
| **Overarching Focus Question for the Session (***the phenomenon being explored across the 3-weeks***)**   * How can I design a pet house that feels JUST RIGHT ---- not too hot, not too cold? | |
| **Central Focus/Topic for today:**  Students will understand:   * Maintaining temperature within the houses constructed.   Therefore, the guiding question for today’s learning is:   * How can temperature be maintained within a building? | **Relationship that this central focus has to the overarching big idea/question for the unit**   * The students will be building a house after analyzing the data from the tested materials from the first week. This will lead them to decide what materials to use in order to reach a stabilized internal temperature. |
| **Student objectives (outcomes):**  Students will be able to:   * Students will be able to analyze data from the first weeks data collection to influence the model they will be creating. * Students will be able to design a model to test a possible solution to the problem. | |
| **Timeline of Activities for the Day** | |
| \**Provide a breakdown of how long each activity will take, who will lead the segments of the activities, when breaks will occur or other transition points, etc.*  *\*Identify by highlighting in blue the portion of the lesson your team wants video-recorded each week. This should be ~45 mins*   1. Discuss teamwork (5 mins) 9:30 - 2. Discuss timeframe (5 mins) 9:35 - 3. Finish cardboard skeleton (30 mins) 9:40 -All 4. Start adding “insulation” (30 mins) 10:10 -All 5. Snack (5 mins) 10:40 - All 6. Finish up testing - 2nd and 3rd round (45 mins) 10:45 - All \*only 15 mins of this at the end 7. Share out designs and temperatures (30 mins) 11:30 - | |
| **Learning Plan (First three E’s of the 5E model)**  *Any of these phases can be repeated should you have more than one activity to describe OR a complex activity with multiple iterations of some phases.* | |
| **ENGAGE**  Discuss Teamwork:  Since we ran into some trouble between groups last week, we will be both giving explicit instructions about teamwork as well as modeling effective teamwork during the explorative sections of the lesson. At the start of the lesson, we will tell them that in order to work effectively, they must; ask each other for help, everyone should be helping and working, and everyone should tell each other about the progress they are making or explain what is not working. We will also warn them, that if they cannot work effectively in the groups that they have, we will split them up into smaller groups so that they can better focus in the smaller groups. We will not do this to any group unless we have to because this would mean that those groups would have to start from scratch. In order to model how to work in a team during construction, we will ask them; what each of their group members are doing, or did all your group members agree to do this?  Discuss Timeframe:  Before the students start continue building their house we are going to set up a time frame for the students to make sure they are completing their design within this last class session. To ensure this, we will write up on the board the following times:   * 30 mins to finish cardboard skeleton * 30 mins to finish adding their first round of insulation * 20 mins to make one change to their house and test * 20 mins to make one change to their house and test   Hopefully giving students these time frames will get them motivated to finish their designs quicker then the second week. We will also be putting a timer up on the board so that the students can see how much time they have left to finish their design.  **EXPLORE**  Finish cardboard Skeleton:  During this time the students should finish up the structure of the house. Each group chose to build their house of the thicker cardboard so after this 30 mins is up they should be done using the cardboard and they should start adding their “insulation.” This mean that the students need to have their house standing, a roof, some type of ventilation, a floor, a door, and must be able to fit Ellie. After they are finishing up this skeleton then the students can start adding their insulation to block heat conduction and to keep the house cool.  Adding Insulation:  Now that students will be expected to have finished their cardboard skeleton, we will have them create their insulation using the material or materials of their choice. We will tell them that now they need to create insulation before they can test their houses. On top of their skeleton, they will layer the packing peanuts, cloth, styrofoam or other materials in ways that they believe to help insulate the house from the heat lamps. Once they have finished creating their insulation and putting it on, they will need to test their housing both on the surface and inside the house for 5 minutes. This will be the first major test before they start to reflect and revise their houses.  **EXPLAIN**  Revision of Design:  Based on the first temperature that the students test in their original design with their insulation, they will go back to their tables and discuss what they need to change moving forward to keep out as much heat as possible. Once the students decide what they want to design or change then the students will flip to the page in their packet (above) and explain what they decided to change or add and why they decided to do this. Once they have written down and recorded their changes then the students will make the changes to their house. After the changes are made to their house they will then test the house again. They will continue to do this until time is up or they believe they have reached the lowest temperature possible for the house.  **ELABORATING/EXTENDING Understanding**  Share out design:  While the students are discussing what they found with their tests and designs, they will have to include at least three out of the six vocabulary terms: heat transfer, stability, ventilation, insulation, heat conduction, air flow. These will be written on the board for students to see and the groups will have 2 to 3 minutes to come to a consensus on what they’re going to share out. The groups will also be encouraged to talk about what temperatures they got from their tests and how their revisions helped them get a lower temperature (or whatever temperature they got, if it ended up increasing). After the students have written down their explanations, they will come to the front of the room and talk about their construction using the key words. We will have all groups present. | |
| **Assessment Evidence (\*This is the Evaluation Phase of the 5E approach)** | |
| **Performance Task(s):**   * Students will construct a house that will be able to maintain its temperature. | **Other Evidence:**   * Students will use their scientific conceptions about heat and heat transfer to inform their building decisions. |
| **Materials + Quantity:**     * Thin cardboard (cereal boxes, cracker boxes, and other thin cardboard) * Other types of cardboard as well (as much as possible) * 6 temperature probes- surface * 3 labquest computers * 6 rolls masking tape * **Duct tape** * A lot of Fabric- box * Cotton balls- 4 bags * Egg cartons- what is on the cart * **Styrofoam- more if possible** * Scissors- 12 pairs * Pencils- 20 * Stuffed elephant (Ellie)- 1 * Rulers- 6 * Packing peanuts- the bag * Heat lamps- 6 (or as many as we can get) * Dry Erase markers * Aluminum foil- 3 rolls * Hot glue guns * **Meter Sticks** | |
| **Required Accommodations/Modifications:**   * This lesson is mainly based around group activities so we will be explicit in explaining that everyone needs to be working together as a group. Defining jobs or duties within your group will help them all work together equally and fairly. We will also be walking around to make sure group members are participating and contributing to the group. * Most of the lesson will be student centered instruction so the students can choose to take a path that fits their own level and we will be walking around to integrate those science concepts applied to what choices they are making with their houses. | |
| **Additional Modifications for Individual Students:** | |