Institute

Inquiry Based Learning
Educational Consultants

3275 Berryhill Rd.
Lima, OH, 45801

419.234.5701
john@iblinstitute.com

We hope the lesson plans add value incorporating inquiry into your classroom and they become part of your teaching arsenal.

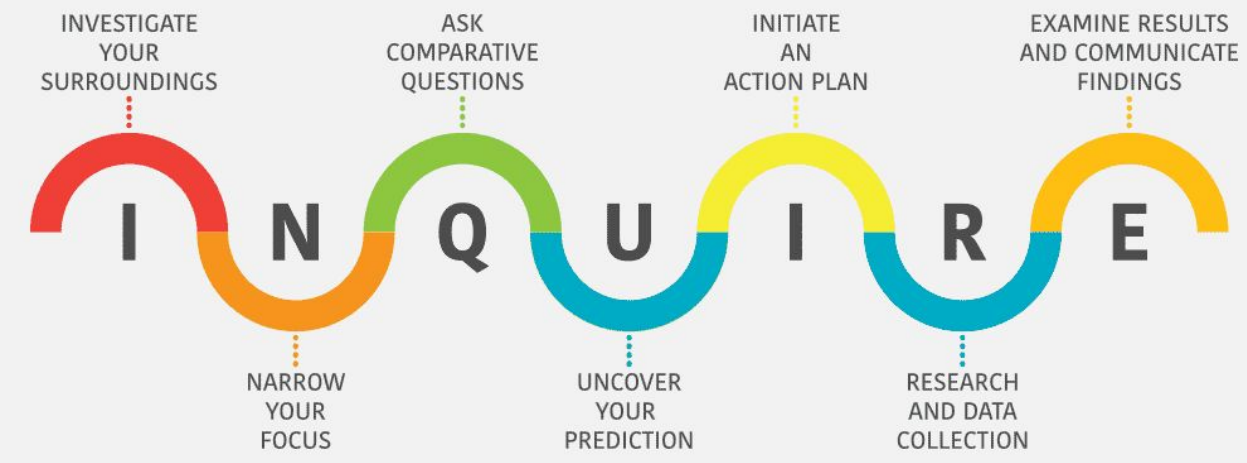
We would appreciate feedback. We would also appreciate a $20 contribution which helps us maintain the website so we can continue distributing these lesson plans to other educators.

Mail your feedback and contribution to:
IBL Institute
Attention: John Hoffman
1101 N. Cole St., Lima, Ohio 45805

Institute
Inquiry-Based Learning
Educational Consultants

Melting Ice Balloons

An inquiry-based lesson plan designed to promote critical thinking by integrating content with traditional and inquiry-based learning.



All Hands-On Learning is NOT Inquiry-Based Learning

Inquiry based learning is process-oriented and does not focus on a single correct answer, but rather emphasizes the process of gathering information and forming a conclusion. Traditional hands-on learning tends to be product-oriented and has students follow a pre-planned procedure to come to a single, specified answer.

Key Terms

Process Skills (PS)

Skills that students will engage in while thinking critically. These include observing, questioning, predicting, planning, investigating, interpreting, and communicating. These skills are found in each step of the inquiry process.

Investigating Surroundings

Observing the overall surroundings. What do I see? What is understood about the topic? What still needs to be understood?

Narrowing Focus

Observing student needs and interests, as well as academic content. Find the balance between natural curiosity and standards-based concepts. What area can be concentrated on to best promote growth and learning?

Questioning

Forming questions about what is not fully understood. Comparative questions can be investigated. They need to be able to lead into an action plan. What can be found out?

Uncover Prediction

Logically thinking to form a prediction about what could happen. What do I expect to happen based on my experiences and knowledge?

Initiate Plan

Figure out the action plan. Design an experiment which will answer the comparative question. What can I do to answer this question? How can I find this out?

Research and Collect Data

Investigating the elements of the experiment. Researching and collecting data that applies to the action plan.

Examine Results

Interpreting the data collected. What does this data mean? What else do I want to find out?

Communicating

Communicating the information that was found to someone else. The way the data is presented. What will the audience want to know? What will the audience be able to understand about this?

Table of Contents

Overview

This is an inquiry-based learning lesson in which students learn about changes in states of matter. Students will be engaged in hands-on activities that involve melting ice to answer a comparative question regarding what materials speed up the melting process of water. Students will analyze their findings and present to the class. The project will link IBL with traditional teaching by giving teachers options to best suit the needs of the class. More questions will emerge to continue scientific investigations and further the learning process.

Practical Application

This experiment allows students to understand changes in matter, specifically the different states of water. Each student will have practice with the scientific process, including documenting and interpreting data.

Lesson Plan

Grade Level: PreK/ Kindergarten/1st

Class:

Teacher:

Time Required/Duration: 3 days, approximately 30 minutes each day

Objectives

1. Incorporate the process of inquiry-based learning into a traditional direct instruction classroom setting.
2. Students will be able to use multiple means to find answers to their questions, including but not limited to participating in the inquiry experience, reading information from primary and secondary sources, watching videos, and talking with more knowledgeable individuals in their community.
3. Students will be able to identify different states of water.
4. Students will be able to investigate how to speed up the change of water from a solid to a liquid.
5. Students will be able to uncover additional questions and think critically about the data found.

Standards

Scientific Inquiry, Practice and Applications

- Apply knowledge of science content to real-world challenges.
- Plan and conduct simple scientific investigations using appropriate safety techniques based on explorations, observations and questions.
- Employ simple equipment and tools to gather data and extend the senses.
- Use data and mathematical thinking to construct reasonable explanations.
- Communicate with others about investigations and data.
- The world is discovered through exploration.
- Exploration leads to observation. Observation leads to questions.

Educational Standards

PreK: With modeling and support, explore the properties of objects and materials.
K.PS.1: Objects and materials can be sorted and described by their properties.
1.ESS.2: Water on Earth is present in many forms.
1.PS.1: Properties of objects and materials can change.

Materials[1]

IBL Institute Provided at No Charge (Shipping and handling fees will apply) :
Each group (3-5 students) should have:

Day 1:

- 1 Ice Balloon, or a few ice cubes
- 1 Bottle of Food Coloring
- 1 Flashlight
- 1 Magnifying Glass
- 1 Tub in which to do the inquiry

Day 2:

- 2 Ice Balloons
- 1 Bottle of Food Coloring
- 1 Flashlight
- 1 Magnifying Glass
- 1 Tub in which to do the inquiry
- 1 Sponge
- 1 Piece of Cloth
- Salt
- Sugar
- 1 string and a ruler (or unifix cubes, to measure the circumference of the ice balloon)
- Gloves
- Notecards
- *Optional:* 1 container (with water) large enough to submerge the ice balloon
- *Optional:* device to take pictures of the inquiry experience
- *Optional:* other materials for students to choose from while coming up with their comparative question

Day 3:

- *Optional:* Chart paper/ projector (to show peers their conclusions)

The IBL Institute will provide all of the necessary items for this inquiry experience.

To order the IBL Institute provided supplies, please contact Jessica Begonia at 419-223-1362 with how many students and groups you will have in your classroom. Supplies will be scheduled for delivery two days before the experiment starts.

Vocabulary

(See Appendix 2 for vocabulary defined)

Comparative Question	Water
Prediction	Ice
Observe	Melt
Measure	Faster
Around	Slower

[1] Please note that these materials are often found in the average home. If needed, students could do this inquiry with their families as an extension or distance learning option.

Instructional Plan

Preparation:

1. Make ice balloons two days before the lesson is planned to start.
    a. Stretch a balloon over a faucet or the neck of a plastic water bottle. (If you are filling the balloon from a water bottle, gently squeeze the bottle to fill the balloon.) Slowly fill the balloon until it is the size desired (about 4 inches in diameter is ideal, making sure all balloons are similar in size is vital).
    b. Remove the balloon from the faucet or bottle and let excess air escape. Tie the top of the balloon.
    c. Place balloon in freezer (to create spheres, the balloons need to be suspended.)
    d. Freeze for approximately 48 hours. They will be ready for the investigation when they are frozen solid.
    e. Leave ice balloons in the freezer until just before the investigation. Cut the neck of the balloon and peel back.
2. Gather the materials students will need to use during the investigation.

Day 1

1. Introduce the topic of ice.
2. Think- pair- share about where students have seen ice before and about what they already know about ice.
3. Write the information students share on chart paper or a whiteboard. Tell students that this is a great start and that they are going to continue to learn more about ice today by observing ice balloons.
4. Observe the ice balloons, or ice cubes, in small groups of 3-5 students. During this time students will be given additional tools (flashlight, magnifying glass, and food coloring) to help them investigate the ice. Students will take notes and sketches of what they notice about their ice balloons in their Investigation Book (see Appendix 5, pg. 21) **(Investigate Surroundings)**
5. Communicate as a class what they observed. Add this information to the chart from the beginning of the lesson.
6. Ask students if the ice did anything over time. Direct conversation towards how the ice was beginning to melt.
7. Think-pair-share when they have seen ice melt before. When did the ice melt quickly? When did the ice melt slowly? What could be a strategy to make the ice melt quickly? How could you get the ice balloon to melt the quickest? **(Narrow Focus)**
8. Introduce the comparative question: Will the ice balloon melt faster if _____or if _____? **(Ask Comparative Questions)** Utilizing student ideas from earlier and and materials being used, give examples of what the group could use as their comparative question. (ex. Will the ice balloon melt faster if it has one cup of salt or one cup of sugar on it?)
9. Small groups will decide what comparative question they would like to investigate. After deciding, students will each write their comparative question in their investigation books.
10. Have students make a prediction about which of their ice balloons will melt faster. Students will write their predictions in their investigation books as well. **(Uncover Prediction)**
11. After making their predictions, have students talk briefly in small groups as to which balloon they think will melt faster.

Day 2

1. Re-engage students by stating each group's comparative question.
2. Have students think-pair-share their predictions of which method will make the balloon melt the fastest.
3. As a class, brainstorm how you would know which balloon melted faster even if it doesn't melt completely. **(Initiate Action Plan)** If students are struggling with this, help lead them towards measuring how large the balloon is with a piece of yarn.
4. Model for students how to measure around the ice balloon. Start with the yarn at one location and wrap it all the way around the balloon until you get to the spot where you started. Use a ruler or unifix cubes to measure the length of the piece of yarn.
5. Explain to students that they will have to measure each balloon before they start and after they finish.
6. Once each group has measured their balloon they can then start their investigation. Make sure to remind students to continue to observe the ice balloons and how they are changing. As the teacher, make sure you are going around to each group and asking them what they notice about their investigation. (ex. Which ice balloon looks like it is melting faster? Slower? Do you think your prediction is still correct?)
7. Allow students to investigate for 10-15 minutes. At the end of the investigation time, instruct students to wipe off their ice balloon if there is excess salt or sugar. Using gloves and safety precautions, students will then measure each balloon a second time and write the measurement in their investigation book. **(Research and Collect Data)**
8. Students will make sure to clean up their areas so that all materials are disposed of properly and that their hands are washed after using the materials from the day.
9. Students will then work with their group to compare the measurements of the two balloons to figure out which balloon was the smallest and therefore the ice balloon that melted the quickest. **(Examine Results)**

Day 3

1. Re-engage students in the comparative question: Will the ice balloon melt faster if _____or if _____?
2. Have students think- pair- share how they were able to investigate this question and collect data.
3. Explain that today students will be able to share their data with their peers. They will do this by organizing all of their data onto a worksheet which they will present.
4. Students will work with their groups from yesterday to analyze the data that was collected. **(Examine Results)**
5. Students will synergize to organize their ideas and findings clearly onto a worksheet which they will be presenting. Each student will write on their own copy of the worksheet.
6. Students will rehearse what they will say to their peers.
7. Groups will take turns communicating their findings with the whole class. The teacher can help make this process go smoothly by asking guiding questions and by projecting the groups' papers. **(Communicate Findings)**
8. Think- pair- share scenarios when you would want ice to melt quickly and when you would want ice to melt slowly.
9. Guide students through the student feedback form (Appendix 6), collecting them once completed.

Instructional Overview

Day 1

1. Introduce the topic of ice.
2. The class will create a chart of what they already know about ice.
3. Students will observe ice balloons and take notes of new details they have noticed about ice.
4. Students will talk about melting and brainstorm different strategies to help the ice melt faster.
5. The teacher will introduce the comparative question.
6. Students will write their own comparative questions and make their own predictions as to the outcome of the investigation.

Day 2

1. Discuss as a class how to determine which ice balloon melted faster.
2. Students will measure their ice balloons prior to conducting their investigation.
3. Students will begin their investigation and will write their observations in their Investigation Books.
4. Students will re-measure their balloons and clean up their workspaces.
5. Students will compare the measurements of their balloons to determine which balloon melted faster.

Day 3

1. Students will analyze the data that was collected by answering questions on a worksheet.
2. Students will communicate findings with the whole class.
3. Students will discuss real life scenarios where it would be important to melt ice quickly or slowly.
4. The teacher will administer the student feedback form.

Post-Assessment

1. Have each student answer the questions on the worksheet.
    a. Discussion about the material during this time should be encouraged, the answers should also be in their own words and what they individually think.
2. Each group will prepare an explanation to the class about their findings. It should cover the data they collected during their investigation and any other relevant information.

Background Science- Teacher Information

The physical properties of water can change, these changes occur due to changing energy. Water can change from a liquid to a solid and from a solid to a liquid, or can be changed into a gas (steam). In this investigation, students will be working with changing the solid into a liquid. As students begin to use different strategies to melt the ice balloon they will come to understand that objects and materials change when exposed to various conditions.

Placing salt on ice can make ice melt. Think about how icy roads are often "salted" in the winter to make them easier to drive on. The salt on the road will melt the ice, and also prevent the road from getting icy. This happens because salt water has a lower freezing point than just water. Because of this, when ice comes into contact with salt, it combines and melts the ice, since it is warmer than the melting point.

Placing sugar on ice can also make the ice melt. Similar to salt, adding sugar to water lowers the freezing point of water. The sugar molecules make it difficult for the water to stay bound together, which is necessary for ice to stay frozen. This is why when making homemade ice cream, it needs to be slightly colder than 32 degrees fahrenheit, water's freezing point, for the ice cream to freeze.

Journaling

Students will document their thoughts and questions each day for the duration of this lesson. Students will be writing in their investigation books, which they will add on to each day. If needing to keep track of what was written each day, students can use different colors to write with on different days throughout the lesson, or the teacher can print one sheet from the investigation book each day. Writing should be done each day, that way students can document what they have learned each day and add any new questions that come to their minds. If the students already regularly engage in a journaling activity, the teacher can choose to use that method instead of the investigation book. The goal of journaling is for students to reflect on their knowledge and how it has grown, as well as to think about and record the questions they have about this topic.

About Inquiry-Based Learning As It Applies To This Lesson Plan

This is a project that works best when students work in small groups (3-5). Inquiry is collaborative in nature. The process takes advantage of students' strengths to contribute to the project. Some are great communicators, some are problem-solvers, and some have well-developed technical skills. In the workplace, we also work in groups. We work as part of a team. The inquiry process develops skills necessary to solve complex problems in the world.

Investigate your surroundings and narrow your focus: Encourage each group to think about when they see ice melting. Have them get familiar with the ice balloons. Encourage them to ask questions about why the ice is melting. Have them discuss: When did the ice melt quickly? When did the ice melt slowly? What could be a strategy to make the ice melt quickly? This is a good time for students to write down questions. We suggest having them write individual questions on individual pieces of paper so the questions can later be sorted. It's not important to sort those now, but this can be revisited once the students are more in tune with the inquiry process.

Ask comparative questions: At the heart of inquiry is the comparative question. Comparative questions are ones that can be investigated. Some questions are very good questions, but they are very difficult to investigate. For example: Why are butterflies attracted to my flower garden? Good question, but difficult to investigate. However, we can take that question and change it to: Are butterflies attracted more to red flowers or white flowers? Do you see where we are going with this? You can now design an experiment to count how many butterflies visited each of the colors and compare the results. More questions will come of this process. Do the findings hold up for different kinds of butterflies? Another experiment can be designed. In the case of ice balloons, the comparative question, at least somewhat, is being provided by you. This makes the lesson plan a guided inquiry. An open inquiry is one in which the students pick the topic, create the questions, create the action plan, etc. The comparative question for this lesson plan is: Will the ice balloon melt faster if _____or if _____? Later, we will revisit the questions the students asked above and have them separate those questions that can be investigated and those that cannot. Often, questions that would be difficult to investigate can be made investigable by turning them into comparative questions.

Uncover your prediction: We are not talking about group-think here. What do you individually think? Each group will be collecting data from their ice balloons. Will the data show that one ice balloon melted faster than the other due to the strategy the group utilized?, Each student will have a prediction and they should record that prediction. A prediction is not the same thing as a hypothesis. A hypothesis might be: All swans are white. A prediction would be: I think the next swan I see will be white. A prediction is based upon the individual's experiences, observations, opinions, knowledge, and instincts.

Initiate an action plan: The experiment has been provided. The action plan was designed to help students answer the comparative question. Students will take the measurements of the ice balloons and logically find an answer to the comparative question. It's not one of those "do the experiment and I will let you know the right answer." There is no right answer. Ask the students to record their data on the data sheet provided. To make future lesson plans or repeats of this one more inquiry-based, simply ask them to make a data sheet and record their findings. Perhaps have half the groups use the data sheet provided and then let the other half come up with their own. Part of inquiry requires you to give up some control to allow your students to figure it out.

Examine results and communicate findings: Each group will present their findings to the class. Typically, each group would prepare a graph, data table, chart, pictures or whatever they want to communicate their findings to the class. A poster or section of white board is helpful. The group goes to the front and each member usually participates. As a group, they share the data found with the class. They share their individual predictions. They share their analysis of the measurements and how they came to their conclusion. How do they answer the comparative question? What did they learn from the experience? Classmates then have an opportunity to ask questions to the presenting group.

Student/Teacher Roles for Each Step:

Investigate your surroundings:	The students are doing this
Narrow your focus:	The teacher is doing this
Ask comparative question:	The teacher and students are doing this
Uncover your prediction:	Each student is doing this
Initiate an action plan:	The teacher is doing this
Research and data collection:	The student and teacher are doing this*
Examine results and communicate findings:	The students are doing this

*You may use the data sheet provided or the student may create their own

Experiment: Group Procedures

Day 1:

1. Look at the ice balloon.
2. Think about what you notice about the ice.
3. Use the tools to investigate the ice more.
4. Talk with your group about what you notice about the ice.
5. In your Investigation Book, draw what you observe using each tool.
6. Look at the different materials that could be used in the investigation (salt, sugar, sponges, water, etc.)
7. Talk with your group about what you think would make the ice melt faster, and what would make the ice melt slower.
8. Decide with your group which two materials you want to investigate.
9. Write the materials your group chose in your Investigation Book where it says "Will the ice balloon melt faster if _____ or if _____?"
10. Write your own prediction in your Investigation Book.

Day 2:

1. Think about the question your group came up with yesterday.
2. Measure the ice balloons. Record the number in your Investigation Book.
3. When you're ready, get the two materials your group chose to investigate.
4. Put the first material in one of the tubs with the ice balloon, making sure it is touching the ice. Label the tub with the note card with the name of the material.
5. Put the second material in the other tub with the ice balloon, making sure it is touching the ice. Label the tub with the note card with the name of the material.
6. Observe the ice balloons as they start to melt. Which one is melting faster?
7. When observation time is over, measure the ice balloons again. Record this number in your Investigation Book.
8. Clean up your work area with help from the teacher.
9. Talk with your group about which balloon melted faster. Look at the measurements from before and after the observation, what do they tell you?

Extensions

A. Another factor in melting ice comes from wind. When wind blows on ice, it can speed up the rate of the ice melting. To investigate how this works, a fan can be used to simulate wind being blown on the ice.
   1. Take two ice balloons or ice cubes and place each in its own tub.
   2. Measure each ice balloon.
   3. Point a fan at one of the tubs, keeping the other tub out of the wind's path.
   4. Set a timer for about ten minutes, talking to students about their observations during this this time. The class can also discuss how this would affect things in the real world, such as where they see this in their lives, the arctic ice caps, and plant and animal life living in those locations.

B. Global warming and melting ice are largely connected. This is a real world application for the lesson, where students can learn about how melting ice plays a part in changes in the weather and environment.
   1. Introduce the concept of Global warming to the class. Ask if they know what it is, or if they have heard anything about it before.
   2. Tell them that the scientific definition of Global warming is the normal temperature of the Earth is getting warmer.
   3. Ask the students how ice, like in the arctic or glaciers, might be affected by Earth getting warmer. Write their ideas on a piece of chart paper or the whiteboard for all of the students to see.
   4. Ask students how melting ice will affect the world, such as the animals, plants, and ocean. Have them pair and share their ideas, then ask them to share some with the class.
      a. The ocean levels could rise.
      b. Animals that live on the ice will have less space to live on.
      c. Usually, the sun shines down on the ice and gets reflected back, keeping the temperature of Earth more cool. Without as much ice, there is less heat being reflected back from the ice, and instead being absorbed by the ocean water. This makes the oceans warmer, which can affect the ocean life and the ways that the ocean affects the weather.
   5. To further this extension activity, students can learn about causes for global warming and what they can do to help.
   6. If students are interested they could create a comparative question about ice melting slower and investigate this question as well.

Comparative Questions- questions we can investigate

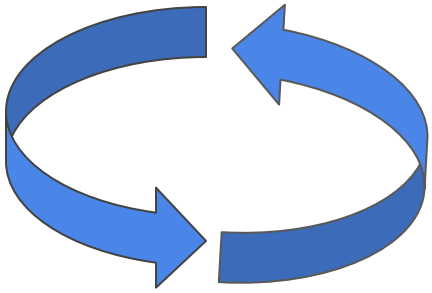
Prediction- what you think before you investigate

Observe- to watch carefully and notice important details

Action Plan- the steps you will take during your investigation

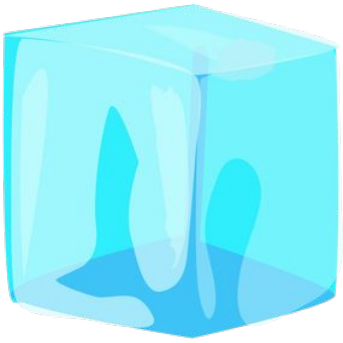
Communicate Findings- explaining what you found to your peers

Measure- using tools to tell us how much or how many



Around- starting at one point and circling back to the same point

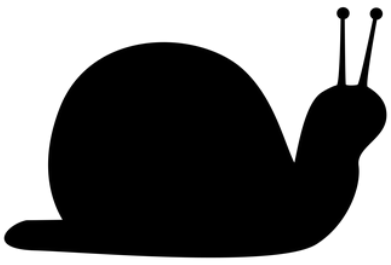
Water- liquid that comes from clouds and forms lakes, rivers, and ponds



Ice- water that is frozen in a solid state

Melt- to change from a solid to a liquid

Faster- to do something with great speed



Slower- to do something with little speed

Investigation Book

Investigator: _____

KWL Chart

Water and Ice

K Things I Know	• • •
W Things I Wonder	• • •
L Things I Learned	• • •

My Observations

Draw what the ice looks like using each material. Write a caption to go with your picture.

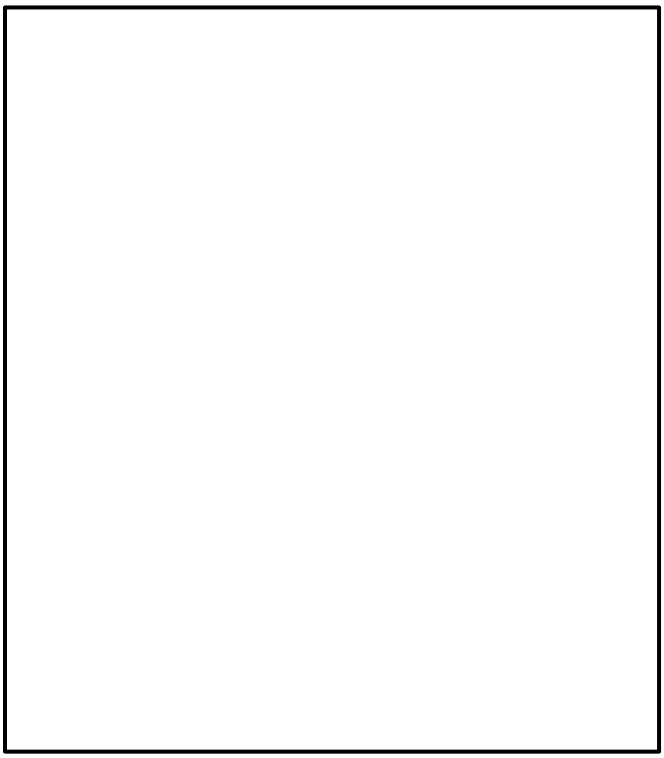
Our Question

What are you going to investigate?

Will the ice balloon

melt faster if

or if



My Prediction

What will make the ice melt the fastest?

The Data

Record the information you find throughout the experiment.

Balloon #1 _____	Size Before	Size After

Balloon #2 _____	Size Before	Size After

This means….

_____

_____

Circle the word that completes the sentence.

My prediction was incorrect/ correct.

Vocabulary

Comparative Questions- questions we can investigate

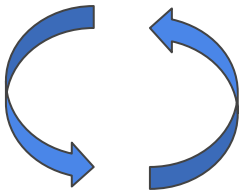
Prediction- what you think before you investigate

Observe- to watch carefully and notice important details

Action Plan- the steps you will take during your investigation

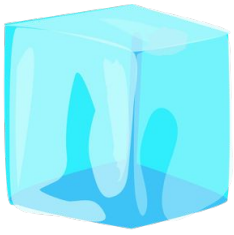
Communicate Findings- explaining what you found to your peers

Measure- using tools to tell us how much or how many



Around- starting at one point and circling back to the same point

Water- liquid that comes from clouds and forms lakes, rivers, and ponds



Ice- water that is frozen in a solid state

Melt- to change from a solid to a liquid

Faster- to do something with great speed

Slower- to do something with little speed

Name: _____

I thought _____ would make the ice melt faster.

Balloon #1 _____	**Size Before**	**Size After**

Balloon #2 _____	**Size Before**	**Size After**

The _____ made the ice melt _____.

I know this because _____

_____ .

Institute
Inquiry-Based Learning
Educational Consultants

Appendix 5- Student Feedback

1. What did you learn from this?

2. What questions do you still have?

3. Was it fun and/or interesting?

Institute
Inquiry-Based Learning
Educational Consultants

Appendix 6- Teacher Feedback

1. What evidence suggests students grasped the major themes of the experiment?

2. Do you anticipate other guided or open inquiry projects arising from this project? What questions did the students ask that suggest understanding and interest in the subject?

3. To what extent did this project fit into your curriculum and teaching agenda?

4. Would you consider doing this again?

5. What would improve this experience?

Please return completed surveys to
jessica.begonia@alloway.com