Institute

Inquiry Based Learning
Educational Consultants

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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

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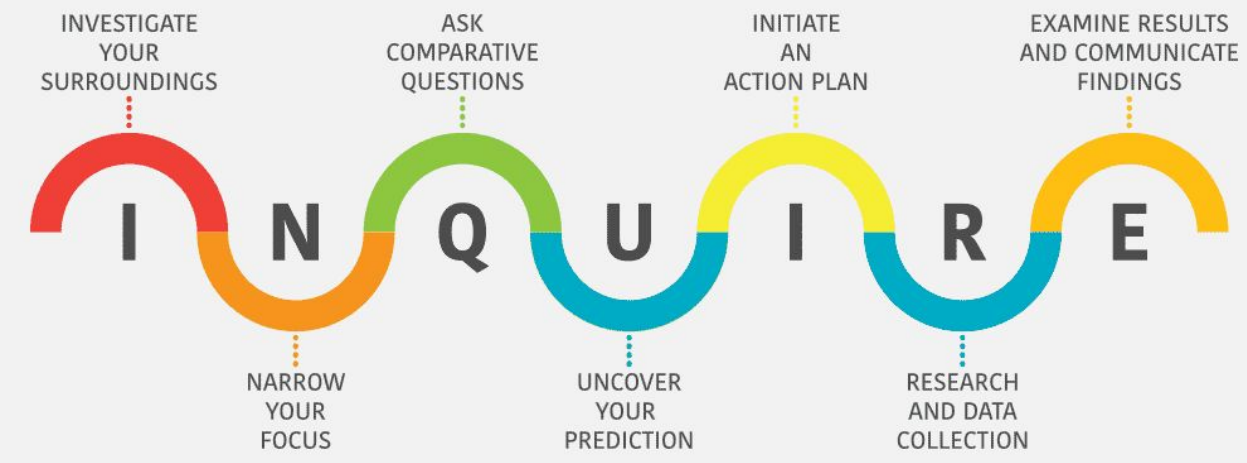
Planting Seeds

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 plants and what they need to survive. Students will be engaged in hands-on activities that involve taking care of plants to answer a comparative question regarding what helps plants grow the best. They 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 class needs. More questions will emerge to continue scientific investigations and further the learning process.

Practical Application

This experiment allows students to understand how plants grow and what they need to survive. Each student will have practice with the scientific process, including documenting and interpreting data.

Lesson Plan

Grade Level: Kindergarten/1st

Class:

Teacher:

Time Required/Duration: Day 1: 45 minutes, 10-15 minutes every few days for an extended time, Final day: 45 minutes

Objectives

1. Incorporate the process of inquiry-based learning into a traditional direct instruction classroom setting.
1. 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.
2. Students will be able to identify things a plant needs to survive.
3. Students will be able to design an experiment to answer a comparative question.
4. Students will be able to complete steps in planting and growing a flower.
5. Students will be able to uncover additional questions and think critically about the data found.

Educational Standards

K.LS.1: Living things have specific characteristics and traits.
K.LS.2: Living things have physical traits and behaviors, which influence their survival.
1.LS.1: Living things have basic needs, which are met by obtaining materials from the physical environment.
1.LS.2: Living things survive only in environments that meet their needs.

Materials

Needed:

1. Soil (from outside or a bag of potting soil)
2. Sharpie marker
3. Other materials for student specific comparative questions.
4. *Optional:* another variety of plant, like succulents

IBL Institute Provided at No Charge (Shipping and handling fees will apply):

1. Zinnia Seeds
2. Plastic cups
3. Spray bottles

May be available for grant funding:

1. Incubator
2. Grow light

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 3 for Vocabulary defined)

Comparative question	Sprout
Prediction	Seed
Observe	Stem
Action Plan	Bloom
Drain	Soil
Grow	Sunlight

Instructional Plan

Day 1:

1. Introduce the concept of plants and how they grow.
2. Ask the students what plants need to grow. Have them think, pair, share their ideas about their knowledge of plants.
3. Have students share with the class, writing their ideas on a piece of paper or a whiteboard. Tell students that they will be learning more about plants and what makes them grow the best.
4. Tell the students that as a class they will be growing and taking care of flowers called Zinnias for a little while. Say that the teacher will take care of one plant normally (watering it every couple days, keeping it by the sunlight, proper drainage, and making sure it has air), but they will get to investigate what other things might change the way the plant grows.
5. Demonstrate how the teacher's seed is planted by taking the cup, poking a few holes in the bottom (explaining that the extra water will drain out of these holes), then placing the soil in the cup about ¾ of the way full. Then, make a small indent with your finger in the middle of the soil and place the seed in the indent. Cover the seed up with soil, then lightly water it. Place it on a window sill near sunlight. **(Investigate Surroundings)**
6. Explain that this is how a plant is normally taken care of, and that you will water it every couple days and keep it near the sunlight.
7. Separate the class into groups of 3-5.
8. Ask the groups to think about how they could change the way that they take care of the plant. **(Narrow Focus)**
9. Introduce the comparative question: "Will the plant grow better if_____ or if _____?" and have them decide in their groups what they want their question to be. Students will each write in their journals what their comparative question is. **(Ask Comparative Questions)**
    a. Their ideas can be anything they think will make the plant grow better, such as using juice or another liquid to water it, draining the water in a different way/ not at all, placing it in a different location, or putting it inside a baggie. Make sure that the materials for their decision are accessible, if they are not, steer them in a direction that will be able to work, but is still similar to their original idea.
    b. Make sure that each group only decides on one change to make to their plant, that way they can tell how their change affected its growth.
10. Have the students poke holes in the bottoms of their cups (unless already prepared for them). Take the students outside to gather soil and place it in their cups, about ¾ of the way full.
    a. If not able to gather soil from outside, prepare by getting a bag of potting soil from the supermarket or a home improvement store.

Instructional Plan Continued

Day 1 (cont.):

11. While still outside or on tile floor, give each group a seed and have them plant it. Walk around to each group and make sure they are planting it correctly. Have students water their plants with their spray bottle once back inside.
12. Have students place their plant near sunlight, or in the area they are choosing to grow their plant.
13. Label each cup with the group number/ name and how they are changing it.
14. Have students go to their seats and write their predictions for the comparative question, as well as completing the journal for the day. **(Uncover Prediction)**

Daily:

1. Each day, have students water/ take care of their plant. **(Initiate Action Plan)**
    a. Before it starts to sprout, water every day making sure it stays wet.
    b. It could take a few days for the seed to sprout.
    c. Water the plant every two or three days, making sure that the soil stays moist, not too wet but not too dry (unless they changed this as their comparative question).
2. Spend 5-10 minutes every few days making observations with their groups about how the plant has grown. **(Research and Data Collection)**
3. Have students write in their journals about their observations and questions they have.
4. If a group's flower dies more quickly than others, have them fill out the worksheet the day their flower can be considered dead. After this, have them plant another seed, this time doing the same process as the teacher's flower. Throughout the time they are growing this flower, have them think about what is different and what is similar in how it is growing.
5. Once every group's seed has sprouted, measure the sprout with a ruler. Have them record their data in their Investigation Book. **(Research and Data Collection)**
6. This process should last at least a week after the plant has sprouted, however it can continue for as long as students are engaged and the class benefits from it.

Final day:

1. Have students observe and measure their flowers for the final time, recording their data.
2. Each group will sit together and talk about how their flower grew (or didn't grow), and how it compares to the teacher's flower. **(Examine Results)**
3. Have students complete the worksheet and prepare for their post assessment presentation. **(Communicate Findings)**
4. The teacher will guide students in filling out the Student Feedback Forms (Appendix 6, page 34)

Instructional Overview

1. The teacher will introduce the topic of plants.
2. The class will make a chart of what they know about what plants need to survive.
3. The teacher will demonstrate planting the flower seed.
4. Each group will create a comparative question regarding what will make the plant grow better.
5. Students will plant a seed and take part in caring for the seed as it grows.
6. The students will observe the plant as it grows and journal their observations.
7. The teacher will take care of a plant normally.
8. Students will answer questions on a worksheet.
9. Each group will present their findings to the class.

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

Fertilizer can help plants grow better than they might have without it. Fertilizer gives plants nutrients that it needs, like nitrogen and potassium. But, depending on the type of fertilizer and what the plant needs, it can also cause there to be too much of a nutrient in the soil. Some fertilizers help the soil to keep in water or to move around air. Some different things people use to make fertilizer are manure, coffee grounds, banana peels, egg shells, epsom salt, fireplace ash, and even ground up bones!

Watering a plant with different types of water can affect how the plant grows. Spring water could be good to water plants with, because it has natural minerals which can help the plant grow. Rain water is also known to be beneficial to the plant, and because it is being reused, it is beneficial to the environment as well. Purified water can have a positive impact on the plant as well, but may not be providing as much nutrients to the plant. Epsom salt mixed in the water is thought to be helpful to plants, but it hasn't been proven. Adding salt or sugar to water before watering plants may actually cause the roots to rot, instead of helping it like some used to think.

The soil that the plant is living in needs to have a way to get extra water out, so that the roots of the plant can be their best. Without drainage, the soil will have too much water, and air cannot easily get to the roots of the plant.

Plants use sunlight for photosynthesis, which is how plants get energy. If they do not have enough sunlight, their leaves might turn yellow. If they don't have enough sunlight for an extended period of time, the plant will die because it has not gotten enough energy. If a plant has too much sunlight, it could get too much energy to be able to use. If this happens too frequently, the plant will continue to try and use the extra energy to make more "food" for itself, and could end up over-producing certain things which could end up killing them.

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 students). 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.

The students will benefit from the background science from the book plants and living things. Make sure the section on the background science is available to each group. Some in the group may have little interest in the material provided whereas others will want to read it in depth, but the end result will be that everyone in the group will know more about plants and what they need. Connect the relevance of the group working with plants as it relates to the comparative question.

Investigate your surroundings and narrow your focus: Encourage each group to think about plants they have seen in their community. Have them get familiar with what plants need to survive. 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 planting seeds, 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 plant grow better 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 measurements of how tall their plant is along with the height of the teacher's control plant. Each student will have a prediction and they should record that prediction. Will the variable help the plant grow taller? Will the variable cause the plant to not survive? 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 data they collect and compare which plant grew the tallest. 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 will share the variables they were testing and their plant measurements. They share their individual predictions. They share their analysis of the measurements and how their plant faired. 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 students 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

Group Procedures

Getting ready:

1. After watching the teacher plant their flower seed, think about what you could change to make the plant grow better.
2. Talk with your group about your ideas. When you choose one thing to change, write it in your Investigation books.
3. Make your own prediction about what will happen to your plant as it grows, and what will happen to your teachers plant as it grows. Draw these in your Investigation Book.

Planting the Seed:

1. Fill the cup with soil, leaving a little room at the top.
2. Make a hole in the middle of the soil with your finger.
3. Place the seed down in the hole. Cover the seed with soil, but do not press down on the soil after it is over the seed.
4. Label the cup with your group name.
5. Water the soil with the spray bottle.
6. Put the cup by sunlight, or where ever your group decided to try to grow the seed.

Daily:

1. With your group, go to your plant.
2. Water your plant with the spray bottle.
3. Observe anything that has changed since the day before. Record what you notice in your Investigation Book.

Extensions

1. Exploring What Plants Need
    a. Have students talk about what plants need to survive.
    b. Synergize to make a list of what plant need (light, water, air, and space)
    c. Pose the question: "Would the plant survive if it had most but not all of these?"
    d. Have students make predictions.
    e. Work as a class to "plant" 5 seeds.
        i. Plant A: Give plant light, water, and air. However, no space. A good model for this would be a pot with soil and seed placed by a window and watered daily but has a sheet of plastic placed on top of the pot.
        ii. Plant B: Give plant water, air, and space. However, no light. A good model would be a pot with soil and seed that is watered daily but is in a closed cabinet.
        iii. Plant C: Give plant air, space, and light. However, no water. A good model would be a pot with soil and seed place by a window but receives no water.
        iv. Plant D: Give plant space, light, and water. However, no air. A good model would be a seed placed in a plastic bag by a window that gets additional water daily.
        v. Plant E: A control plant that is in a pot with soil placed by a window that gets watered daily.
    f. Observe the growth of each plant. Note which plants sprout. How long did these plants survive? Can a plant be successful without these needs met?
    g. Discuss the investigation as a class.

2. Global warming and growing plants are largely connected. This is a real world application for the lesson, where students can learn about how plants are affected by changes in the weather and environment.
    a. 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.
    b. Tell them that the scientific definition of global warming is the normal temperature of the Earth is getting warmer.
    c. Ask the students how plants 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.
    d. Ask students how extremely hot or extremely cold temperatures could affect different types of plants.
    e. If students are interested they could create a comparative question about what temperature is best for plant growth.
    f. To further this extension activity, students can learn about causes for global warming and what they can do to help.
3. Making Fertilizer
    a. Have each student in the class eat a banana.
    b. As they eat, explain that plants need nutrients just like people do. Explain that even though people don't eat banana peels, they have things in them that plants can use to grow healthy.
    c. Once they're done, give each group or table a jar to put their peels in.
    d. Fill the jar with water, then put the lid on the jar.
    e. Wait a week, then take the peels out of the jar.
    f. Fill a spray bottle with the water, using it to water the plants.

4. Decorating Cups
    a. If wanting to make the cups more personalized, the group can decorate their cup before putting the soil inside.
    b. Provide stickers and markers for the students to decorate.
    c. Be sure they do not cover the holes in the bottom of the cup.

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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

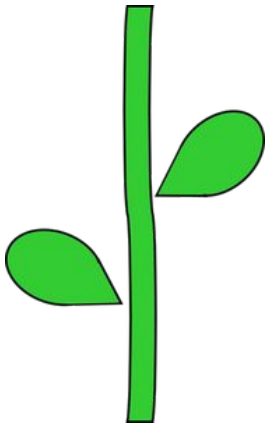
Communicate Findings- explaining what you found to your peers

Drain- when extra water is able to leave the soil

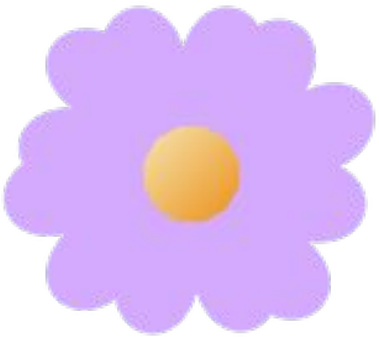
Grow- to be able to live and get larger

Sprout- when a plant just begins to grow

Seeds- the small parts made by plants that allow new plants to grow



Stem- the thin part of a plant that develops and supports the plant



Bloom- to produce flowers

Soil- surface where many plants grow

Sunlight- the energy that comes from the sun that helps plants grow

Growing Plants

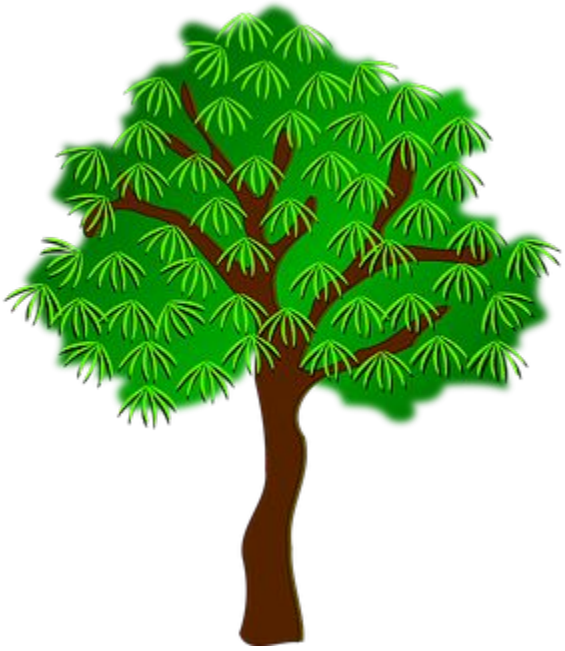
Name: _____

Growing Plants

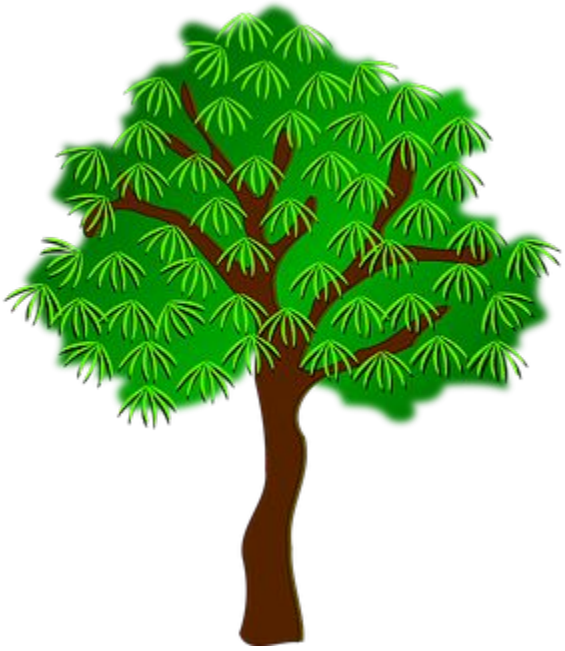
Name: _____

Some plants grow pretty flowers.

Some plants grow pretty flowers.



Some plants grow lots of leaves.



Some plants grow lots of leaves.

Plants can look very different.

Plants can look very different.

Plants are alike in many ways.

Plants are alike in many ways.

All plants need space to grow.

All plants need space to grow.

Plants need water to survive.

Plants need water to survive.

Plants need lots of light and air.

Plants need lots of light and air.

If plants have everything they need they can grow big and strong.

If plants have everything they need they can grow big and strong.

Investigation Book

Investigator: _____

KWL Chart

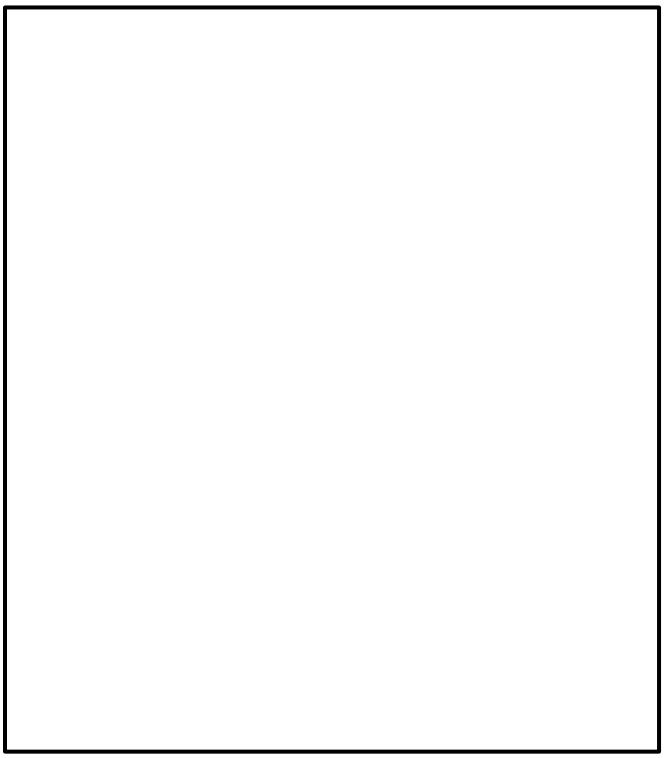
Plants

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

Our Question

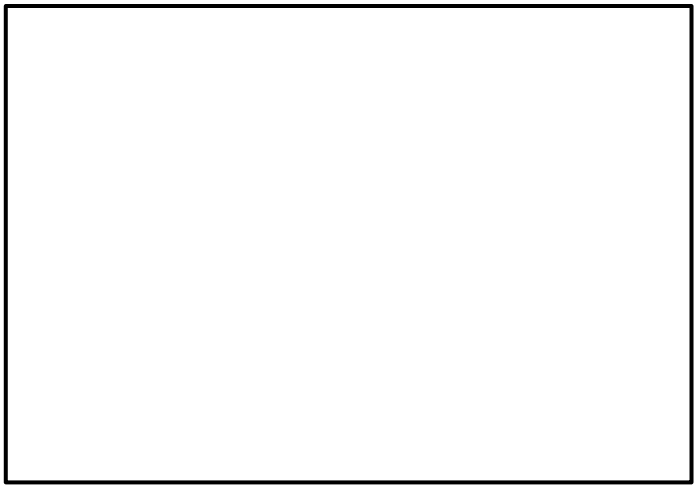
What are you going to investigate?

Will the plant grow taller if _____ or if _____?

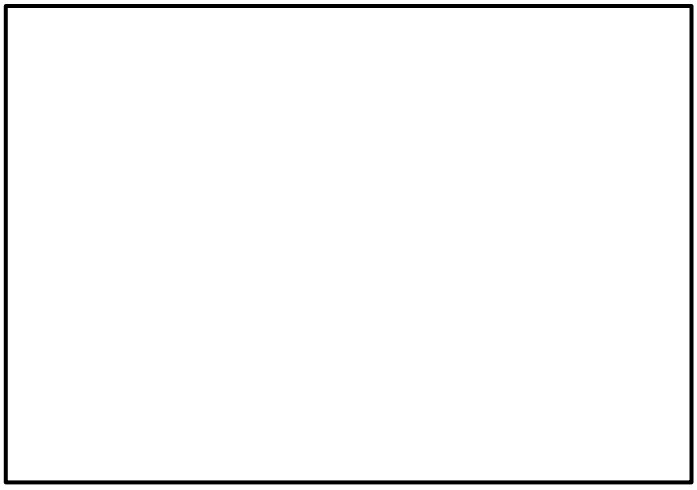


My Prediction

What will the plants look like at the end?



My Teacher's Plant



Our Plant

Data Log

Date	Height of Plant with Normal Conditions	Height of Plant with _____

The Data Explained

Record the information you found.

Plant #1	Height at 14 days	Height at End

Plant #2	Height at 14 days	Height at End

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

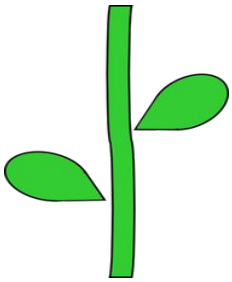
Action Plan- the steps you will take during your investigation

Drain- when extra water is able to leave the soil

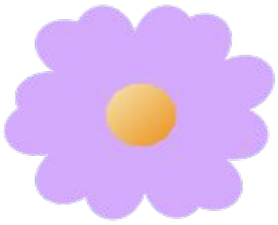
Grow- to be able to live and get larger

Sprout- when a plant just begins to grow

Seeds- the small parts made by plants that allow new plants to grow

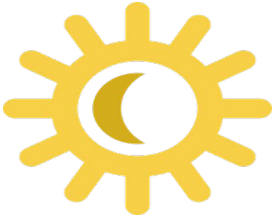


Stem- the thin part of a plant that develops and supports the plant



Bloom- to produce flowers

Soil- surface where many plants grow



Sunlight- the energy that comes from the sun that helps plants grow

Name: _____

I thought _____ would make the plant grow faster.

Plant #1	Height after sprout	Height at end

Plant #2	Height after sprout	Height at end

The _____ made the plant grow _____ .

I know this because _____

_____ .

Appendix 6- Student Feedback

1. What did you learn from this?

2. What additional questions come to mind after having done the experiment?

3. Was it fun and/or interesting?

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Appendix 7- 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