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
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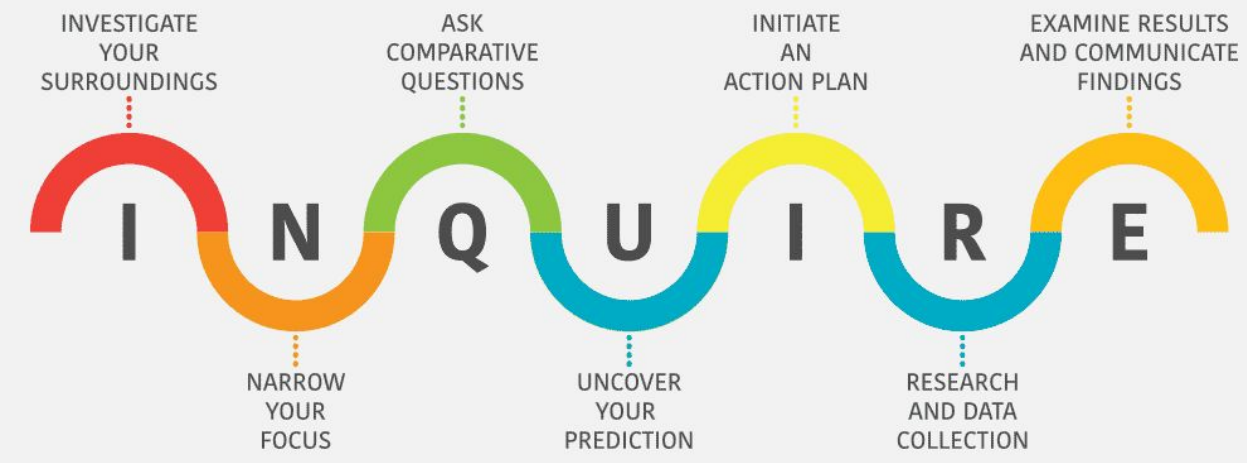
Rummaging Through Rocks

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 different types of rocks. Students will be engaged in hands-on activities that involve collecting and sorting rocks. 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 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 how geologists collect and sort rocks. They will learn about the environment their school is located in and what types of rocks it has around it. Each student will have practice with the scientific process, including documenting and interpreting data.

Lesson Plan

Grade Level: 6th

Class:

Teacher:

Time Required/Duration: 3-5 45-60 minute class periods

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 the different types of rocks, such as igneous, metamorphic, and sedimentary.
3. Students will be able to design an experiment to answer a comparative question.
4. Students will be able to complete steps in collecting, identifying, and sorting rocks from outside the building.
5. Students will be able to uncover additional questions and think critically about the data found.

Educational Standards

6.ESS.1: Minerals have specific, quantifiable properties.

6.ESS.2: Igneous, metamorphic, and sedimentary rocks have unique characteristics that can be used for identification and/or classification.

6.ESS.3: Igneous, metamorphic, and sedimentary rocks form in different ways.

6.ESS.4: Soil is unconsolidated material that contains nutrient matter and weathered rock.

6.ESS.5: Rocks, minerals, and soils have common practical uses.

8.ESS.4: Evidence of the dynamic changes of Earth's surface through time is found in the geologic record.

Materials

Needed:

1. Access to an area with rocks to gather and analyze
2. Access to a sink and paper towels

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

1. Tape
2. Plastic containers (1 per student)
3. Magnifying glass

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
Prediction
Observe
Action Plan
Communicate Findings
Rock
Mineral
Igneous
Metamorphic
Sedimentary
Minerals
Intrusive
Extrusive

Instructional Plan

Day One

1. Give students the background science pages either at the beginning of class or assigned to read before starting the lesson. **(Investigate Surroundings)**
2. Have a class discussion about the differences and similarities between igneous, sedimentary, and metamorphic rocks. Students should be taking notes in their Investigation Books about the characteristics. Their notes will help them classify the rocks the next day.
3. Students will discuss and take notes of what causes those characteristics, and if any of those factors are around their environment. What has happened in their environment? Have them think about this question and explain the next steps in grouping rocks.**(Narrow Focus)**
4. Separate the class into small groups of 3-4 students.
5. Have each group come up with a comparative question about the rocks they will find in the environment. (ex. “Will there be more igneous or sedimentary rocks in my area?” Or “Will the rocks be smaller, like pebbles, or will they be larger, like a golf ball?”) They will also list how they can sort their rocks to help their investigation. They should use resources available to them to help categorize and sort rocks into the designated categories. **(Ask Comparative Questions)**
6. Each student will predict what they think will happen. They should record their own, personal, prediction as well as an explanation of why they predicted that, in their Investigation Books. **(Uncover Prediction)**
7. Groups will go outside and collect rocks for them to eventually sort. Each group should choose one area to investigate, and collect rocks for 10 minutes. Collect rocks that fit in the container. **(Initiate Action Plan)**
8. Go inside and wash them off, using water and drying them with paper towels.
9. Put them in the containers, label them with the name and group, and set them aside for the next day.
10. Students will write in their Investigation Book.

Day Two

1. In their groups, students will obtain their rocks from the day before.
2. The students will sort the rocks into the categories they decided on the day before.
3. They will collect their data and record it in their Investigation Books.
    a. Students can do this by each sorting and counting their own rocks, then as a group adding these all together, or whatever way they feel is best. Try to allow them to come up with their own method as to how to collect this data.
4. Students will write in their Investigation Book. **(Research and Collect Data)**

(Optional) Day Three

1. Students will do an investigation into their environment and what the rocks would likely have been exposed to.
2. Students will ask a comparative question about what environmental factors would play a role in the formation of the rock or how it got there.
3. The students will research and use computers to try to answer their comparative question.
4. Each group will write in their Investigation Books and start preparing for their presentation.

Final Day

1. Students will spend 15 minutes at the beginning of the lesson, creating a presentation for their class. They will use their assessment worksheet to guide them.
2. Each group will get 5-10 minutes to present their findings to the class.

Instructional Overview

Day One

1. The teacher will introduce the topic of rocks.
2. Students will read and discuss the background science.
3. The teacher will explain the procedures they will be completing.
4. Students will come up with a comparative question concerning the rocks they will be collecting.
5. Each group will come up with a comparative question, as well as how to measure it.
6. Groups will go outside and collect rocks.
7. Students will write in their Investigation Books.

Day Two

1. Students will classify, sort, and count their rocks. They will record this in their Investigation Books.
2. Each student will answer the assessment worksheet.
3. Groups will prepare for their presentations the following day.
    a. OR Extend the lesson to 8th Grade standards by looking into what caused the rock to form they way it did, looking at geographic formations in the area and researching online to find answers. An extra day can be spent on this if desired.

Day Three

1. Groups will spend the first 15 minutes of class preparing for their presentation.
2. Groups will have up to 10 minutes each to share their findings with the class.
    a. OR Have students finish up finding their geologic record.

Post-Assessment

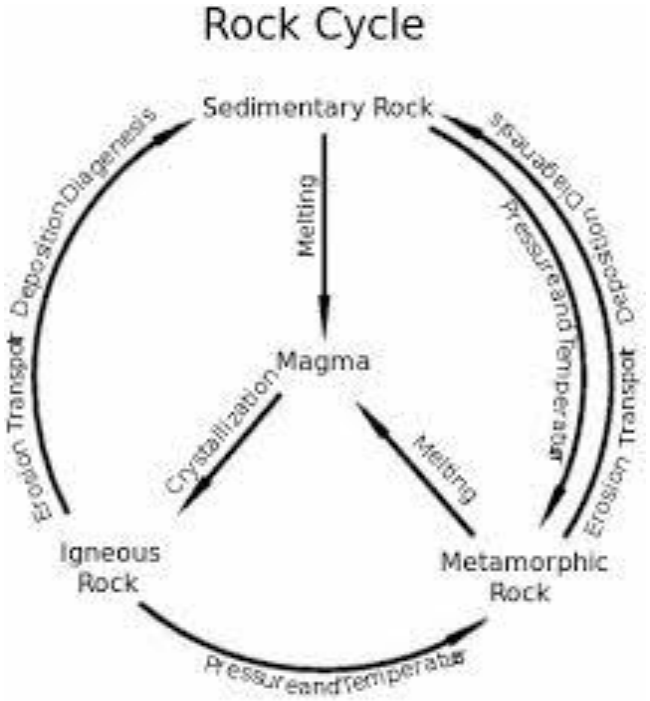
1. Have each student answer the questions on the worksheet.
    a. Discussion about the material during this time should be encouraged, the answers should also be in their own words and what they individually think.
2. Each group will prepare an explanation to the class about their findings. It should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

Background Science

Minerals and mineraloids are the materials that make up rocks. Minerals and mineraloids both are made of chemicals, which determine which type of mineral they are. Minerals, such as quartz, calcite, and feldspar, have crystalline structures and are inorganic in their origin. Mineraloids are the structures that are not crystalline and/or were formed from organic matter, such as Amber which comes from fossilized tree resin. Mineraloids are not true minerals, because they do not meet the criteria of being both crystalline and inorganic.

A rock is a material that is naturally made from minerals and mineraloids. Sometimes a rock can be made of just one mineral, but usually it is a compound of two or more minerals and/or mineraloids. Rocks can vary quite a bit in characteristics such as their size, color, texture, and shape. They are classified into three categories: Igneous, Metamorphic, and Sedimentary. Rocks are sorted into one of those three categories by the way they were formed.

Igneous rocks are formed from magma cooling in the crust or mantle of the Earth. There are Intrusive and Extrusive Igneous rocks, differing by where they are formed. Metamorphic rocks come from other rocks that have changed shape. They change from old rocks which are exposed to high heat, high pressure, and/or hot fluids,. They change and solidify again into new rocks. Sedimentary rocks are formed when sediment and small particles of minerals accumulate. This often happens in water on the Earth's surface.



Journaling

Students will document their data, thoughts, and questions each day for the duration of this lesson. This can be done with technology such as Google Docs or Word, with pencil and paper, using the Investigation Book, or any other method that best fits the class. During each class, the students will respond to prompts provided by the teacher, as well as anything they would like to make a note of for later. The prompts can be modified to best suit the class. For the class period covering the anticipatory set, students will respond to prompts at the end of class. These prompts will allow students to respond to the material covered and write their own inquiries. For class periods where a short time is spent collecting data, students will respond to prompts about the data after it is recorded. On the final day, students will respond to prompts at the end of class, these can be used as an exit slip to assess learning.

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 rocks they have seen in the area. This is a good time for students to ask 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 rocks, the comparative question, at least somewhat, is being provided by you. This makes the lesson plan a more guided inquiry, but is still left open for students to create their comparative question themselves. 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 will be regarding shadows. Examples are: "Will the rocks collected near the water have more metamorphic rocks or more igneous rocks?" or "Will the rocks collected near the trees have more small grain rocks or more large grained rocks?". 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 predicting what rocks they think they will collect, relative to their comparative question. 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 students will come up with an action plan for how to organize and classify the rocks their group found. Different students might have different ideas to go about doing this, and some may end up with the same results even with different processes. Have students explore as many of these processes as time allows. Letting them come up with this part is important, though it may be difficult to let them figure it out for themselves. When students need help, try to assist them by asking guiding questions so that they figure it out, instead of just telling them. 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. They will have their worksheet to guide their presentations. They share their individual predictions. They share their analysis of their data and what kind of rocks they collected, along with the way they sorted them. 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 and the teacher are doing this
Narrow your focus:	The students are is doing this
Ask comparative question:	The students are doing this
Uncover your prediction:	Each student is doing this
Initiate an action plan:	The group is doing this
Research and data collection:	The students 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

Day One

1. Discuss with your group the question you want to investigate. Think about what type of rocks might be around the area, and how they would have gotten there. Decide on a question and write it in your Investigation Book. Come up with a way to organize the rocks to best relate to your comparative question.
2. Each person should make their own prediction about what the outcome of the investigation will be. You will each write your own predictions in your own Investigation Book.
3. Go outside and pick a location to collect rocks from. Gather rocks from that location and fill each of your containers with the rocks.
4. Bring the rocks inside and record your thoughts for the day in your Investigation Book.

Day Two

1. Review the comparative question and your predictions. Do you think your prediction will hold true, or have you changed your mind since collecting the data?
2. Organize and sort the rocks based on your groups established action plan. Make changes based on how well the organization process turned out, making notes of the changes in the Investigation Book.
3. Complete the worksheet individually. Discussion with group members is encouraged, but answers to the worksheet should be in your own words.
4. Prepare for the presentation the following day.

(Optional) Day Three

1. Use the internet and first hand resources to investigate the geologic history of the location of your school. Document what your find.
2. Brainstorm what might have an impact on the rocks that are found in this area.
3. Think about the human influence on the area. How has it impacted the rocks you found, or might find in other areas near you?
4. Complete the worksheet.

Extensions

1. Rocks and minerals are common, and in our lives in a wide variety of ways.
    a. Students can look around the classroom and try to find things that might be made out of rocks or minerals.
    b. They can use computers to research what these items are made out of. They may find other objects made out of rock that they find interesting that they can write down on a piece of notebook paper.
    c. The class can share what they have found with one another. If they are engaged in this activity, it can be made into a take home activity by having students make a list of things in their home that are made of rock. They can share these with one another as well.

2. Rocks and minerals can also make amazing structures in nature.
    a. Students can research different rock formations and structures and write them on notebook paper.
    b. Going to a website with a list of formations, or going to image search may be helpful to students.
    c. Some students may have even seen large rock structures in real life. If any student has gone to one of these areas, they can be encouraged to share their experience with their class.

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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

Rock- a material naturally made from minerals and mineraloids

Mineral- chemicals that are inorganic in nature and form in crystalline structures

Mineraloid- chemicals that are mineral-like, but are organic in nature and/ or do not form in crystalline structures.

Igneous- "volcanic rock" a type of rock that forms when magma is cooling

Metamorphic- a type of rock that forms when rocks change shape

Sedimentary- a type of rock that forms when sediment accumulates

Investigation Book

Investigator: _____

Things I Want to Investigate About Rocks

What are the defining characteristics of each type of rock?

Igneous Rocks	
Metamorphic Rocks	
Sedimentary Rocks	

What factors will you be investigating?

What is your comparative question?

What is your prediction? Why do you think this?

Data Collected		
Metamorphic Rocks	Sedimentary Rocks	Igneous Rocks

This means that….

What made you excited about this project?

What is something you learned after this project?

Name: _____

My Geological Findings

Many aspects of rocks were studied including _____.

There was a focus on _____

_____.

The question that was being investigated was: _____

_____

My Data

This means that _____

_____

_____

_____

_____

Appendix 6- Student Feedback

1. Was your prediction accurate? Why or why not?

2. What did you learn through this process?

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