2 - Inductive Reasoning

Content Area: **Mathematics**
Course(s):
Time Period: **Marking Period 1**
Length: **5 weeks**
Status: **Published**

Summary of Inductive Reasoning

This unit explores the process of recognizing patterns and generalizing relationships observed and experienced through reflective practice. Inductive reasoning is a precursor to deductive reasoning, and it offers potential premises for individuals to use in logical arguments. Inductive reasoning uses incomplete information and therefore has elements of uncertainty; accordingly, many fallacies are associated with inductive reasoning. In this unit, students will be introduced to a list of logical fallacies and will work to identify them in a variety of scenarios. Students will also spend time in this unit working with numerical sequences, both arithmetic and geometric, as well as visual sequences and Ravens matrices, and will use pattern recognition to explain relationships among the terms in a sequence as well as predict the next term that follows. Inductive reasoning relates to the beginning stages of learning, as such, the mathematics in this unit is paired with opening strategies in chess theory. Students will explore opening sequences and discuss the rationale behind various sequences and predict the future moves that are likely to follow. Students will learn that inductive reasoning does not guarantee outcomes, but the strength of their conclusions may be assessed in terms of varying levels of reliability.

Revision Date: July 2023

Essential Questions for Inductive Reasoning

- What is inductive reasoning?
- How does one explore relationships among terms in search of pattern recognition?
- What is the difference between arithmetic and geometric sequences, and how can they be expressed algebraically?
- What are logical fallacies, as they relate to inductive reasoning?
- What are the first principles that guide opening strategies in chess?
- What are the classical opening sequences in chess, and why are they considered logically sound as positional arrangements?

Enduring Understandings for Inductive Reasoning

- Inductive reasoning is a method in which a general principle is derived from a collection of specific data, it is the process of reflecting upon one's observations and experiences to arrive at a general understanding of relationships.
- A variety of heuristics may be used to explore possible patterns, including the use of systematic lists, organizing information into a table, drawing a diagram, and working backwards.
- Arithmetic and geometric sequences may be expressed algebraically, organized into a table, and graphed on the coordinate plane.
- Logical fallacies arise from incomplete information and flawed inductive reasoning.
- Opening sequences in chess have been developed over centuries and are founded upon basic principles.

- Different chess openings are logically sound, and particular formations may be selected based on individual comfort levels with positional strategies.

Objectives for Inductive Reasoning

Students Will Know

- Arithmetic and geometric sequences – how to identify, express algebraically, and graph on the coordinate plane.
- Various logical fallacies that may occur with inductive reasoning.
- Opening sequences based on foundational chess principles – including the importance of central squares, piece mobility, and king safety.

Objectives for Inductive Reasoning

Students Will Be Skilled At

- Recognizing numerical and visual patterns.
- Expressing arithmetic and geometric sequences using algebraic notation.
- Identifying and avoiding conclusions based on logical fallacies.
- Selecting and integrating first principles into opening chess strategies.

Learning Plan for Inductive Reasoning

Class time will initially be used by the instructor in this unit to present numerical and visual sequences, and to encourage students in employing a variety of tactics to identify patterns among the terms. Students will work individually and in small groups, to practice writing algebraic expressions for the sequences, as well as graphing them on the coordinate plane. Analogies will be made across mathematics, logic, and chess, tying together fallacies that arise from incomplete information. Classroom materials include instructor-designed content that feature an assortment of real-life scenarios highlighting flawed conclusions reached through inductive reasoning, and students will work together to identify counterexamples and root causes of the fallacies. Most of the time in this unit will be allocated to students' exploration of opening strategies and game simulations with their peers. Frequent whole group discussions will be incorporated at the end of class periods to clarify key concepts and respond to further questions about logical fallacies and opening strategies. The implementation of opening sequences in chess are often fraught with individual errors that come from a lack of understanding. For all students, especially those without prior experience in opening chess strategies, the instructor will need to carefully connect each lesson to fundamental principles and reinforce students' comprehension of key concepts that accompany the practice of inductive reasoning.

Evidence/Performance Tasks for Inductive Reasoning

During this unit, students will be administered many written assessments as entrance and exit tickets, along

with homework assignments to be completed outside of class time. Short exercises in class will be given as opportunities to practice identifying different types of logical fallacies, predicting the next term in numerical and visual sequences, and naming first principles incorporated in multiple opening strategies for chess. The instructor will gauge student comprehension based on their written answers along with their participation in class discussions. To facilitate more verbal participation at the individual level, students will frequently be divided into pairs for interactive gaming opportunities with their peers. Evidence of student learning will be apparent when the students meet with the instructor to discuss their reflections on inductive reasoning, and will also present itself when students engage in chess matches with their peers.

Materials for Inductive Reasoning

Lecture notes and classroom activities designed by instructor
Internet resources, including YouTube instructional videos and teacher-recommended chess education websites.
Book: "Mathematical Reasoning Through Chess" by Dr. Gary Wenger (in progress)

Standards for Inductive Reasoning

Applying skills through chess provides an inclusive learning environment for all students. It promotes teamwork, mutual respect, and learning about each other's points of view. These activities incorporate the following elements:

New Jersey Diversity and Inclusion Law: In accordance with New Jersey's Chapter 32 Diversity and Inclusion Law, this unit includes instructional materials that highlight and promote diversity, including: economic diversity, equity, inclusion, tolerance, and belonging in connection with gender and sexual orientation, race and ethnicity, disabilities, and religious tolerance.

LA.K-12.NJSLSA.L4	Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate.
LA.K-12.NJSLSA.L5	Demonstrate understanding of word relationships and nuances in word meanings.
LA.K-12.NJSLSA.L6	Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.
LA.K-12.NJSLSA.R2	Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.
MA.F-BF.A.1	Write a function that describes a relationship between two quantities.
MA.F-BF.A.2	Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.
MA.F-IF.A	Understand the concept of a function and use function notation
MA.F-IF.B	Interpret functions that arise in applications in terms of the context

MA.F-LE.A.1	Distinguish between situations that can be modeled with linear functions and with exponential functions.
MA.A-CED.A	Create equations that describe numbers or relationships
MA.A-CED.A.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
MA.A-REI.A	Understand solving equations as a process of reasoning and explain the reasoning
MA.A-REI.B	Solve equations and inequalities in one variable
MA.A-REI.D	Represent and solve equations and inequalities graphically
MA.A-SSE.A	Interpret the structure of expressions
MA.A-SSE.B	Write expressions in equivalent forms to solve problems
TECH.9.4.2.CI.1	Demonstrate openness to new ideas and perspectives (e.g., 1.1.2.CR1a, 2.1.2.EH.1, 6.1.2.CivicsCM.2).
TECH.9.4.2.CI.2	Demonstrate originality and inventiveness in work (e.g., 1.3A.2CR1a).
TECH.9.4.2.CT.3	Use a variety of types of thinking to solve problems (e.g., inductive, deductive).
	Critical thinkers must first identify a problem then develop a plan to address it to effectively solve the problem.

Suggested Accommodations and Modifications

Link to Google Doc with list of accommodations and modifications:

https://docs.google.com/spreadsheets/d/1jqF3mSHC48EXTGESYLOmnO3ZbM_R5_etPyYULfrQhwE/edit#gid=1426178898