

Inductive and Deductive Reasoning Syllabus

	WHAT (skills, goals, knowledge, concepts, readings)	HOW (activities)
DAY 1	“Recursive Formulas and Inductive Reasoning”	
Morning	<ol style="list-style-type: none"> 1. Cake cutting problem 2. Introductions, rules, honor code 3. Pre-Assessment Test 4. Intro to recursive formulas 5. Make recursive formulas 6. Return to cake cutting problem 	<ol style="list-style-type: none"> 1. Have out on desks. Students work independently for awhile, then do intro’s, then return to problem. 2. Names and math background, discuss rules and honor code, etc. 3. Pre-Assessment Test 4. Lecture 5. Student make their own recursive formulas, present them to class, have class guess. 6. Students find recursive formula
Afternoon	<ol style="list-style-type: none"> 1. ND ch. 1 - fractions, $11 \times 11 = 121$ pattern 2. Intro to inductive reasoning 3. Traffic Jam activity – practice finding formulas 	<ol style="list-style-type: none"> 1. TA reads and discusses. Students do $(11,111,111,111)^2$ 2. Lecture and discuss, get student examples 3. Go outside (if possible), use students as markers to play game
Late Afternoon/ Homework	<ol style="list-style-type: none"> 1. Thought Question - dogs 2. Practice recursive formulas 3. Daily letter 	<ol style="list-style-type: none"> 1. Students write answers quietly – discuss now or next day. 2. Students work on recursive formulas assignment individually. 3. Students write short letter to instructor & TA
Supplement	<ol style="list-style-type: none"> 1. Polygon Corners 2. Begin Crisscross Cubes activity (in day 2) 3. Coin-weighing problems 	<ol style="list-style-type: none"> 1. For whole class, in pairs or groups 2. For whole class, in pairs or groups 3. Give to students who finish assignments before you want to collect them from the whole class
DAY 2	“Explicit Formulas and Figurate Numbers”	
Morning	<ol style="list-style-type: none"> 1. Discuss thought question if not discussed yesterday; hand back/review assignments. 2. Intro to explicit formulas 3. Triangular numbers and sum of integers formula 4. Find explicit formulas for cake cutting problem and traffic jam 5. Crisscross cubes activity – practice finding formulas 	<ol style="list-style-type: none"> 1. Each student explains or reads his/her answer to thought question, followed by general discussion and instructor commentary. 2. Lecture, then find explicit formulas from recursive formulas assignment 3. Lecture with opportunities for students to solve problems 4. Students work individually 5. Distribute cubes. Students may work individually or with someone sitting next to them.

Afternoon	1. ND ch. 2 - Roman numbers, 0, bases and exponents 2. Finish crisscross cubes 3. Square, pentagonal numbers	1. TA reads and discusses. 2. As above 3. Lecture mixed with student problem-solving and explanations.
Late Afternoon/ Homework	1. Thought Question - circular numbers 2. Explicit Formulas assignment 3. Daily letter	1. Students write answers quietly – discuss next day. 2. Students work on assignment individually. 3. Students write short letter to instructor & TA
Supplement	1. Penny problem 2. Function machine game	1. For whole class (in pairs) or individual early finishers. 2. For whole class. Explain game. Instructor/TA leads one or two games, then students lead.
DAY 3	“Deductive Reasoning”	
Morning	1. Circular Numbers discussion 2. Intro to deductive reasoning. 3. Census-Taker Problems	1. Each student explains or reads his/her answer to thought question, followed by general discussion and instructor commentary. 2. Lecture – read through census-taker problems first, observe why they do not use inductive reasoning. 3. Students work individually or with someone sitting next to them, focusing on solving the problems.
Afternoon	1. ND ch 3 - Prime numbers 2. Intro to Syllogisms 3. Distinguish between true/false and valid/invalid. 4. Identify valid/invalid syllogisms	1. TA reads and discusses 2. Short lecture, then Syllogistically Speaking worksheet. 3. True/False, Valid/Invalid worksheet – discuss, time to work on individually, students correct own work as its reviewed. 4. Syllogism sheet (p. 80), students work individually.
Late Afternoon/ Homework	1. Thought Q – Bad day 2. Inductive/Deductive Assignment – distinguish between two types of reasoning 3. Census-Taker Problems again 4. Daily letter	1. Students write answers quietly – discuss now or next day. 2. Students work on assignment individually. 3. Students work individually, focusing on writing clear explanations of their solutions. 4. Students write short letter to instructor & TA
Supplement	1. Venn diagrams	1. Venn diagram of writing, science, math; students put themselves into the diagram by what they like to do. Then students work individually on Venn Diagram worksheet(s). Finally, students solve Get It Together p. 83-87 problems in groups.

DAY 4		“Axiomatic Systems”	
Morning	<ol style="list-style-type: none"> 1. Discuss thought question 2. Truth, validity, and soundness 3. Intro to axiomatic systems 4. Review syllogisms 5. Identify valid/invalid arguments based on given axioms 	<ol style="list-style-type: none"> 1. Each student explains or reads his/her answer to thought question, followed by general discussion and instructor commentary. 2. Read over handout and discuss. 3. TA leads matrix height problem – students assigned characters, use clues to put characters in order. 4. Observe that syllogisms are a simple axiomatic system. Pass back first syllogism sheet, review troublesome problems. May want to do another syllogism sheet. 5. BACO Axioms – students work individually 	
Afternoon	<ol style="list-style-type: none"> 1. ND ch. 4 - $0.99\dots=1$, $\sqrt{2}$, rational/irrational #s 2. Lady/Tiger problems 	<ol style="list-style-type: none"> 1. TA reads and discusses, instructor explains graphical proof if necessary (today or tomorrow) 2. Students work individually or with someone sitting next to them 	
Late Afternoon/ Homework	<ol style="list-style-type: none"> 1. Thought Question – Levels of Proof 2. Practice matrix problem solving 3. Daily letter 	<ol style="list-style-type: none"> 1. Students write answers quietly – discuss tomorrow. 2. Students work individually on matrix problem packet 3. Students write short letter to instructor & TA 	
Supplement	<ol style="list-style-type: none"> 1. Dames for Delphi & Frieda’s Fiance 2. Line-Up Logic 	<ol style="list-style-type: none"> 1. For individuals or whole class. Solution to Dames for Delphi is a good example to hand out to class. Might have students critique each other’s explanations. 2. Students work in groups to solve problems. 	
DAY 5		“Proofs”	
Morning	<ol style="list-style-type: none"> 1. Intro to proofs 2. Intro to graphical proofs. 3. Graphical proof of Pythagorean Theorem 4. Practice graphical proofs 	<ol style="list-style-type: none"> 1. Discuss thought question – Levels of proof discussion 2. Remind or review $\sqrt{2}$ proof from ND ch 4. Challenge students to prove graphically that the area of triangle is $\frac{1}{2} b \cdot h$, one or two students present. 3. Explore the Pythagorean Theorem using graph paper and ruler. Then give Graphical Proof of Pythagorean Theorem lecture 4. Students work individually on Graphical Proofs assignment 	
Afternoon	<ol style="list-style-type: none"> 1. ND ch 5 - triangular & square numbers (review) 2. Finish graphical proofs assignment. 3. Examples of algebraic proofs 	<ol style="list-style-type: none"> 1. TA reads and discusses. 2. Finish graphical proofs assignment. 3. Proofs that $0.99\dots=1$, converting repeating decimals to fractions. Instructor/TA demonstrate, students try on their own examples. 	

Late Afternoon/ Homework	1. Finish loose ends from the week 2. Daily letter	1. Pass back/review any assignments not already returned, students have time to finish unfinished assignments. [For day sites: no homework, weekend] 2. Students write short letter to instructor & TA
Supplement	1. Proof by contradiction that $\sqrt{2}$ is irrational and/or there are an infinite number of primes 2. Syllogism handout p. 104 (day 3)	1. Lecture to whole class. 2. Use for whole class, or for students who would like/need more practice with syllogisms.
* * * * WEEK TWO * * * *		
DAY 6	“Limits and Fibonacci Numbers”	
Morning	1. Discuss old work 2. Intro to limits 3. Limit of a regular polygon as number of sides approaches ∞ 4. Proof that $1/2 + 1/3 + \dots \rightarrow \infty$, terms “converge” & “diverge”	1. Pass back/review old work – students explain problems when appropriate 2. Lecture 3. Cutting paper circles activity 4. Lecture
Afternoon	1. ND ch 6 - Fibonacci #s 2. Intro to Fibonacci numbers and the golden ratio 3. Fibonacci and golden spirals	1. TA reads and discusses 2. Lecture with guided discovery/problem solving 3. Explain, then students work individually.
Late Afternoon/ Homework	1. Thought Question – limits 2. Worm problems 3. Daily letter	1. Students write answers quietly – discuss now or next day 2. Students work individually 3. Students write short letter to instructor & TA
Supplement	1. Snowflake curve 2. Worm on rubber rope 3. Proof by contradiction – consecutive Fibonacci numbers	1. Present to whole class. Let class start drawing curves, but might not expect everyone to finish it, only students who are enjoying it when they have time. 2. Use with whole class. Challenging – give hints. 3. Might give it to a student to prep. then have student explain to whole class.
DAY 7	“Symbolic Logic”	
Morning	1. Discuss thought question/old work 2. Intro to symbolic logic: not, and, or, if-then, if and only if, truth tables 3. Practice converting between English and symbols	1. Each student explains answers to thought questions. Students present solutions to old assignments as appropriate 2. Symbolic logic lecture 3. Students work on symbolic logic worksheets then review together
Afternoon	1. ND ch 7 - Pascal’s triangle 2. Observe patterns in Pascal’s triangle 3. Truth tables group activity	1. TA reads and discusses 2. Pascal’s triangle patterns lecture/demonstration and Pascal’s triangle coloring activity

		3. In groups, students make truth tables on the floor out of squares of construction paper, copy solutions onto their own papers.
Late Afternoon/ Homework	1. Thought Question – one example 2. Practice symbolic logic and truth tables 3. Self-Evaluations	1. Students write answers quietly – discuss now or next day 2. Students work on symbolic logic worksheets individually and/or continue truth tables group activity 3. Students write self-evaluations covering the aspects of performance listed on the board.
Supplement	1. More time building truth tables 2. Carpool Axioms	1. This activity can go on indefinitely 2. For whole class or individuals
DAY 8	“Symbolic Arguments and Paradoxes”	
Morning	1. Discuss thought question/old work 2. Introduction to contrapositive 3. Symbolic Arguments	1. Each student explains or reads his/her answer to thought question, followed by general discussion and instructor commentary. 2. Worksheet with lecture/explanation 3. Worksheets and activities
Afternoon	1. ND ch 8 - factorials, combinations 2. Analyzing Paradoxes	1. TA reads and discusses 2. Read together, make sure students understand. Then students work individually.
Late Afternoon/ Homework	1. Begin painted cube project 2. Daily letter	1. Explain project. Students have time to work on project individually. 2. Students write short letter to instructor & TA
Supplement	1. Analyzing arguments in truth tables group activity (day 7) 2. BACO axioms part 2	1. Students work in groups, using truth table tiles to analyze arguments 2. For individuals or whole class in small groups.
DAY 9	“Reasoning Fallacies”	
Morning	1. If day site, check progress on painted cube project. 2. Intro to fallacies	1. TA/students lead function machine (or other activity) while instructor checks in with each student. 2. Lecture
Afternoon	1. ND ch 9 - infinities 2. Fallacy skits	1. TA reads and discusses 2. Pairs of students write short skits. Act out, audience guess which fallacy is being enacted.
Late Afternoon/ Homework	1. Complete painted cube project 2. Daily letter	1. Students finish working individually on painted cube project. 2. Students write short letter to instructor & TA
Supplement	1. “Number Patterns” from <i>Get It Together</i>	1. Students work in groups to solve problems. A review of many of the sequences already presented.

DAY 10	“Strategies”	
Morning	1. Distinguish between a solution and a strategy 2. Bottle-counting problems 3. Start fallacy identifications	1. Very brief lecture 2. Students work individually or with others sitting next to them 3. Students work individually. Instructor/TA circulate, answering questions.
Afternoon	1. ND ch 10 - geometry stuff 2. Finish fallacy identifications 3. Light-switching problem	1. TA reads and discusses 2. As above. 3. Students work individually (or in pairs)
Late Afternoon/ Homework	1. Finish loose ends from the week. 2. Daily letter	1. Pass back/review any assignments not already returned, students have time to finish unfinished assignments. [For day sites: no homework, weekend] 2. Students write short letter to instructor & TA
Supplement	1. Perplexing paths	1. For individuals or whole class.
* * * * WEEK THREE * * * *		
DAY 11	“Abductive Reasoning”	
Morning	1. Review bottle-counting problems, intro to modular arithmetic 2. Intro to abductive reasoning 3. Blocker game 4. Review Light-switching problem	1. Students present solutions, instructor or TA lectures on modular arithmetic, students do modular arithmetic problems. 2. Lecture, students generate examples 3. Students pair up, play game, figure out general strategy, explain why strategy works. 4. Have students who reached the complete solution explain. Use as example of abductive reasoning.
Afternoon	1. ND ch 11 - combinatorics 2. Review fallacy identification worksheet 3. Debates	1. TA reads and discusses 2. Instructor has marked good responses on student papers. Students explain their marked responses. 3. Instructor/TA chooses two volunteers and assigns topic and sides. Students debate. After debate audience gives constructive feedback on fallacies used and overall poise, debating styles, etc.
Late Afternoon/ Homework	1. Thinking about reasoning worksheet 2. Sticky gum problems 3. Daily letter	1. Students work individually – discuss now or next day 2. Students work individually 3. Students write short letter to instructor & TA
Supplement	1. “Mysteries” from <i>Get It Together</i>	1. Students work in groups to solve problems.

DAY 12	“Tower of Hanoi”	
Morning	1. Discuss reasoning worksheet 2. Tower of Hanoi 3. Formal inductive proofs	1. Instructor/TA leads discussion, all students asked to participate. 2. Students play game and find the formulas individually or with others sitting nearby 3. Lecture
Afternoon	1. Hotel Infinity part 1 2. Debates	1. TA reads and discusses 2. As in day 11.
Late Afternoon/ Homework	1. Challenging Syllogisms 2. Daily letter	1. Students work in pairs (preferably) or individually (day site) 2. Students write short letter to instructor & TA
Supplement	1. Meta-Formulas 2. Truth Tellers and Liars	1. “Lecture” with guided problem-solving to whole class, if algebra skills strong. 2. For whole class or individuals.
DAY 13	“Game Theory”	
Morning	1. Review analyzing arguments 2. Paper-Scissors Game 3. Prisoner’s Dilemma, Tragedy of the Commons	1. Students present their responses. 2. Write rules on board, students copy into notebooks. Play in various pairs. Students report on scores, ways games went. Discuss implications. 3. Lecture
Afternoon	1. Hotel Infinity part 2 2. Infinity tricks 3. Cantor’s string proof and discussion of uncountable infinity	1. TA reads and discusses 2. Lecture with interruptions 3. Lecture
Late Afternoon/ Homework	1. Thought Question – Game Theory and tragedy of the commons 2. Daily letter	1. Students write individually (discuss next day) 2. Students write short letter to instructor & TA, including anything they are particularly proud of and want mentioned in their evaluations
Supplement	1. Juggling Act	1. For whole class (if not previously used for individuals)
DAY 14	“Reasoning Outside the Box”	
Morning	1. Discuss game theory thought question 2. Nine dots puzzles 3. Hidden assumptions exercises	1. Each student shares ideas, then general discussion, and instructor/TA commentary. 2. Put on board, students work in notebooks individually 3. Students work individually or in small groups, potentially of their own choosing
Afternoon	1. Lateral Thinking Puzzles 2. SPE’s 3. Site-specific activities	1. TA selects and leads 2. Instructor distributes, a student collects 3. Visit other classes, prepare for closing day, etc.

Late Afternoon/ Homework	1. Finish loose ends from the week. 2. Daily letter	1. Pass back/review any assignments not already returned, students have time to finish unfinished assignments. 2. Students write short letter to instructor & TA
Supplement	1. Any activity not previously used or completed.	
DAY 15	"Closure"	
Morning	1. Pass back/discuss all remaining work, take stuff down from walls 2. Reading list 3. ND ch 12 – closure 4. Certificates 5. Other stuff specific to site	1. Students present solutions as appropriate 2. Pass out and discuss, students may want to add their own recommended books to it. 3. TA reads and discusses 4. Instructor & TA hand out 5. Presentations, visit to other classes, etc.
Supplement	1. Is math discovered or created?	1. Students write about the question, then each student shares, then open discussion.