

Simply Elementary, Watson!

Inductive and Deductive Logic

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Grade Level	9th – 10th Grade	**Time Frame**	3 class periods
Subject	Mathematics	**Duration**	105 minutes
Course	Geometry		

Essential Question

How can we use facts and patterns to draw logical conclusions?

Summary

In this lesson, students explore the differences between inductive and deductive logic and how to use that reasoning to draw logical conclusions.

Snapshot

Engage

Students discuss their methods for finding the next figure in a pattern to introduce the idea of reasoning.

Explore

Students use given information to draw conclusions about what is going to be on the lunch menu, unknowingly exploring inductive and deductive logic.

Explain

Students formalize their understanding of inductive and deductive reasoning.

Extend

Students predict the sum of the interior angles of a 13-gon using both inductive and deductive reasoning and an interactive GeoGebra activity.

Evaluate

Students create their own inductive or deductive problem and then find the logical conclusion of their peer's problem.

Standards

ACT College and Career Readiness Standards - Mathematics (6-12)

G704: Analyze and draw conclusions based on a set of conditions

Oklahoma Academic Standards Mathematics (Geometry)

G.RL.1.2: Analyze and draw conclusions based on a set of conditions using inductive and deductive reasoning. Recognize the logical relationships between a conditional statement and its inverse, converse, and contrapositive.

Attachments

- Inspecting Interior Angles—Simply Elementary, Watson - Spanish.docx
- Inspecting Interior Angles—Simply Elementary, Watson - Spanish.pdf
- Inspecting Interior Angles—Simply Elementary, Watson.docx
- Inspecting Interior Angles—Simply Elementary, Watson.pdf
- Lesson Slides—Simply Elementary, Watson.pptx
- What's For Lunch_Blue—Simply Elementary, Watson - Spanish.docx
- What's For Lunch_Blue—Simply Elementary, Watson - Spanish.pdf
- What's For Lunch_Blue—Simply Elementary, Watson.docx
- What's For Lunch_Blue—Simply Elementary, Watson.pdf
- What's For Lunch_Red—Simply Elementary, Watson - Spanish.docx
- What's For Lunch_Red—Simply Elementary, Watson - Spanish.pdf
- What's For Lunch_Red—Simply Elementary, Watson.docx
- What's For Lunch_Red—Simply Elementary, Watson.pdf

Materials

- Lesson Slides (attached)
- What’s for Lunch? Red handout (attached; one per group; print two-sided)
- What’s for Lunch? Blue handout (attached; one per group; print two-sided)
- Inspecting Interior Angles handout (attached; one per student; print two-sided)
- Pencils
- Paper
- Calculators
- Student devices with internet access

10 minutes

Engage

Introduce the lesson using the attached **Lesson Slides**. **Slide 3** displays the lesson's essential question. **Slide 4** identifies the lesson's learning objective. Review each of these with your class to the extent you feel necessary.

Display **slide 5** and introduce the Give Me Five strategy. Then, ask the class what they notice about the three figures on the slide.

After two minutes of "think time" (or wait time), ask five students to share their thoughts.

Teacher's Note: Guiding the Activity

To meet your students' needs, consider having them share with Elbow Partners prior to having them share aloud with the class.

Transition to **slide 6** and facilitate a discussion to come to a consensus about what the next iteration (Figure 4) of the pattern should look like. Use this time to help students practice communicating their reasoning.

Teacher's Note: Purpose

The point of this activity is to start a discussion about how we reason and know things about patterns. There are multiple ways to examine and think about this problem. Any solutions that students can reasonably justify should be validated.

30 minutes

Explore

Show **slide 7** and split students into groups of 2–3. Provide half of the groups with a copy of the attached **What's for Lunch? Red** handout and the other half with a copy of the attached **What's for Lunch? Blue** handout. Here students are given information about how the menu at the cafeteria is determined, but the same information is presented differently on the two handouts—do not yet share this information with the class.

As groups complete their handouts, walk around and monitor their work. Help students who are struggling, but be careful not to give them any answers.

Consider asking questions like the following:

- Why do you think that?
- Does the whole group agree?
- What have you tried already?

After groups have completed their work, have them partner with another group that had the opposite handout to discuss their results.

20 minutes

Explain

Display **slide 8** and ask a group to present their results and share how they reached their conclusions. Make sure they explain their reasoning. Do not affirm or correct the answers. After one group has shared, ask the class if anyone else had different answers or different reasonings. As needed, use the hidden **slide 9** for what should be on the menu.

Teacher's Note: Guiding the Activity

As students share, expect students with the Red version of the handout to not have the correct answer for the November 5th date. Consider asking for a show of hands for how many students with the Red version of the handout had to revise that answer. And if the question does not naturally come up, ask if there was any way for those with the Red version of the handout could have known that the first Monday of the month was special. Then facilitate a brief discussion on how only having part of a pattern may not be enough information to draw accurate conclusions.

Show **slide 10** and lead a class discussion on the following questions:

- Whose reasonings were more convincing?
- Which handout do you think was easier? Why?
- Which handout was more difficult? Why?
- Did you change anything when you worked with the group who did the other handout?

Display **slide 11** and use the slide to share the definitions of *inductive* and *deductive reasoning*.

- *Inductive Reasoning*: the process of observing data, recognizing patterns, and making generalizations about those patterns
- *Deductive Reasoning*: the process of showing that certain statements follow logically from agreed-upon assumptions and proven facts

Have students work in their groups to determine which reasonings presented used inductive reasoning and which used deductive reasoning.

Show **slide 12** and read the prompt from the slide: “The first four numbers in a sequence are 3, 6, 9, and 12. What is the fifth number in the sequence?” Ask students to come to a logical conclusion and then decide whether they use inductive or deductive reasoning.

Repeat this using slides **13–15** with the following prompts:

- Ruthie takes a nap every afternoon. The time is 1:45 p.m., what is Ruthie doing?
- Amir got to school at 7:59 a.m. on Monday, at 8:01 a.m. on Tuesday, and at 8:03 a.m. on Wednesday. What time will he get to school on Friday?
- If I get to work on time, I will be assigned to a better station. I got to work on time today.

Sample Student Responses:

- **Slide 12:** The next number is 15, because I added 3 more. This is inductive reasoning.
- **Slide 13:** It is afternoon and Ruthie takes a nap every afternoon, so she must be taking a nap. This is deductive reasoning.
- **Slide 14:** Amir will get to school at 8:05 a.m. on Thursday and 8:07 a.m. on Friday, because he is showing up 2 minutes later each day. This is inductive reasoning.
- **Slide 15:** If getting to work on time means being assigned a better station, then my getting to work on time means that I was assigned a better station. This is deductive reasoning.

30 minutes

Extend

Display **slide 16**. Give each student a copy of the attached **Inspecting Interior Angles** handout and calculator. Provide students with the link to the GeoGebra activity: k20.ou.edu/7g. Here students use the provided tools to create polygons and effortlessly find the angle measures of the interior angles. Have students follow the directions on their screen, and then use their results and calculators to complete the "Measure the Angles" portion of their handout. Students are to use this information to answer the questions in the "Find the Pattern" portion and predict the sum of the interior angles of a 13-gon.

Once several students are done with Parts A and B, move to **slide 17**. The directions are also on the handout for students to be able to easily work ahead. Students are directed to navigate to the "Use the Facts" portion of the GeoGebra activity to complete the corresponding portion of their handout. Again, they are asked to predict the sum of the interior angles of a 13-gon, but this time they are given the formula.

15 minutes

Evaluate

Display **slide 18** and introduce the Commit and Toss strategy. Ask students to take out a half-sheet of paper and create their own inductive or deductive reasoning problem like they saw during the Explain phase of the lesson. Remind students that they need to give enough information that someone could use either inductive or deductive reasoning to answer their question. Give students approximately 5 minutes to complete this task.

Move to **slide 19** and have students crumple their papers and gently toss them into the middle of the room. Then have students pick up a paper, other than their own, and answer the question on the paper.

Use student responses to determine if additional practice is needed.

Resources

- K20 Center. (n.d.). Elbow partners. Strategies. https://learn.k20center.ou.edu/strategy/116
- K20 Center. (n.d.). Commit and toss. Strategies. https://learn.k20center.ou.edu/strategy/119
- K20 Center. (n.d.). GeoGebra. Tech tools. https://learn.k20center.ou.edu/tech-tool/2352
- K20 Center. (n.d.). Give me five. Strategies. https://learn.k20center.ou.edu/strategy/150
- K20 Center. (n.d.). *Inspecting interior angles* [Web app]. GeoGebra. https://www.geogebra.org/m/ca3cxmcz