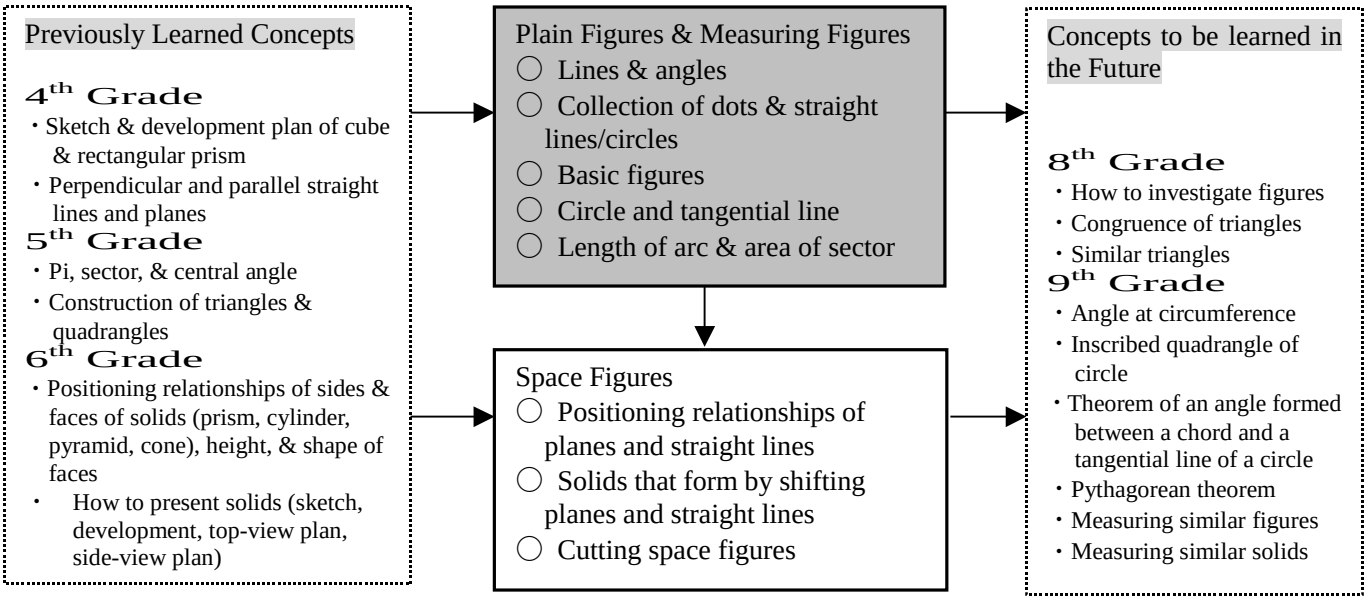
7th Grade, Class A Mathematics Lesson Plan

November 14, 2000 (Tuesday)
3rd Period Gym #1
Instructor: Tatsuo Suginaka
Number of Students: 18

1. Name of the Unit: Plain Figures and Measuring Figures

2. Relationship of the Unit to the Curriculum



3. Instructional Plan

Plain Figures and Measuring Figures (Total: 15 lessons)

○ Straight lines and angles ・・・・・・・・・・・・・・・・ 3 lessons
○ Collection of dots and straight lines and circles ・・・・・ 2 lessons
○ Basic figures ・・・・・・・・・・・・・・・・・・・・・・ 4 lessons
○ Circle and tangential line ・・・・・・・・・・・・・・・・ 1 lesson
○ Length of arc and area of sector ・・・・・・・・・・・・・ 3 lessons (this lesson is 3/3)
○ Further exploration and exercises ・・・・・・・・・・・・ 2 lessons

4. Instruction of this Lesson

(1) Title: Length of Arc and Area of Sector

(2) Goal

① Think about what kind of information is needed in order to find the area of a sector, and proceed with good foresight to an activity that finds the area of the side of a cone.
② Examine and think of a way to find the area of the side of a cone mathematically, using the length the generating line of the cone and the radius of the base.

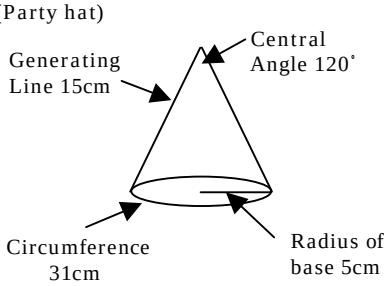
(3) Relationship of the Lesson to the Goal of Mathematics Education at the School

This lesson is a higher potential lesson which requires using the previously learned concept of measuring a sector and thinking about finding the area of the side of a cone, which has a curved surface. The majority of my students are not good at examining and thinking about solids without having concrete objects. Therefore I planned this lesson to ask the students to actually measure a model of a cone in the classroom to help each individual student to think about the problem more easily. I hope

this activity will not be carried out using student trial and error, but rather will be based on the student's previously learned knowledge. Using this knowledge and having good foresight, thinking out, and coming up with good ideas can help the students discover a higher mathematical solving process. I think this experience can be shared and jointly owned by the students.

Regarding the topic of the area of the side of a cone, this topic was moved from the 9th grade curriculum to the 7th grade curriculum this year (2000) as a part of a reorganization of the course of study. I believe it is not necessary to generalize the formula for the area of the side of a cone using mathematical symbols in the 7th grade curriculum. However I think the content holds potential for higher learning. Therefore, I decided to present this problem and made a thought out plan in order to foster students' thinking ability.

(4) Learning Process

Steps	Activity of the Students	Teacher's Support and Points to Remember	Evaluation View Point
Intro-duction 5 min.	1. Confirm the Problem • Think about cone shaped things in everyday life. • Think about a cone shaped party hat. ➢ It can be made from a sector. ➢ If the central angle of the sector changes, the shape of the hat also changes. • Think about how to find the area of the hat. • Confirm the formula for area of sector. Area of sector = Area of circle × Ratio $S = \pi r^2 \times a / 360$ $S = \pi r^2 \times l / 2\pi r$	• Make the students realize that the side of the cone is constructed from a sector, about which they learned previously. • Confirm with the students that finding the area of the side of cone is the same as finding the area of a sector. • The ratio of sector (how much portion of a complete circle) is not only determined by its central angle but also by the length of its arc.	
Develop-ment 35 min.	2. Posing the Problem Let's find area of the party hat! Tools: paper, rulers, protractors, compasses, calculators	(Party hat)  • Pass out the party hats and various tools for investigation.	

3. Individual Activity

- Think about the problem by measuring the lengths and angles of the solid and tracing the face of it on paper.

- Ask to the students to measure various parts of the solid without dismantling it.
- Walk around the classroom and encourage the student's activity.

Did the students try to investigate the area of the side of the cone on their own?

Did they measure the solid while having good foresight and logical thinking?

Students' anticipated solutions

① *Try to investigate the area by tracing the side of cone by rolling it on a sheet of paper.*

② *Try to find a ratio of the central angle of the sector that is located on the side of the cone using a thin flexible protractor.*

③ *Try to find a ratio of the arc of the sector that is equal in length to the circumference of the base using a thin flexible ruler.*

④ *Measure the diameter or radius of the circle which forms the base of the cone and calculate the circumference. Then find out the ratio of the sector.*

4. Presentation Activity

[Pre.①] [Pre.②] ⇨ Find the area using radius and central angle

[Pre.③] [Pre.④] ⇨ Find the area using radius and length of arc

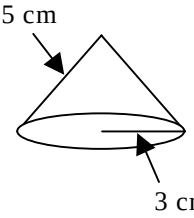
- Confirm the method that uses the radius and central angle by looking at method ① and ②.
- Explain the method that uses the radius and the length of the arc by looking at method ③.
- If method ④ was not presented by the students, the teacher will ask a question.

Were the students able to find the area of the side using the results from their measuring activity?

"Is there any other way to find the length of the arc?"

・Presentation ④

1. Circumference of the base：$2\pi \times 5 = 10\pi$
2. Length of the arc of the sector：10π
3. Circumference of a circle which radius equals to the length of generating line：$2\pi \times 15 = 30\pi$
4. Ratio of sector：$10\pi / 30\pi = 1/3$
5. Area of sector：$\pi \times 15^2 \times 1/3 = 75\pi (\text{cm}^2)$

	5. Confirmation of the Learned Contents Length of arc = Circumference of base Ratio = Length of arc / circumference Area of sector = area of circle × ratio	・ Confirm the length of circumference of the base is as same as the length of the arc. ・ Using flash cards, summarize what the students learned on the blackboard using flash cards.	
	6. Firmly Establishing Students Learned Contents ［Exercise］ Please find the area of the side of the cone that has a dimension of 5 cm generated line and 3 cm radius for the base.  ・ Individual activity→presentation→ checking the answer	・ Walk around the classroom	Were the students be able to find the area of the side of the cone using the length of generated line and the radius of the base?
Expansion 6 min.	7. Expansion of the Learned Contents ［Further Exploration Ⅰ］ Is there any easy way to know the ratio of the sector? ［Further Exploration Ⅱ］ Is there any easy way to find the area of the side of the cone? ・ Discussion	・ Ask the students to pay attention to the ratio of the length of the generated line to the radius of the base.	Did the students try hard to examine and think of a way to find ratio of the sector and area of the side of a cone mathematically?
Conclusion 4 min.	8. Summary of This Lesson ・ Be able to understand that “if you can find the length of the generated line of the cone and the radius of the base, you can find the area of the side of the cone.”		

(5) Evaluation

① Were the students able to do the measurement activity for finding the area of the side of cone by having good foresight and discovering their own method? 〈Interest･desire･attitude〉 〈Mathematical thinking〉〈Expression･manipulation〉

② Were the students able to find the area of the side of cone using the length of the generated line and the radius of the base, and could they examine and think mathematically.
〈Interest･desire･attitude〉〈Mathematical thinking〉