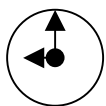


[~50 minute lesson]

United States Public Release Lesson 3 Lesson Graph [8th grade]

[9 1/2 minutes]

Public Class Work: Teacher says that today we will learn about exponents. She holds up cubes linked together to represent 2^2 , 2^3 , 2^4 . She says, “look at the growth--very, very big”.

Exponents (Power)

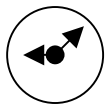
 2^3 Exponent

Base

The exponent tells how many times the base is multiplied.

The teacher then plots a graph showing the growth from 2^2 , 2^3 to 2^4 .

The teacher then works on three examples to demonstrate how to multiply exponents.



[3 1/2 minutes]

Private Class Work: Working on Section One of Worksheet

Section one of the worksheet

Teacher asks students to do first three problems and look for a pattern.

Students work individually for two minutes, then work in groups of five.

Students work in groups of five to discuss patterns found that have to do with exponents.

1. $a^2 \cdot a^4$

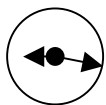
2. $a^2 \cdot a$

3. $a^3 \cdot a \cdot a^4$

RULE: $a^m \cdot a^n$

[2 1/2 minutes]

Public Class Work: Discussing Section One of Worksheet

After students give answers to the problems: (1) a^6 (2) a^3 (3) a^8 (a student says $3+1+4$)T: “When you multiply the same base, it’s added”. They come up the 1st rule: **RULE: $a^m \cdot a^n = a^{m+n}$** 

[4 1/2 minutes]

Private Class Work: Working on Section Two

Students work in groups on problems four to six to find a rule.

The teacher asks them to expand so that they can see the pattern more quickly.

Section two of the worksheet

4. $(a^2)^3$

5. $(a^3)^2$

6. $(a^2)^4$

RULE: $(a^m)^n$

[2 minutes]

Public Class Work: Whole Class Discussion of Section Two of Worksheet

Students give answers to the problems: (4) a^6 (5) a^6 (6) a^8 and the rule: **RULE: $(a^m)^n = a^{mn}$** 

[5 minutes]

Private Class Work: Students Work on Section Three of Worksheet

Teacher asks students to notice there are two items being raised to a power. She says: “see if you can come up with a rule”.

Teacher moves from group to group helping students with the three problems.

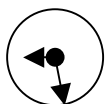
Section three of the worksheet

7. $(a \cdot b)^3$

8. $(a \cdot b)^5$

9. $(a \cdot b)^4$

RULE: $(a \cdot b)^m$



[4 minutes]

Public Class Work: Discussing Section Three of Worksheet

Students give answers to problems:

(7) $a^3 \cdot b^3$ (8) $a^5 \cdot b^5$ (9) $a^4 \cdot b^4$

and the rule: **RULE: $(a \cdot b)^m = a^m \cdot b^m$**

T: “Now we will work on division.”

*On the whiteboard:*Dividing Exponents

$$\frac{2^4}{2^2} = \frac{2 \cdot 2 \cdot 2 \cdot 2}{2 \cdot 2} = 2^2 \quad \left(\frac{4}{2}\right)^3 = \left(\frac{4}{2}\right) \left(\frac{4}{2}\right) \left(\frac{4}{2}\right) = \frac{4^3}{2^3}$$

[3 minutes]

Private Class Work: Students Work on Section Four

Students work on problems 10-12, while teacher circulates.

10. $\frac{a^6}{a^2}$ 11. $\frac{a^4}{a}$ 12. $\frac{a^3}{a^2}$ RULE: $\frac{a^m}{a^n}$

[1 minute]

Public Class Work: Whole Class Discussion Section Four of Worksheet

Students share their answers: (10) a^4 , (11) a^3 , (12) a . They come up with the 4th rule: **RULE: $a^m \div a^n = a^{m-n}$**

[3 minutes]

Private Class Work: Students Work in Groups on Section Five

Students work on problems 13-15 while teacher circulates.

13. $\left(\frac{a}{b}\right)^3$ 14. $\left(\frac{a}{b}\right)^5$ 15. $\left(\frac{a}{b}\right)^6$ RULE: $\left(\frac{a}{b}\right)^m$

[1 minute]

Public Class Work: Discussing Section Five of Worksheet

Students share their answers: (13) $\frac{a^3}{b^3}$, (14) $\frac{a^5}{b^5}$, (15) $\frac{a^6}{b^6}$, (16) $\frac{a^m}{b^m}$. They then come up with the 5th

rule: $\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$



[12 minutes]

Private Class Work: Students Work in Groups

The teacher asks the students to work in groups to prove the following

“Come up with proofs and you will present them tomorrow”

“Think about how you are going to get 0 power.

Think what can I do mathematically to get a^0 . How would you get a^{-n} ?

Use rules of multiplication and division to prove.”

On the whiteboard

Prove

$a^0 = 1$

$a^{-n} = \frac{1}{a^n}$