Welcome to the course of Basic Physics. Myself, Priya Rawat, Assistant Professor from Government College of Arts, Science and Commerce, Sanquelim. Let us continue the series on Unit 2 : Properties of Matter.
Today, let us start with model number 12. Pressure difference across curved surfaces Part 2.

In this module you'll be able to understand the excess pressure inside the liquid drop as well as the excess pressure inside the soap bubble.

The learning outcomes are

- you will be able to derive an equation for excess pressure inside a drop of liquid,
- so also derive an expression for excess pressure inside a soap bubble

To understand pressure inside a drop of liquid. Let us take this example of a liquid drop denoted by P with radius R. As we know due to surface tension, this liquid drop will try to minimize the area of free surface and the force of surface tension will be directed inward. But as we know the pressure cannot be zero. There will be excess internal pressure counterbalancing this force of surface tension, which will be directed outwards perpendicular to the surface, as shown in the figure.

In doing so, it will try to increase the surface area, which is nothing but work done in increasing the surface area. Thus the increase in surface area is stored as potential energy and in the figure is indicated by the dotted lines. The change in radii is denoted by ‘ dr ‘, which is nothing but the displacement. Thus as we know the excess pressure outside for a liquid bubble is less than the pressure inside the liquid bubble.

Let us consider the pressure inside the liquid bubble to be Pi, and let us denote the pressure outside the liquid bubble. That is, the atmospheric pressure to be P, not. Thus the excess pressure inside the liquid drop. Is nothing but the difference of internal pressure P. Two external pressure P node given by equation. One as we know the work is done to increase the surface area, it is denoted by. The W which is nothing but the product of force due to surface tension and displacement. In this, the displacement is nothing but the are the force can be given as the product of excess pressure into surface tension into displacement of surface as seen in equation 2. Excess pressure is denoted by P and Surface area offers. Vertical shape is given by 4 Pi R-squared where R is the radius an they are is nothing but displacement of surface. Thus the increase in potential. Energy denoted by Du is nothing but the product of surface tension into increase in the area of this free surface. This can be given by the next equation here, T denotes surface tension increase in surface area is nothing but the difference of original surface area with the new surface area. Here the new surface area is nothing but the surface. Area of this dotted sphere. And the original surface area is nothing but the surface area of this solid sphere. Coming back to this equation, let us use the identity aplus B the whole square. Which is nothing but a ^2 + B ^2. Plus 2A B here let us consider are to be ANDRBB. So opening the brackets we get so using the identity we get the equation R ^2 + 2 RDR plus D R-squared and let US Open this bracket by multiplying this for π to each of these terms within the bracket. Thus the final equation we will get. 4 by R-squared Plus. Eight π RDR. Plus four Pi D R ^2. Here, let us neglect the term D R-squared as we know the change in displacement is negligible. Canceling the term for π R squared with four Pi R-squared we get the increase in potential energy to be T. Eight π RDR as we see from equation 2 an equation 3. To maintain. To counterbalance the surface tension, there arises excess internal pressure. Thus we can equate equation two with equation 3 and equating equation two and three. We get the final equation for excess pressure in terms of surface tension which is nothing but the ratio of two T. Upon our where R is the radius of liquid drop. Similarly, you can find the pressure inside a soap bubble. The only difference between a liquid drop and the soap bubble will be the number of resurface, the number of free surface for a soap bubble will be one that lies inside the soap bubble that is F and the soap solution and the outside with this external surface. With atmospheric pressure similarly, let us consider for a soap bubble, the internal pressure to BPI, an external pressure that is atmospheric pressure to be P not. Similarly, we can get the relation for excess pressure as 40 by R-squared. The only difference here will be. In the number of free surface that is 2. Thus the work done is given by equation 2, that is P4 Pi. R Square Dr and the final equation for excess pressure inside a soap bubble is given by 40. By hope you have understood these two derivations.

Thank you.