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# Analysis of Depth and Liquid Density Factor at Hydrostatic Pressure Assisted by PhET Simulation

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**Abstract:** The study has been conducted to analyze the depth factor of liquids and the density factor of liquids assisted by PhET simulation. This research is quantitative descriptive research with data presented descriptively, tables, and graphs. The data is obtained through a simulation of hydrostatic pressure in a PhET simulation. The results show that the relationship between the density of the liquid and the depth of the liquid to the pressure of the liquid is directly proportional. If the density of the liquid and the depth of the liquid are greater, the pressure will also be greater. The application of hydrostatic pressure is seen in the design of submarines which need to take into account the amount of hydrostatic pressure in the sea.

**Keywords:** Density; Depth; Hydrostatic pressure; PhET

## Introduction

Science is the mastery of knowledge that not only presents facts, concepts, or principles but also a process of inquiry. Natural Science (IPA) is a field of study related to how to find out about nature systematically (Norrizqa, 2021) and also Science is not only mastering a collection of knowledge in the form of facts, concepts but also a process of discovery (Ardhani et al., 2021). Science looks at phenomena that occur in nature based on experiments and human observations. Science is considered important because it has a close relationship with humans and the surrounding environment. Science looks at phenomena that occur in nature based on experiments and human observations. Science is considered important because it has a close relationship with humans and the surrounding environment.

Science is one of the compulsory subjects applied in schools, both at the elementary, junior high, and high school levels. Science lessons are expected to make students more sensitive to natural phenomena that occur around them. In addition to the sensitivity possessed by students, the understanding and mastery of science concepts that are directly related to the daily lives of students will be maximized. There is a lot of science material that students learn at school. Science lessons can be carried out by looking at the surrounding natural phenomena.

One of the natural phenomena that occur in the environment is "pressure". The concept of pressure is one that must be studied in science. Pressure occurs in solids, liquids, and gases. Liquid pressure is also known as hydrostatic pressure. Hydrostatic pressure is the pressure that appears under the surface of water that is not moving (still). Several studies state that there are still many students who experience learning difficulties in hydrostatic pressure material. Students find it difficult to interpret the factors that affect hydrostatic pressure (Sitompul & Firdaus, 2022). In addition, students also experience difficulties in comparing hydrostatic pressure in different liquids (Adi et al., 2018).

Practicum activities are an alternative to train students' science processes (Ferlianti et al., 2022). This activity can be carried out in the laboratory provided at

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school. If the laboratory facilities are not available, practicum can be carried out through a computer-based or Android-based virtual laboratory. The virtual laboratory is designed so that students can carry out experiments with computer-based simulations. The laboratory is simulated and visualized through a digital format, so students can explore concepts and theories. A virtual laboratory can be defined as a virtual learning environment that simulates experiments in a real laboratory with equipment and materials contained in a computer (Putri et al., 2022).

Technological developments in the industrial era 4.0 have experienced rapid development. Advances in technology can facilitate the learning process. One form of technological progress is the existence of a virtual laboratory that aims to simulate certain experiments. One of the virtual laboratories is PhET. PhET (Physic Education Technology) is a simulation developed by the University of Colorado that contains simulations of learning physics, biology, and chemistry for the benefit of learning in class or individual learning. PhET Simulation emphasizes the relationship between real-life phenomena and the science that underlies it, supports learning with an interactive and constructivist approach, provides feedback, and provides a creative workplace (Haryadi & Pujiastuti, 2020). PhET simulations can also be used as learning media for students anywhere and anytime because they can be accessed online or offline, so this can facilitate learning.

By looking at the misconception problems that occur in students, it is necessary to know the factors that influence the amount of hydrostatic pressure. This activity can be carried out through a virtual simulation experiment, namely PhET. This study aims to determine the depth factor of the liquid and the density of the liquid with respect to hydrostatic pressure.

## Method

This research is a descriptive-quantitative study with an experimental method using PhET simulations. The data were obtained through PhET simulation activities and the data were described descriptively, tabularly and graphically.

## Result and Discussion

The data in this study were obtained through PhET simulations. The PhET simulation menu is available for the fields of science studies, one of which is physics. Hydrostatic pressure simulation using PhET simulation can help to determine the factors that affect the value of hydrostatic pressure. In the physics simulation, there is a hydrostatic pressure simulation, namely "under pressure". There are several components in the "under pressure" simulation including a pressure gauge, the density of a liquid, the depth of the liquid, and the acceleration due to gravity. Each of these components can be set in value according to need. This study focuses on the factors that affect the amount of hydrostatic pressure that occurs, namely the depth of a liquid and the density of the liquid and looks at the relationship between these two factors.

**Table 1.** Relationship between Hydrostatic Pressure and Liquid Depth in Gasoline Medium

| Density of Liquid ($Kg/m^3$) | Depth of Liquid (m) | Hydrostatic pressure (kPa) |
|---|---|---|
| | 1 | 6.414 |
| 700 | 2 | 13.682 |
| | 3 | 20.296 |

**Table 2.** Relationship of Pressure Hydrostatic Pressure and Depth of Liquid in Water Medium

| Density of Liquid ($Kg/m^3$) | Depth of Liquid (m) | Hydrostatic pressure (kPa) |
|---|---|---|
| | 1 | 9.791 |
| 1000 | 2 | 19.754 |
| | 3 | 29.207 |

**Table 3.** Relationship between Hydrostatic Pressure and Liquid Depth in Honey Medium

| Density of Liquid ($Kg/m^3$) | Depth of Liquid (m) | Hydrostatic pressure (kPa) |
|---|---|---|
| | 1 | 13.011 |
| 1420 | 2 | 27.754 |
| | 3 | 41.172 |

Table 1 shows the results of observations with the same liquid density and different depths showing that the value of hydrostatic pressure tends to increase. The amount of hydrostatic pressure depends on the type and depth of the liquid. The deeper the surface of the liquid, the greater the pressure. The hydrostatic pressure of a liquid type is its density and does not depend on the shape of the container (Yulianto et al., 2017). The pressure generated on the liquid is then given to the object so that it can be felt by objects that hit the liquid.

With reference to table 1, the observations in tables 2 and 3 also experience an increase in pressure if the depth of a liquid is higher. With a different density, the resulting pressure will also be different because it has different densities. However, it can be seen that even though the density of the liquid used in the simulation is different, the pressure change at a certain depth shows an increase. The higher the depth of the liquid, the greater the pressure generated. Likewise for the density of liquids, the greater the density of the liquid, the greater the pressure generated.

Apart from using PhET simulations to see the factors that affect the amount of hydrostatic pressure,

there are equations that can be used to investigate the value of hydrostatic pressure. The equation for hydrostatic pressure also uses acceleration due to gravity. If the density of a substance is greater, the hydrostatic pressure will also be greater, as well as if the position of an object is deeper, the hydrostatic pressure will be greater due to the influence of gravity. And hydrostatic pressure is not affected by the volume of liquid (Late & Yuliati, 2017). By looking at the results of observations that have been made, it is necessary to know the relationship between the factors that cause differences in hydrostatic pressure, namely the depth of the liquid and the density of the liquid.

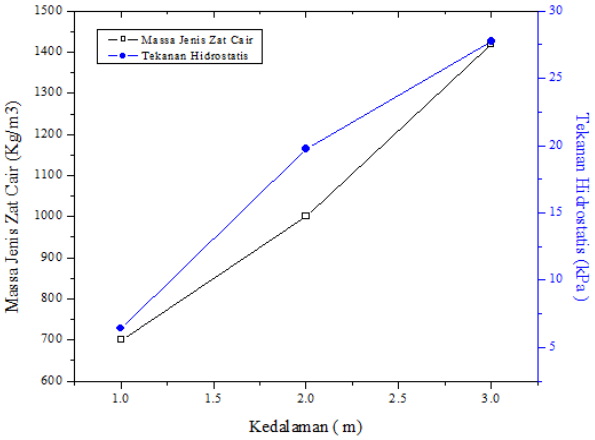


**Figure 1.** Relationship between density of liquid and depth of liquid

Figure 1 shows that there is a relationship between the density of the liquid and the depth of the liquid. The greater the density of a liquid and the depth used to measure pressure, the greater the resulting pressure value. So in this study, the results show that the depth of a liquid and the density of a liquid has a considerable influence on hydrostatic pressure. This is also proven through the hydrostatic pressure formula where the hydrostatic pressure is directly proportional to the density of the liquid, the acceleration due to gravity, and the depth of the liquid itself.

Hydrostatic pressure is a phenomenon that often occurs in the natural environment around us. To understand this natural phenomenon, it is important to study science (Santika et al., 2022). Hydrostatic pressure can be felt significantly in diving activities. Divers will feel great pressure when diving in sea water rather than diving in lake water. This is because the density of seawater and lake water is different. Sea water has a higher density than lake water (Prasasti et al., 2016). The application of hydrostatic pressure can also be seen in the process of making dams. At the bottom of the dam, it is deliberately made bigger and thicker because the pressure will be greater if the depth of the liquid is higher. If this is not done, the dam will quickly break down and sink, causing a disaster in the form of a flood (Prasasti et al., 2016). In designing a submarine, it is necessary to take into account the hydrostatic pressure in the sea so that the submarine is able to dive to a depth of hundreds of meters without experiencing damage or leaks caused by hydrostatic pressure (Zubaidah et al., 2017).

## Conclusion

It can be concluded that the depth of the liquid will cause the hydrostatic pressure received by the object to be greater. Likewise with the density of liquids. If the density of the liquid is large, the pressure generated will also be large. The relationship between the density of the liquid and the depth of the liquid to the pressure of the liquid is directly proportional. If the density of the liquid and the depth of the liquid are greater, the pressure will also be greater.

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**Conflicts of Interest**
The authors declare no conflict of interest.

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