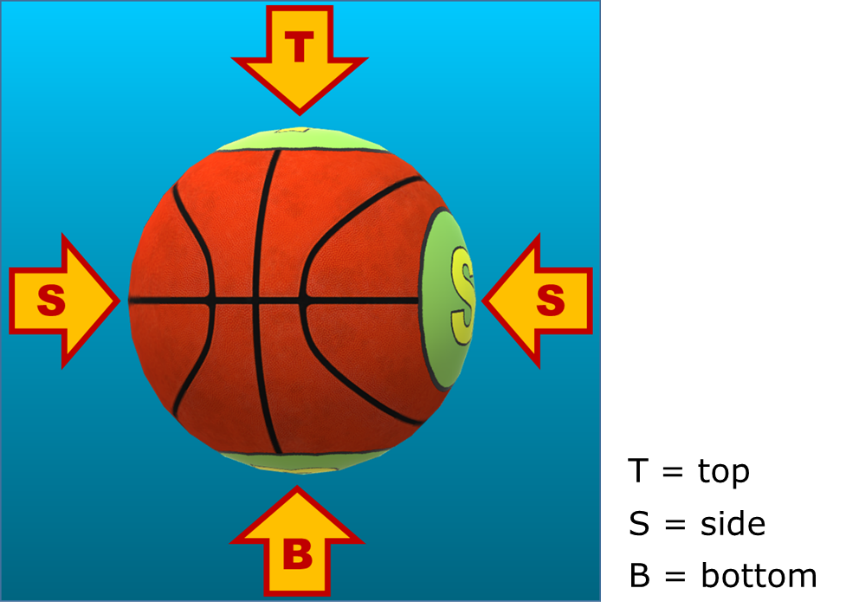
**Underwater basketball**

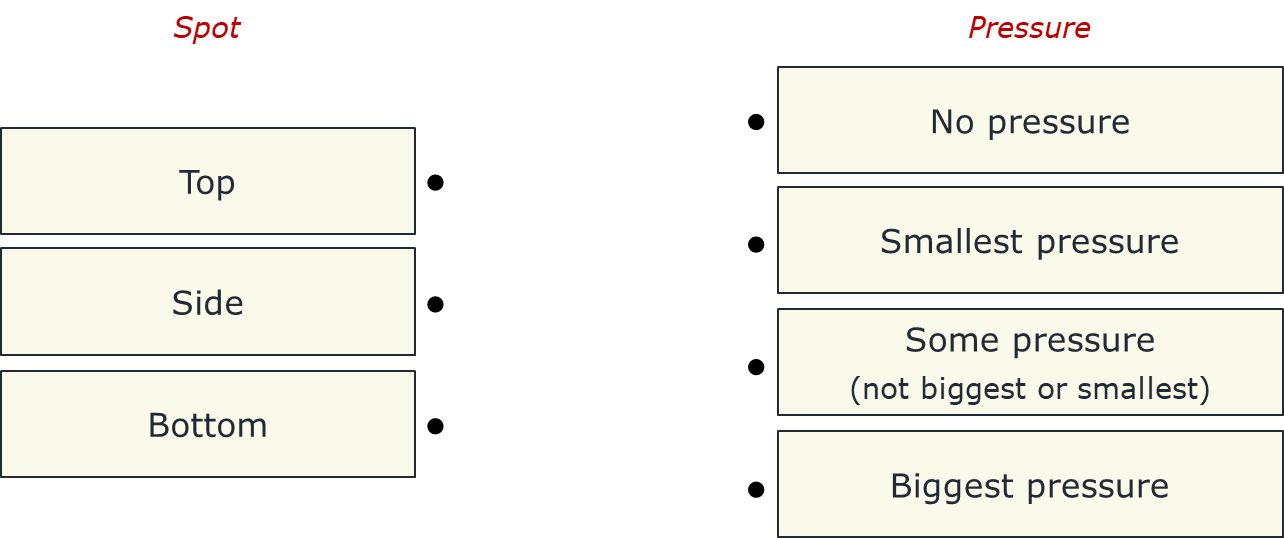
Some large spots have been painted onto a basketball.

The ball is pushed underwater.



How hard does the water press on each of the spots?

*Join the name of each spot to a pressure to show what you think.*



*Physics > Big idea PMA: Matter > Topic PMA2: Floating and sinking > Key concept PMA2.2: Pressure in fluids*

|  |
| --- |
| **Diagnostic question** |
| **Underwater basketball** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Pressure increases with depth in a fluid, so the force exerted by a fluid is larger on the lower surface of an immersed object than on the upper surface. This results in an upward force on the object. |
| Observable learning outcome: | Explain how pressure pushes on an object submerged in a fluid. |
| Question type: | Linking ideas |
| Key words: | Pressure, depth |

**What does the research say?**

Students often think that fluids can only exert a pressure when they are moving, and assume that the pressure is in the direction of motion (Sere, 1986; Driver et al., 1994).

Engel Clough and Driver (1985) found that 67% of 12-year-olds, 80% of 14-year-olds and 87% of 16-year-olds (n=84) realised that pressure increases with depth in a liquid. However, only 13% of 12-year-olds, increasing to 34% of 16-year-olds recognised that pressure in the liquid acts in all directions. It is common for students to have the misunderstandings: that pressure *is the weight of the liquid;* and that pressure in a liquid pushes only downwards.

**Ways to use this question**

This task is intended for discussion in pairs or small groups. It is best done as a pencil and paper exercise.

Students should consider whether the water is pressing on each spot, and then decide how the pressure on each spot compares to the pressures on the other ones. Listening in to the conversations of each group will often give you insights into how your students are thinking. Each member of a group should be able to report back to the class.

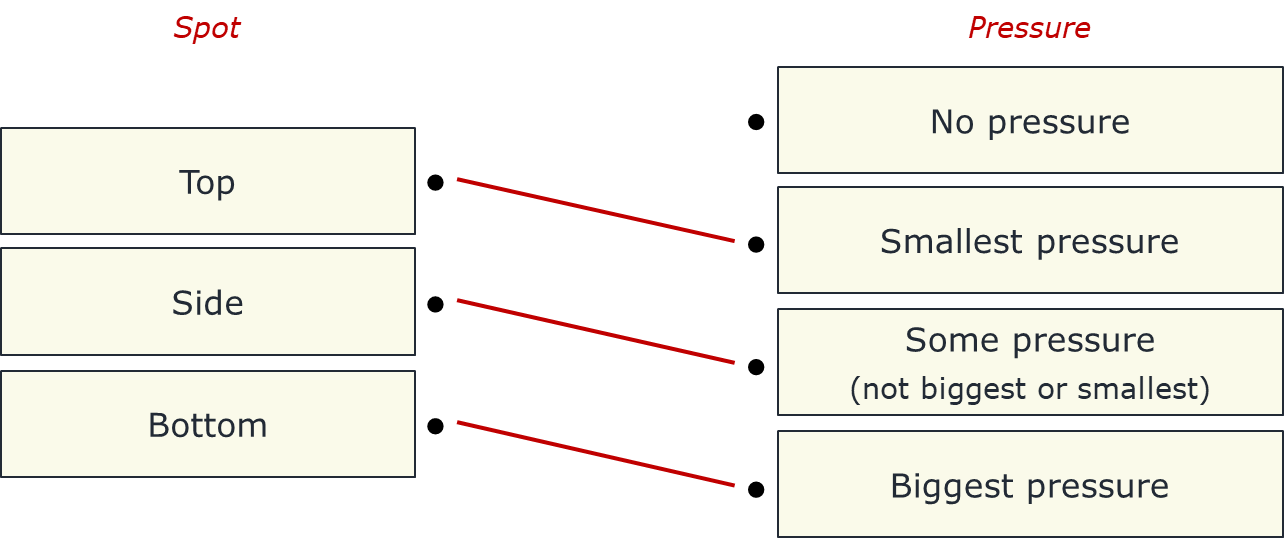
Feedback from each group can be used, with careful teacher questioning, to bring out a clear description or explanation of the science.

*Differentiation*

The quality of the discussions can be improved with a careful selection of groups; or by allocating specific roles to students in the each group. For example, you may choose to select a student with strong prior knowledge as the scribe, and forbid them from contributing any of their own answers. They may question the others and only write down what they have been told. This strategy encourages contributions from more members of each group.

NB in any class, small group discussions typically improve over time and a persistence with this strategy is often very successful in the medium to long term.

**Expected answers**



**How to respond - what next?**

The resultant force of the water on the basketball is upwards (buoyancy) because the pressure on the bottom of the ball is bigger than the pressure on the top. Because pressure increases with depth, the pressure on the sides is midway between the pressures on the top and bottom. The pressure of the water on the sides is equal all around the ball, so the resultant sideways force is zero.

Besson (2004) found that 67% of 14- to 18-year-olds (n=73) did not make a connection between pressure differences and buoyancy.

Some students will not recognise that the pressure of water increases by any significant amount over the distance from the top of the ball to the bottom. These students may think that the ball is squeezed equally in all directions, which makes it ‘pop’ up to the surface, because this is the direction of least resistance. One student, in Besson’s study said that the push of water on each spot was the same because ‘the buoyant force is equal to the weight of the volume of liquid displaced by the ball’. The student can recall a related fact, but their understanding is not sufficient to answer the question correctly.

Often students focus on the weight of the water pressing down on the top of the ball, or the force of the water pressing up from the bottom. They may not consider that there is any pressure on the sides.

If students have misunderstandings about how pressure pushes on an object submerged in a fluid, it may be necessary to review and consolidate the understanding that pressure increases with depth and that pressure is the same in all directions in a fluid.

Careful questioning can then elicit the understanding that when a ball is pushed underwater, no matter what the ball is made of, the pressure in the water surrounding the ball is identical to what it would be if the ball was not there (or if it were a ball of water). Asking students to draw labelled diagrams to show what they think is happening helps to check and to consolidate their understanding.

The following BEST ‘response activity’ could be used in follow-up to this diagnostic question:

* Response activity: Diving deep

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG), from an idea by Besson (2004).

Images: Peter Fairhurst (UYSEG).

**References**

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