



💧 Lesson Plan: Forces in fluids

Grade Level: 8

Subject: Physical Science

Duration: 45–60 min

NGSS MS-PS2-2: Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

🎯 Learning Objectives

By the end of this lesson, students will be able to:

- **Calculate** pressure by dividing force by area, and report the answer in pascals.
- **Explain** why water pressure increases as a diver goes deeper while air pressure decreases as a climber goes higher.



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the object is greater than the pressure above it. When this buoyant force is strong enough to balance gravity, the object floats.

- **Density:** The amount of mass packed into a unit of volume, calculated by dividing an object's mass by its volume. An object denser than the fluid around it sinks, because the buoyant force cannot overcome gravity.
- **Pascal's principle:** The rule that a force applied to a fluid sealed inside a container changes the pressure by the same amount in every direction, not just the direction of the push.



- **Hydraulic:** Describing a machine that puts pressure on a trapped fluid to do work. Because that pressure is passed to a larger surface, the force on the larger surface is much greater than the force applied.
- **Bernoulli's principle:** The rule that when a fluid moves faster, the pressure inside that fluid drops. Air moving quickly over a wing presses down less than the slower air below, so the wing is pushed upward.
- **Barometer:** An instrument meteorologists use to measure the pressure of the air. Its reading is highest at low elevations, where the most air is stacked above it.

 Materials Needed: (all links are included in this PDF)

- Printed copies of the Forces in Fluids Study Guide
(<https://newpathworksheets.com/api/guide/study-guide-science-grade-8-forces-in-fluids-1.pdf>)



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- Density test objects for each group: a cork stopper, a plastic bottle cap, a steel washer, and a small wooden block
- A digital balance and a graduated cylinder per group for measuring mass and volume to calculate density
- A capped plastic water bottle with three pinholes punched around its side, for the Pascal's principle squeeze demonstration
- Two empty aluminum cans resting on drinking straws, for the Bernoulli's principle air-speed demonstration



Lesson Procedure

Step 1: Introduction (5 minutes)

- Open by asking: why do a diver's ears hurt more the deeper she swims, while a climber has the hardest time breathing at the top of the mountain?
- Have students press a flat thumb on the desk, then press the point of a pencil with the same push, and name which one creates more pressure and why area is the reason.
- Preview the four ideas the lesson builds toward using the Study Guide headings: calculating pressure, pressure in fluids, buoyancy, and Pascal's and Bernoulli's principles.
(<https://newpathworksheets.com/api/guide/study-guide-science-grade-8-forces-in-fluids-1.pdf>)

Step 2: Direct Instruction (15 minutes)

- Work through the Study Guide's pressure example, 10 newtons over 2 square centimeters giving 5 pascals, then have students compute the pressure on a diver from 10,000 newtons



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- Groups reshape the same clay into an open hull, float it, and explain why the mass never changed but the object now displaces enough water for the buoyant force to balance gravity.
- Complete the vocabulary matching worksheet together, stopping on Pascal, hydraulic, and Bernoulli's principle so students attach each term to the demonstration they just watched.
(<https://newpathworksheets.com/api/vocabulary/vocabulary-science-grade-8-forces-in-fluids-1-1.pdf>)

Step 4: Independent Practice (15 minutes)



- Students complete Practice Worksheet 1 on their own, using the barometer and mountain diagrams to justify where air pressure is greatest and where breathing is hardest.
(<https://newpathworksheets.com/api/worksheet/worksheet-science-grade-8-forces-in-fluids-1-1.pdf>)
- Students work the Practice Worksheet 2 data-table items, deciding which listed substances float in water at 1.0 g/cm^3 and what change would make a 1.02 g/cm^3 tar ball float.
(<https://newpathworksheets.com/api/worksheet/worksheet-science-grade-8-forces-in-fluids-1-2.pdf>)
- Circulate and require each student to name the two forces acting on a fish in a deep lake, buoyant force and gravity, before moving on.

Step 5: Assessment (10 minutes)

- Assign Practice Worksheet 0 as the graded check; it covers the pressure formula, the density formula, and which side of a submerged object receives the greatest pressure.
(<https://newpathworksheets.com/api/worksheet/worksheet-science-grade-8-forces-in-fluids-1-0.pdf>)



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ranking.

For learners needing support:

- Give students a pre-labeled diagram of a submerged fish with the buoyant-force and gravity arrows already drawn, so they compare arrow lengths instead of building the whole force picture from scratch.
- Let students test the cork stopper, bottle cap, steel washer, and wooden block in the water tub before answering any float-or-sink worksheet item.



Extension Activities

- Build aluminum-foil boats and compete to see which hull holds the most steel washers before sinking, then explain the winner using density and buoyant force.
- Build a Cartesian diver from a sealed plastic bottle and an eyedropper, and use it to show how a submarine changes its density to rise and sink.
- Cut a curved paper airfoil, hold it in front of a fan, and record how the lift changes when the fan speed changes to test Bernoulli's principle.

Complete List of Available Resources:

- NewPathWorksheets: Forces in fluids (<https://newpathworksheets.com/science/grade-8/forces-in-fluids-1>)
- Study Guide PDF (<https://newpathworksheets.com/api/guide/study-guide-science-grade-8-forces-in-fluids-1.pdf>)



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FORCES IN FLUIDS

Calculating Pressure

Pressure is calculated by dividing force by area and is measured in units called **pascals**. For an example, if a force of 10 newtons was exerted over an area of 2 square centimeters, the pressure would be 5 pascals.

Lesson Checkpoint:
What is pressure and how is it calculated?

Pressure in Fluids

In **fluids**, which are substances that can flow, pressure is the sum of each of the forces of each particle in the fluid. Examples of fluids include liquids such as water and gases such as air and helium.



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Lesson Checkpoint:
What effect does a change in elevation or depth have on fluid pressure?

Buoyancy

Buoyancy, or the tendency to float, is the result of unequal fluid pressure exerted on a person or object. At the surface, fluid pressure is greater under an object than above the object with the net result being an upward or buoyant force.

If the **density** of an object is too great, it will not be able to float. Density is the amount of mass per unit of volume. Since gravity has the effect of pulling down objects of greater mass, some objects will sink because the buoyant force upwards is not strong enough to overcome the force of gravity. Density can be calculated by dividing the mass of an object by its volume.

Lesson Checkpoint:

What is buoyancy and what is its relationship to density?



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This principle forms the basis for **hydraulic** equipment. In a machine operated by hydraulics, pressure on a confined fluid gets transferred to a larger surface. The result is a large increase in force on that surface.

Bernoulli's Principle

According to **Bernoulli's** principle, when the speed of a fluid is increased, the pressure in that fluid decreases. This principle is the basis for how a plane lifts off the ground and flies. The wings of a plane are designed so that the fluid *above* the wing, which is air, goes faster than the air *below* the wing. The result is a decrease in downward pressure on the plane. When this occurs, the pressure lifting the plane becomes greater than the pressure pushing down on the plane. At this point, the plane is able to take off and as long as it holds its speed, it will stay up despite the force of gravity.



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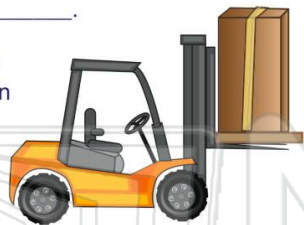


Name _____ Class _____ Date _____

1

All **hydraulic** equipment requires the use of _____.

- A vapor
- B friction
- C fluid
- D light



2

In the diagram below, a layer of **oil** sits on top of a layer of **water**. The explanation for this is _____.

- A the density of the oil is less than the density of water
- B the density of water is less than the density of oil
- C the densities of water and oil are the same
- D the densities of both the water and oil are changing



3

Density is calculated by dividing the mass of a substance by its _____.

- A momentum
- B velocity
- C acceleration
- D volume

$$D = \frac{m}{v}$$

4

If the density of an object is **10 g/cm³** and its mass is **200 g**, then its volume would be which of the following?

- A 10 cm³
- B 20 cm³
- C 30 cm³

$$D = \frac{m}{v}$$

5



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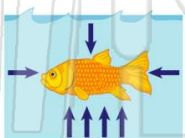
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9

Imagine a fish swimming in a deep lake. What **two forces** are acting on this fish at the same time?

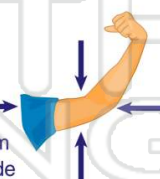
- A buoyant force and gravity
- B density and pressure
- C buoyant force and volume
- D density and volume



10

In the picture below, what statement about air pressure is **correct**?

- A it is the same on the top and bottom of the arm
- B it is greater on the top side of the arm
- C it is greater on the bottom of the arm
- D air does not exert pressure



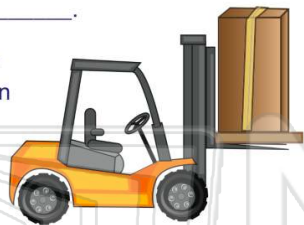


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1

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(C)

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(A)

3

Density is calculated by dividing the mass of a substance by its _____.

- A momentum
- B velocity
- C acceleration
- D volume

$$D = \frac{m}{v}$$

(D)

4

If the density of an object is **10 g/cm³** and its mass is **200 g**, then its volume would be which of the following?

- A 10 cm³
- B 20 cm³
- C 30 cm³

$$D = \frac{m}{v}$$

(B)

5



(B)

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7

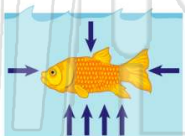
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(B)

9

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(A)

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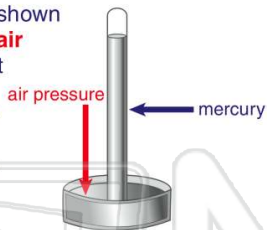
(A)



Name _____ Class _____ Date _____

1

The instrument shown here measures **air pressure**. What is the name of this instrument?



- A thermometer
- B hygrometer
- C volt meter
- D barometer

2

If an aluminum can containing a small amount of water is heated, then quickly cooled, it will suddenly **crush** with no apparent force. What **force** causes the can's **collapse**?



- A air pressure outside of the can
- B the metal particles melt
- C gravity increases
- D pressure in the can increases

3

In the diagram below, where would a **barometer** show the largest measurement?



- A 1
- B 2

4

Using the diagram below, determine where a mountain climber would have the **toughest** time **breathing**.



- A 1

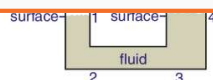
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- C 3
- D 4



- C make the tube from point 2 to point 3 longer
- D make point 1 and point 4 equal surface areas

9

The use of **hydraulic equipment** is based on **whose** principle?

- A Newton's
- B Bernoulli's
- C Pascal's
- D Einstein's

10

In order for a hydraulic cylinder to **work**, it must _____.

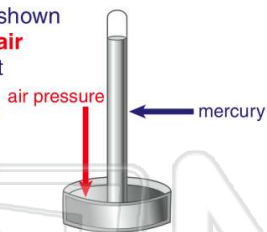
- A have air in it
- B be open on one end
- C be open on both ends
- D be sealed on both ends



Name _____ Class _____ Date _____

1

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- A thermometer
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D**2**

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A**3**

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- A 1
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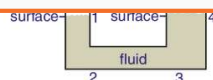
- A 1

D**5****C****7**

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D

- C 3
- D 4



- C make the tube from point 2 to point 3 longer
- D make point 1 and point 4 equal surface areas

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C**10**

In order for a hydraulic cylinder to **work**, it must _____.

- A have air in it
- B be open on one end
- C be open on both ends
- D be sealed on both ends

D

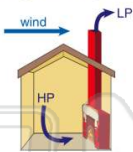


Name _____ Class _____ Date _____

1

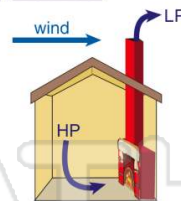
Smoke moves **up** a chimney and **away** from the house. In addition to heat rising, the explanation for this is the air pressure at the **bottom** is _____.

- A** greater than the air pressure at the top
- B** equal the air pressure at the top
- C** less than the air pressure at the top
- D** decreasing in the fireplace

**2**

If there was **no wind** above the chimney, smoke would probably _____.

- A** go up faster
- B** not go up as well
- C** evaporate
- D** disappear

**3**

The reasoning that explains **smoke going up a chimney** is the same for _____.

- A** a plane taking off
- B** a car skidding to a stop
- C** a plane descending
- D** a car accelerating

4

When a plane is taking off, **where** on the plane is air exerting the **least** amount of **pressure**?

- A** below the cabin
- B** in front of the plane
- C** behind the tail

**5**

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7

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9

The brakes on a car work by **hydraulics**. A car's **brakes** may **fail** to work if there is _____.

- A** an increase in air pressure
- B** a decrease in humidity
- C** a loss of brake fluid
- D** engine oil that needs to be changed

**10**

Strong winds during a storm sometimes cause **roofs** on houses to get **blown off**. What could be the **reason** for this?

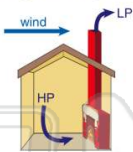
- A** Speed of the air above the roof increases air pressure on the roof.
- B** The walls of the house get weaker.
- C** The basement of the house gets moved.
- D** Speed of the air above the roof decreases the air pressure on the roof.



Name _____ Class _____ Date _____

1

Smoke moves **up** a chimney and **away** from the house. In addition to heat rising, the explanation for this is the air pressure at the **bottom** is _____.

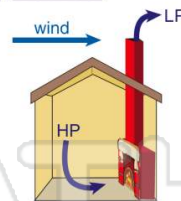


- A greater than the air pressure at the top
- B equal the air pressure at the top
- C less than the air pressure at the top
- D decreasing in the fireplace

A

2

If there was **no wind** above the chimney, smoke would probably _____.



- A go up faster
- B not go up as well
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- D disappear

B

3

The reasoning that explains **smoke going up a chimney** is the same for _____.

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- C a plane descending
- D a car accelerating

A

4

When a plane is taking off, **where** on the plane is air exerting the **least** amount of **pressure**?



- A below the cabin
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- C behind the tail

D

5



C

7

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B

9

The brakes on a car work by **hydraulics**. A car's **brakes** may **fail** to work if there is _____.



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- B a decrease in humidity
- C a loss of brake fluid
- D engine oil that needs to be changed

C

10

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- A Speed of the air above the roof increases air pressure on the roof.
- B The walls of the house get weaker.
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- D Speed of the air above the roof decreases the air pressure on the roof.

D



Name _____ Class _____ Date _____

Match each of the following terms to its definition:

Buoyancy

Pascal

Barometer

Hydraulic

Bernoulli's Principle

Pressure

1. - the ability an object to float in water



2. - a scientific instrument meteorologists use to measure air (atmospheric) pressure



3. fluid t

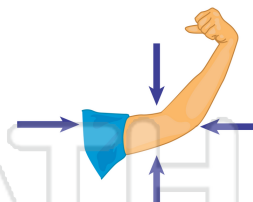


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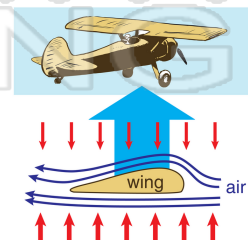
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5. - the force exerted on the surface of an object



6. - increasing the speed of a fluid decreases its pressure





Name _____ Class _____ Date _____

Match each of the following terms to its definition:

Buoyancy

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Pressure

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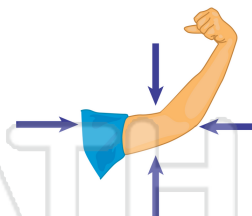


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5. pressure - the force exerted on the surface of an object



6. Bernoulli's Principle - increasing the speed of a fluid decreases its pressure

