Storyboard

Module: Molecular Physics

Version history

Version number	Date	Author	Change description
1	26 Jan 2015	Magic	SB 1st cut
2	18 Feb 2015	Magic	Queries to ERC
3	04 Mar 2015	ERC	ERC comments
4	05 Apr 2015	Magic	Fixes
5	08 Apr 2015	ERC	Review
6	08 Apr 2015	Magic	Fixes

Module Information

Class	Subject	Section	Subsection
7	Physics	Thermal Physics	Molecular Physics

Learning Objective/s for the Module

#	Description
1	Explain the term gas pressure in terms of the molecular-kinetic theory
2	Understand the term pressure and express it by the formula: pressure = force / area
3	Derive and apply the definition of pressure and density $p = \rho gh$ equation and apply it
4	Explain the nature of buoyancy in liquids and gases
5	Apply the law of Archimedes in solving problems

Metadata Table (type/insert words/terms separated by comma)

Text appearing on clickable BUTTONS in orange colour
On Screen Text in blue colour
Audio script in green colour

[Please follow this key for identifying content]

[Add rows as necessary]

	Sub-Module 0 [copy/paste this table to build a new interactive presentation or audio book]					
	Animated Presentation					
	LEARNING OBJECTIVES: Introduction					
Development Brief	**[Description of sub-module for media development team.]**					
References	TBA					
Introduction	NA					
Instruction	Txt	NA	Aud		Vis	NA
Frame	Visual Description	Text on screen	Audio	Action		
1	Show a boy and a girl with their father sitting inside an airliner.	Zarina, Arman and their father are flying to Aktobe.	Zarina and Arman are flying with their father to visit their uncle in Aktobe. Zarina, however, is not feeling so well .	Next goes to next frame. Back goes to previous frame		

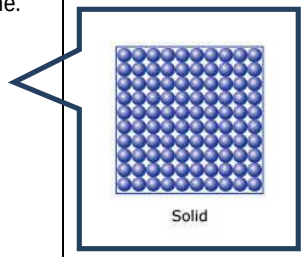
	The girl is pressing her hands to her ears, and looking distressed.		. .	
2	Zarina turns to her father.		Zarina: Something is pressing on my ears. It's paining!	Next goes to next frame. Back goes to previous frame
3	Father explains that it is pressure acting on her ears. He hands her a packet of chewing gum.		Father: It's just air pressure acting on your ears. Here, chew this and it will be all right.	Next goes to next frame. Back goes to previous frame
4	Zarina chews the gum. Arman puts out his hand.		Arman: I want some chewing gum too. And what is air pressure?	Next goes to next frame. Back goes to previous frame
5	Father explains.		Father: You know that you have an ear drum that helps you to hear sounds. The air inside the airplane is putting a force on your eardrums.	Next goes to next frame. Back goes to previous frame
6	Zarina is happily chewing gum. Arman examines a piece of gum as he speaks.		Arman: How does chewing gum help?	Next goes to next frame. Back goes to previous frame
7	Father points to the seat belt sign.		Father: It's a slightly long story. I'll explain that sometime later. Right now we are coming in for a landing.	Next goes to next SM.

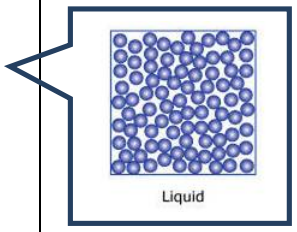
	Sub-Module 1 [copy/paste this table to build a new interactive presentation or audio book]
	Activity Interactive Presentation

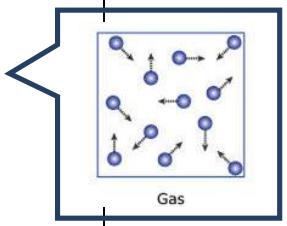
	LEARNING OBJECTIVES: Explain the term gas pressure in terms of the molecular-kinetic theory					
Development Brief	**[Description of sub-module for media development team.]**					
References	TBA					
Introduction	NA					
Instruction	Txt	NA	Aud		Vis	NA

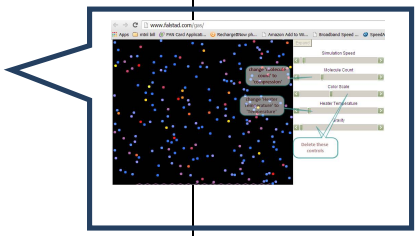
Frame	Visual Description	Text on screen	Audio	Action
1	Zarina and Marina are going out to ride their bicycles. Zarina is pumping up the front wheel.	Zarina and Marina are about to go out cycling.	Marina: Strange isn't it? You can't touch air, but air makes the tyre so hard. Zarina: High pressure makes all the difference.	Next goes to next frame.
2			Marina: What is pressure? Zarina: Well, my father explained it the other day. I'll tell you about it later. Marina: No. Tell me about it now. Unless it's very complicated, of course.	Next goes to next frame. Back goes to previous frame
3	Zarina stops pumping.		Zarina: It's not complicated. You know that all matter is composed of atoms and molecules? Marina: Yes. Zarina: The atoms and molecules are not stationery. Instead they are free to move.	Next goes to next frame. Back goes to previous frame
4	The girls are seen from behind, riding their bicycles. They get smaller as they ride away into the frame. Zarina's voice fades away in sync.		Marina: Move? You mean they move around just like we are moving around? Zarina: Let me try to explain it the way my father did. Imagine you are very small. Very, very small. So small that you are the size of a molecule . . .	Next goes to next frame. Back goes to previous frame

5	Show the girls looking at an array of molecules (ref. diagram captioned "Solid") from very close. Show an animation of molecules in solid. (https://www.chem.purdue.edu/gchelp/liquids/character.html)	• In solids, the atoms and molecules do not actually move from place to place; instead they vibrate	Zarina: These are molecules in a solid. Marina: They are not moving much! Zarina: Yes. In solids, the atoms and molecules do not actually move from place to place. Instead they vibrate.	Next goes to next frame. Back goes to previous frame.
6	Show an animation of molecules in liquid. (https://www.chem.purdue.edu/gchelp/liquids/character.html) Show the girls looking at liquid molecules.	• In liquids, atoms and molecules tend to move around as well as vibrate	Zarina: In liquids, atoms and molecules tend to move around as well as vibrate.	Next goes to next frame. Back goes to previous frame.
7	Show an animation of molecules in gas. (https://www.chem.purdue.edu/gchelp/liquids/character.html) Show the girls looking at gas molecules.	• In gases, the vibration and movement of the molecules is quite vigorous • In gases, movement increases with rise in temperature and rise in pressure	Marina: Ooh! These are really moving! Zarina: Yes. In gases, the vibration and movement of the molecules is quite vigorous. Also, In gases, the speed of movement increases with rise in temperature and rise in pressure. Marina: I wish we could see that!	Next goes to next frame. Back goes to previous frame.

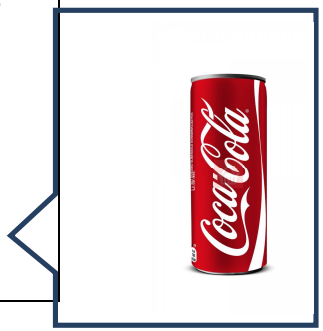






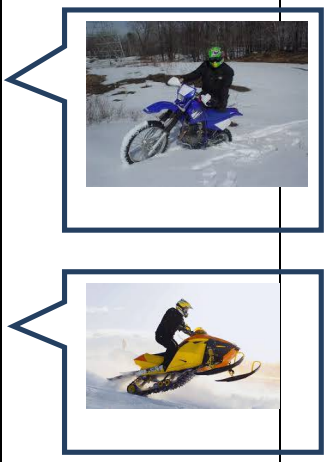
8	Show a simulation, where the following can be changed with sliders: • Temperature • Pressure *(URL of sample including Java code is given in screen grab)*	Drag the sliders to see the effects of temperature and pressure on the molecular motion of a gas	Can you show Marina and Zarina how changing temperature and pressure affect motion of molecules? Drag the sliders to see the effects of temperature and pressure on the molecular motion of a gas. In a gas, an increase in temperature will increase the molecular motion. This will increase the pressure of the gas. Also an increase in pressure will increase the molecular motion. This will increase the temperature of the gas.	Next goes to next SM. Back goes to previous frame. 

	Sub-Module 2 [copy/paste this table to build a new interactive presentation or audio book]					
	Activity – select (drag and drop)					
	LEARNING OBJECTIVES: Understand the term pressure and express it by the formula: pressure = force / area					
Development Brief	Questions will be posed, accompanied with a diagram. Learner must select 1 of 3 answers, A 60 s timeout is provided. On right, wrong or timeout, feedback is provided to give the answer and the reasoning. **[Description of sub-module for media development team]**					
References	TBA					
Introduction	NA					
Instruction	Txt		Aud	Answer the questions by selecting the correct option.	Vis	NA
Frame	Visual Description	Text on screen	Audio	Action		
1		The pressure inside a	The pressure inside a	Next goes to next frame.		

	Provide a timer with a 60 s timeout (a slowly turning hour glass, with a digital countdown display). Graphic artist to please ensure that illustrations do not carry trade names and copyrighted logos. Feedback	bottle of soda is caused by CO_2 gas The pressure in a glass bottle is $0.25x10^5$ Pa, and the area of the cap is $0.5x10^{-3}$ m^2 What is the force acting on the cap? i) $1.25x10^3$N(Correct Value)) ii) $5x10^3$N iii) 12.5N iv) $5x10^7$N On incorrect answer: Not quite correct. Try again On second incorrect answer or timeout: Not quite correct. The correct answer is $5x10^6$N On correct answer: That is correct. Well done	bottle of soda is caused by CO_2 gas contained in the liquid. The pressure in a glass bottle is $0.25x10^5$ Pa, and the area of the cap is $0.5x10^{-3}$ m^2. What is the force acting on the cap? i) $1.25x10^3$N(Correct Value)) ii) $5x10^3$N iii) 12.5N iv) $5x10^7$N On incorrect answer: Not quite correct. Try again. On second incorrect answer or timeout: Not quite correct. The correct answer is 5 Mega Newton. On correct answer: That is correct. Well done.	Next is inactive till feedback is shown. 
2	Graphic artist to please ensure that illustrations do not carry trade names and copyrighted logos.	If the same soda is packaged in a can, What factors will determine the force acting on the top of the can (you can select more than one choice): i) The volume of the can ii) The diameter of the can iii) The area of the top of the can	If the same soda is packaged in a can, What factors will determine the force acting on the top of the can (you can select more than one choice): i) the volume of the can ii) **The diameter of the can. [CA]** iii) **The area of the top of the can. [CA]**	Next goes to next frame. Back goes to previous frame. 

		iv) The height of the can On incorrect answer: Not quite correct. Try again. On second incorrect answer or timeout: Not quite correct. The correct answers are • The diameter of the can, and • the area of the top of the can On correct answer: You are right. The answers are • The diameter of the can, and • the area of the top of the can	iv) The height of the can. On incorrect answer: Not quite correct. Try again. On second incorrect answer or timeout: Not quite correct. The correct answers are • The diameter of the can, and • the area of the top of the can On correct answer: You are right. The answers are • The diameter of the can. • The area of the top of the can.	
3		You cannot push an unsharpened pencil through a bicycle inner tube no matter how hard you press. But you can do it with a needle. This is because: i) You can exert more force with a needle ii) You can exert more pressure with a needle iii) The rubber of the inner tube can stretch iv) The pencil is softer than the needle On incorrect answer: Not	You cannot push an unsharpened pencil through a bicycle inner tube no matter how hard you press. But you can do it with a needle. This is because: i) You can exert more force with a needle. ii) **You can exert more pressure with a needle.** **[CA]** iii) The rubber of the inner tube can stretch iv) The pencil is softer than the needle. On incorrect answer: Not	Next goes to next frame. Back goes to previous frame.

	Show zoomed animation of pressure at tip of pencil and tip of needle.	quite correct. Try again. On second incorrect answer or timeout: Not quite correct. The correct answer is: You can exert more pressure with a needle On correct answer: You are right. The answer is: You can exert more pressure with a needle	quite correct. Try again. On second incorrect answer or timeout: Not quite correct. The correct answer is: You can exert more pressure with a needle. On correct answer: You are right. The answer is: You can exert more pressure with a needle.	
4		Arrows used in target practice are pointed. This is because: i) A point exerts high pressure, which allows it to pierce the target ii) A point applies greater force, which allows it to pierce the target iii) A point allows the arrow to be aimed accurately iv) A point allows the arrow to fly straighter through the air On incorrect answer: Not quite correct. Try again On second incorrect answer or timeout: Not quite correct. The correct answer is: A point exerts high pressure, which allows it	Arrows used in target practice are pointed. This is because: i) **A point exerts high pressure, which allows it to pierce the target. [CA]** ii) A point applies greater force, which allows it to pierce the target. iii) A point allows the arrow to be aimed accurately. iv) A point allows the arrow to fly straighter through the air. On incorrect answer: Not quite correct. Try again. On second incorrect answer or timeout: Not quite correct. The correct answer is: A point exerts high pressure, which allows it	Next goes to next frame. Back goes to previous frame.

		to pierce the target On correct answer: You are right. The answer is: A point exerts high pressure, which allows it to pierce the target	to pierce the target. On correct answer: You are right. The answer is: A point exerts high pressure, which allows it to pierce the target.	
5		A snowmobile is able to travel easily on deep snow, whereas a motorcycle sinks into the snow. This is because : i) The caterpillar tracks on the snowmobile provide a larger area of contact with the snow than the motorcycle tyres. A lager area of contact puts less pressure on snow, and allows movement without sinking ii) The caterpillar tracks of the snowmobile put less force on the snow, and thus prevent sinking iii) The smooth undersurface of the caterpillar tracks on the snowmobile disturbs the snow less than the rough motorcycle tyre treads. iv) The faster pace of the snowmobile prevents the vehicle from sinking. The motorcycle cannot go as	A snowmobile is able to travel easily on deep snow, whereas a motorcycle sinks into the snow. This is because : i) The caterpillar tracks on the snowmobile provide a larger area of contact with the snow than the motorcycle tyres. A lager area of contact puts less pressure on snow, and allows movement without sinking ii) The caterpillar tracks of the snowmobile put less force on the snow, and thus prevent sinking iii) The smooth undersurface of the caterpillar tracks on the snowmobile disturbs the snow less than the rough	Next goes to next frame. Back goes to previous frame. 

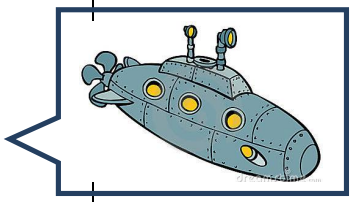
		fast and thus sinks into the snow. On incorrect answer: Not quite correct. Try again On second incorrect answer or timeout: Not quite correct. The correct answer is: The runners and caterpillar tracks on the snowmobile provide a larger area of contact with the snow than the motorcycle tyres. A lager area of contact puts less pressure on snow, and allows movement without sinking On correct answer: You are right. The answer is: The runners and caterpillar tracks on the snowmobile provide a larger area of contact with the snow than the motorcycle tyres. A lager area of contact puts less pressure on snow, and allows movement without sinking	motorcycle tyre treads. iv) The faster pace of the snowmobile prevents the vehicle from sinking. The motorcycle cannot go as fast and thus sinks into the snow. On incorrect answer: Not quite correct. Try again. On second incorrect answer or timeout: Not quite correct. The correct answer is: The runners and caterpillar tracks on the snowmobile provide a larger area of contact with the snow than the motorcycle tyres. A lager area of contact puts less pressure on snow, and allows movement without sinking On correct answer: You are right. The answer is: The runners and caterpillar tracks on the snowmobile provide a larger area of contact with the snow than the motorcycle tyres. A lager	

			area of contact puts less pressure on snow, and allows movement without sinking	
5		You have completed this section. Well done.	You have completed this section. Well done.	Next goes to next SM.

	Sub-Module 3 [copy/paste this table to build a new interactive presentation or audio book]					
	Activity – select					
	LEARNING OBJECTIVES: Explain the nature of buoyancy in liquids and gases Apply the law of Archimedes in solving problems					
Development Brief	**[Description of sub-module for media development team.]**					
References	TBA					
Introduction	NA					
Instruction	Txt		Aud	Answer the questions by selecting the correct option.	Vis	NA

Frame	Visual Description	Text on screen	Audio	Action
1	Show the options. Option i) shows the raft with the desk at level with water. Option ii) shows raft logs half-submerged. Option iii) shows almost the entire raft above the	At summer camp at Kolsai lake, teams of students build a raft to go to the other side. Team A consists of three students weighing 55kg, 60kg and 60kg. Team A's raft is made of 5 logs, each with a volume of 110 liters. The raft itself weighs 50 kg.	At summer camp at Kolsai lake, teams of students have been given the task of making a raft and sail it to the other side of the lake. Team A consists of three students weighing 55kg, 60kg and 60kg. Team A's raft is made of 5 logs, each with a volume of 110 liters. The raft itself weighs 50 kg.	Next goes to next frame.

	water. Show a slowly turning hourglass and a digital count down timer which counts down from 60 s. Feedback	Which of the following options shows how Team A's raft floats: i) <diagram of raft with top desk awash> ii) **<diagram of diagram of raft half submerged> [CA]** iii) <diagram of diagram of raft floating high> On incorrect answer: That is not quite right. Try again On timeout or second incorrect answer: That is not quite right. The correct answer is <show the correct diagram> On correct answer: That is right. The correct answer is <show the correct diagram>	Which one of the options correctly depict s how team A's raft will float: On incorrect answer: That is not quite right. Try again On timeout or second incorrect answer: That is not quite right. When fully submerged, the 5 logs can displace 550 liters of water which weighs 550kg. To support 225 kg, which is the combined weight of team A and the weight of the raft, the logs need to be half-submerged. On correct answer: That is right. When fully submerged, the 5 logs can displace 550 liters of water which weighs 550kg. To support 225 kg, which is the combined weight of team A and the weight of the raft, the logs need to be half-submerged. Well done.	
2	Show a slowly turning	At a summer camp, teams	At another competition at summer camp, different teams	Next goes to next frame.

	hourglass and a digital count down timer which counts down from 60 s. Show a submarine floating on the water. Show it submerging, with a stream of bubble escaping from the sub. Show the options. Feedback	of students have made model submarines that could actually submerge. Team B's submarine weighs 1.8 kg, and floats on water. The submarine can flood its ballast tank with 0.4 kg of water to allow it to submerge, Which of the following options are true (select all that apply): i) When floating on the surface, the weight of the submarine is less than the weight of the water it displaces II) When submerged, the weight of the water in the ballast tanks is greater than the weight of the water displaced by the submarine iii) Flooding the ballast tanks with water decreases the buoyancy of the ship On incorrect answer: Not quite correct. Try again On second incorrect answer or timeout: Not quite correct. The correct answers are: • When floating on the surface, the weight of	made model submarines that could actually submerge and then float again. Team B's submarine weighs 1.8 kg and floats on water. The submarine can flood its ballast tank with 0.4 kg of water to allow it to submerge, Which of the following options are true (select all that apply): i) **When floating on the surface, the weight of the submarine is less than the weight of the water it displaces. [CA]** II) When submerged, the weight of the water in the ballast tanks is greater than the weight of the water displaced by the submarine. iii) **Flooding the ballast tanks with water decreases the buoyancy of the ship. [CA]** On incorrect answer: Not quite correct. Try again. On second incorrect answer or timeout: Not quite correct. The correct answers are: • When floating on the surface, the weight of the submarine is less than the weight of the water it	Back goes to previous frame. 

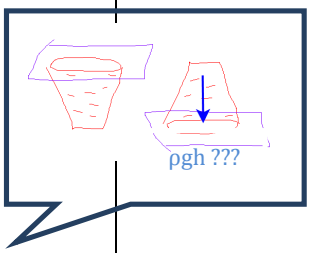
		the submarine is less than the weight of the water it displaces • Flooding the ballast tanks with water decreases the buoyancy of the ship On correct answer: You are right. The correct answers are: • When floating on the surface, the weight of the submarine is less than the weight of the water it displaces • Flooding the ballast tanks with water decreases the buoyancy of the ship	displaces. • Flooding the ballast tanks with water decreases the buoyancy of the ship. On correct answer: You are right. The correct answers are: • When floating on the surface, the weight of the submarine is less than the weight of the water it displaces. • Flooding the ballast tanks with water decreases the buoyancy of the ship.	

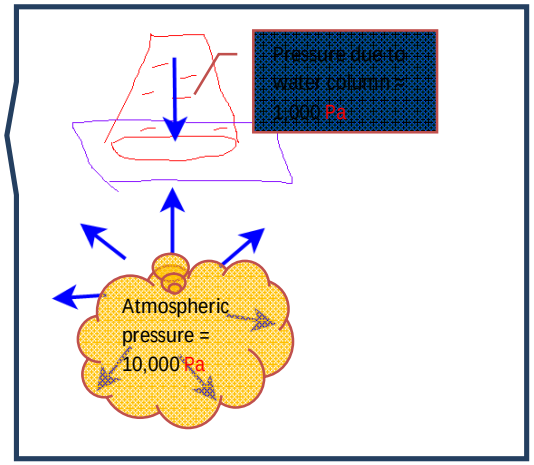
[Add rows as necessary]

	Sub-Module 4 [copy/paste this table to build a new interactive presentation or audio book]
	Interactive presentation
	LEARNING OBJECTIVES: Derive and apply the definition of pressure and density p = ρgh equation and apply it
Development Brief	**[Description of sub-module for media development team.]**
Referen	TBA

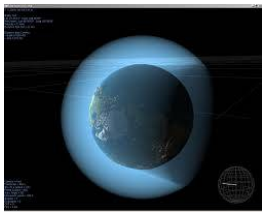
ces						
Introduction	NA					
Instruction	Txt		Aud		Vis	NA

Frame	Visual Description	Text on screen	Audio	Action
1	Show an animation where a glass tumbler is filled to the brim with water and a smooth piece of card is placed on the mouth. The tumbler is quickly turned upside down. The card stays on the mouth of the tumbler, and the water does not fall out.	Look at the experiment and see if you explain it. • Density of water = 1000 kgm^{-3} • Height of water in tumbler = 0.1m • Gravitational field strength g = 10 Nkg^{-1} Pressure acting downwards on the card = ρgh = 1000x0.1x10 = 1000 Nm^{-2}= 1000 Pa	Look at the experiment and see if you explain it. The column of water in the tumbler has density of 1000 kgm^{-3}. Height of the tumbler is 0.1m and g is 10 NKg^{-1}. The pressure due to the column of liquid in the tumbler equals ρgh which equals 1000 Nm^{-2} or 1000 Pascals of pressure on the card. Yet the card stays where it is and holds up the water in the glass.	Next goes to next frame.
2	Animate and progressively display the experiment.	1. Why does the water not fall out? 3. Atmospheric pressure ≅ 10,000 Pa	1. Is it possible that there is another pressure which is balancing the pressure exerted by the water column? 2. It turns out that there is indeed another pressure. This is the pressure exerted by the atmosphere which is called atmospheric pressure. 3. A typical value of atmospheric pressure is	Next goes to next frame. Back goes to previous frame.





		4. This overcomes the pressure due to the water column	10,000 Pascals. 4. This easily overcomes the pressure due to the column of water in the glass.	
3		Atmospheric pressure is due to ρgh of air, where h = 100 km	The atmosphere exerts a huge pressure all around. This is because atmospheric pressure is generated by a layer of air which is about 100 km high. However, atmospheric pressure is nothing compared to the pressure generated by denser materials, such as water.	Next goes to next frame. Back goes to previous frame.
4		Density of the air at sea level = 1.2 kgm^{-3} Density of water = 1000 kgm^{-3} Water is 1000 times as dense as air Just 10 m of water produces pressure equal to atmospheric pressure	The density of water is about 1000 times that of air. As a result, even small columns of water can exert great pressure. For example, a column of water just 10 m high produces a pressure equal to that of the atmosphere.	Next goes to next SM. Back goes to previous frame. Do You Know? displays pop-up screen that overlays the current screen. Content of pop-up is given in frames that



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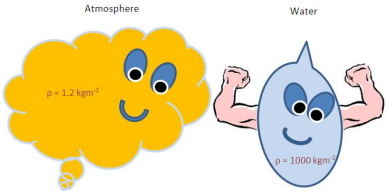
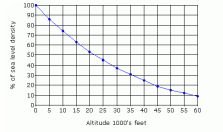


				follow.
5	Show this in a pop-up in response to the "Do You Know" in frame 4.	Density Variation with Altitude	The density of the air at sea level is 1.2 kgm^{-3}. This density does not remain constant, but decreases as we go higher. A graph of the density variation of air as the altitude increases is shown.	Back goes to previous frame



http://www.recreationalflying.com/tutorials/meteorology/section1a.html