M6 Physics ST30204

13 May to 19 September 2025

Teacher Robert Baker

Class Meetings on Thursaday from 10:20 to 12:10 in Room 3101

Basics Materials Provided by:

Glencoe Science, Physics Principles and Problems

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Topics covered

Week	ST30102 M6 Physics	Side Notes
1	Magnets	
2	Forces Caused by Magnetic Fields	
3	Practice Problems	Week 1-3 Chapter 24, Glencoe
4	Electric Current from Changing Magnetic Fields	
5	Changing Magnetic Fields Induce EMF	
6	Practice Problems	Week 4-6 Chapter 25, Glencoe
7	Interactions of Electric and Magnetic Fields and Matter	
8	Electric and Magnetic Fields in Space	
9	Practice Problems	Week 7-9 Chapter 26, Glencoe This would be a good time to revise and prepare for midterm exams
10	Revise for midterm exams.	
11	Temperature and Thermal Energy	

12	Change of State, and Laws of Thermodynamics	
13	Practice Problems	Week 10-12, Chapter 12, Glencoe
14	Properties of Fluids	
15	Forces within a Liquid	
16	Fluids at Rest, and in Motion	
17	Solids	
18	Practice Problems	Week 13-17 Chapter 13, Glencoe Revise and prepare for final exams
19	Revise for final exams.	

Syllabus is subject to change to accommodate holidays and any irregularities, or changes of plans.

Topic 1, Magnetic Fields, weeks 1-3

Objectives:

- Students will learn to assign forces of attraction or repulsion between magnetic poles.
- Students will learn to relate magnetism to electric charge and electricity.
- Students will learn to describe how electro-magnetism can be harnessed for practical applications.
- Students will learn how to manipulate basic force equations related to magnetism

Materials:

- The class will be delivered in lectures and tutorials held in class
- A study guide covering major topics from the unit
- Handouts, and worksheets come from Chapter 24 of Physics Principles and Problems

- If possible, have several magnets, insulated copper wire, a battery, and a compass handy for demonstration purposes

Week 1

Procedures:

- Meet and greet the class.
    - As this is the first time meeting these students, take care to use student names, and set the tone for the class
- This week will be mostly talking unfortunately
    - Ask the students what they know about magnets
    - Try to gauge the basic knowledge of students
- Teacher can fill in the gaps in student knowledge. Teacher may want to use magnets to demonstrate several of the basic ideas in magnetism
    - How do magnetic materials arise in nature?
    - How can we visual the magnetic field lines?
    - What are some basic properties of magnets?
    - Are the magnetic field lines real?
    - How we use the concept of flux to understand magnetic strength
- Allow students time to complete some concept checking questions from handouts, or worksheets
    - Check these answers as a class, by discussion, and diagrams on the board
- If time begin discussing how electric current produces a magnetic field.
    - We can understand that magnetism arises from a fundamental property of the electron
    - Because of this it should be no surprise that when electrons move free from the atom, they generate a magnetic field
    - We can discuss as a class, and make diagrams about the geometry of wires
- Introduce Right Hand Rule to know the direction of the magnetic field in relation to the flow of current in the wire.

Conclusion:

- Students will have been introduced to the basics of magnetism
- Students demonstrated their knowledge through the concept checking questions
  - Any mistakes will be corrected through classroom discussion
- Stretch target of introducing how current creates magnetic fields may have been discussed
  - This topic will be revised, and students will demonstrate their understanding by manipulating force equations, interpreting diagrams, and creating their own diagrams

Week 2

Procedure:

- Greet the class
- Revise last week's topic
  - Of special interest is the right hand rule
    - Make sure to introduce, or re-introduce the right hand rules
  - Reinforce the notion that electro-magnetism is in 3-space
    - Revise symbols used to diagram situation in 3-space on the board
- Pick up the discussion of magnetic fields generated by a current through a wire.
- Teacher may wish to give a demonstration with the compass, copper wire, and battery
  - Place the compass and wire together
  - Connect the wire to the battery, and obverse the compass needle
  - Notice how the compass need reacts at different angles of orientation to the wire
  - Repeat this demonstration by moving the compass to be on top of the wire, and below the wire
- From this we can clearly see the effect of electro-magnetism

- The induced field not only has an effect on the compass, but also generates a force on the wire
    - This force can be found through the application of our first force equation
- Teacher can write the force equation on the board
    - Make sure to highlight the units being used
    - Demonstrate the algebra about manipulating this equation
- Let students work together on the handouts, and worksheets about this equation
    - This may take several minutes, and teacher should monitor student progress, offer help and assist as needed
    - When ready allow students to work each of the practice problems at the board
    - Make sure appropriate diagrams have been drawn
- Teacher can then follow up by asking concept checking questions
- If time allows we can ask if a force is produced by current through a wire in a magnetic field, what happens to charged particles in a magnetic field
    - Draw a diagram of the situation on the board; say an electron is moving into a magnetic field, what forces would we expect the electron to experience?
    - It seems from the right hand rule, we should be able to predict the direction of the force so long as the electron is moving perpendicular to the magnetic field

Conclusion:

- Students revised key concepts of the previous class
- Students demonstrated their understanding of today's class by solving several problems related to our first force equation; $F = ILB(\sin\Theta)$
    - This equation simplifies to $F = ILB$, when $\Theta = 90°$
- Students were introduced to the next topic, time permitting
    - In such a case, students have the idea planted in their mind that charged particles experience a force when moving through a magnetic field

Week 3

Procedure:

- Greet the class
- Revise last week's topic
  - Remind students of the right hand rule
  - Remind students of our first force equation
- Re-introduce the idea of a charged particle moving through a magnetic field
  - From the right hand rule, we already know the direction of the force
- Teacher can draw the situation on the board for students and introduce the next force equation $F = qvB(\sin\Theta)$
  - When $\Theta = 90°$, this equation simplifies to $F = qvB$
- Allow students time to solve various problems related to this equation
  - Teacher may need to remind students about the charge of an electron
  - Teacher can monitor student progress, and offer help as needed
- When finished we can revise on the board
  - Allow individual students the chance to solve problems at the board
  - Ensure that good diagrams of the situation are presented
- With any time remaining, go through additional questions and problems
  - This gives the students more experience at problem solving, and boosts student confidence
- At the end collect the additional practice problems
- Time permitting, introduce the next topic.
  - This unit told us that electric currents can produce magnetic fields
  - The next unit will tell us something about creating electric currents from magnetic fields

Conclusion:

- In this class, students finished their work on magnetic fields, and demonstrated their understanding by completing several problems
- Additional problems have also been done for practice
  - The number of problems completed is a marginal indicator of an individual student’s understanding and comfort level with the materials presented

Topic Conclusion:

Did students understand and demonstrate an appropriate level of understanding?

Do any topics warrant additional time and resources to understand?

What could the teacher do to improve the student’s performance in this topic?

Topic 2, Electro-Magnetic Induction weeks 4 to 6

Objectives:

- Students will learn to describe how changing magnetic fields can generate electric potential differences.
- Students will apply this phenomenon to the construction of generators and transformers.

Materials:

- The class will be delivered in lectures and tutorials held in class
- A study guide covering major topics from the unit
- Handouts, and worksheets come from Chapter 25 of Physics Principles and Problems
- A volt meter, length of wire, and a variety of magnets will be handy for demonstration

Week 4

Procedure:

- Greet the class
- Remind students that electric current can produce a magnetic field, as we saw in the previous unit
- In this unit, we will see how to generate an electric current with a magnetic field
- Teacher can demonstrate this with a volt meter, length of wire, and magnet
    - We should observe that the current produced is related to the strength of the magnet, the speed at which the wire moves through the field, and the direction the wire moves through the field
    - This observation motivates the equation for Electromotive Force (EMF)
        - $EMF = BLv(\sin\Theta)$
        - EMF is at a max when $\Theta = 90°$
- The effective current and voltage can be used to describe an alternating current and voltage
    - $I_{eff} = 0.707\ I_{max}$
    - $V_{eff} = 0.707\ V_{max}$
- A generator and a motor are similar devices. A generator converts mechanical energy to electric energy, whereas a motor converts electric energy to mechanical energy.
- Let students spend some time working through example problems from the handouts, and worksheets
    - Teacher should monitor the class, and offer assistance as needed
    - When complete, allow individual students to come to the board and present solutions
    - Teacher should ensure that proper diagrams are presented
- If time allows, introduce the next topic. We saw that a magnetic field can induce an electric current.
    - Instead of moving the wire through a magnetic field, perhaps we can vary the magnetic field strength to achieve the same result

Conclusion:

- Students demonstrated their knowledge of the EMF by solving various problems
    - Students gained confidence by working together, and showing their solutions on the board
- The next topic may have been introduced time permitting
    - This plants the idea in the student's mind about where the topic is going

Week 5

Procedure:

- Greet the class
- Revise the previous topic
    - Teacher can ask concept checking questions to ensure student understanding
- Discuss Lenz's Law
    - Lenz's law states that an induced current is always produced in a direction such that the magnetic field resulting from the induced current opposes the change in the magnetic field that is causing the induced current.
    - Teacher can draw a diagram on the board to help illustrate the point
- Discuss self-inductance
    - Self-inductance is a property of a wire carrying a changing current. The faster the current is changing, the greater the induced *EMF* that opposes that change.
    - Teacher can attempt to draw the situation to aid student's understanding
- Discuss how transformers work
    - A transformer has two coils wound about the same core. An AC current through the primary coil induces an alternating *EMF* in the secondary coil. The voltages in alternating-current circuits may be increased or decreased by transformers.
    - Transformer Equation: $(I_s/I_p) = (V_p/V_s) = (N_p/N_s)$
    - p- primary, s – secondary, I current, V volts, N number of turns in the coil
- At this point, students can work out problems from the handout, and worksheets
    - Teacher will monitor the situation, and offer help as needed
    - When finished, several students will share their solutions on the board

    - Teacher can ensure that appropriate diagrams are presented
- This classroom discussion and problem solving may go a little long
    - If time permits, teacher can let students know next class will be time to solve more problems, and demonstrate understanding of the topic

Conclusion:

- Students showed understanding by solving problems from the handout and worksheet
- Depending on progress, next class will be dedicated to further problem solving
    - If student progress is good, then we can cut the practice problem section short
    - I currently predict that the extra problem solving class will be needed

Week 6

Procedure:

- Greet the class
- Revise topics from the last two class meetings
- This class meeting is to extra, and can be cut to accommodate future classroom needs, and exams
    - If the students have demonstrated a good understanding from previous classes, it might be better to skip
    - If students are weaker on the topic, then the extra practice would be beneficial
- Students can solve the additional problems from the handout and worksheet
    - Teacher should monitor the situation, and offer help as needed
    - When finished, allow individual students to demonstrate their solution on the board
    - Teacher should ensure appropriate diagrams are presented
- Teacher can collect this work for evaluation
    - The number of problems solved is marginal indicator of the level of understanding that the students have about the topic
- Should this period be unnecessary, proceed to next unit.
    - Be wary of pushing on too quickly, as magnetism, and electromagnetism are quite difficult for many students to fully understand

    - Monitor the class closely during problem solving sessions, and carefully evaluate their work

Conclusion:

- Students demonstrated their ability to understand the presented materials by solving a number of problems about electro-magnetic induction
- The next unit, Electromagnetism, will build on the understanding of the previous two.

Topic Conclusion:

Did students understand and demonstrate an appropriate level of understanding?

Do any topics warrant additional time and resources to understand?

What could the teacher do to improve the student's performance in this topic?

Topic 3, Electromagnetism, weeks 7-9

Objectives:

- Students will learn how combined electric and magnetic fields can be used to determine the masses of electrons, atoms, and molecules.
- Students will be able to explain how electromagnetic waves are created, travel through space, and are detected.

Materials:

- The class will be delivered in lectures and tutorials held in class
- A study guide covering major topics from the unit
- Handouts, and worksheets come from Chapter 26 of Physics Principles and Problems

Week 7

Procedure:

- Greet the class
- Revise the right hand rule
- Teacher introduces the topic of finding the mass of an electron
  - Discuss the historic, scientific development
- Teacher can go through an example problem for the class
- When finished, students can work on practice problems together
  - Teacher should monitor the situation, and offer help as needed
  - When finished, students can present solutions at the board
  - Teacher can assure the solutions are correct, and any diagrams are appropriate
  - These problems should give students some confidence in using the equations to solve problems; $(q/m) = (v/Br)$; $(q/m) = (2V/B^2r^2)$
- If time, we can have a classroom discussion about how atoms of the same element can have different masses.

Conclusion:

- Students gained some experience and confidence manipulating the equations used to find the mass of particles in an EM field
- Students demonstrated their ability to understand the presented materials by solving a number of problems about electro-magnetic induction
- Students gained an understanding of how combined electric and magnetic fields can be used to determine the masses of electrons, atoms, and molecules.

Week 8

Procedure:

- Greet the class
- Revise previous equations
- Discuss how the electromagnetic waves are coupled and propagate through space
- Discuss how the wavelength is equal to the velocity divided by the frequency
- Students can try some practice problems after an example is shown.
    - Teacher can monitor the class, and offer help as needed
    - When finished, students can present some solutions to the class
    - Teacher can ensure the quality of the board work, and appropriateness of the diagrams
- Discuss some of the applications of electromagnetic waves, and properties of waves through different mediums

Conclusion:

- Students have gained an understanding of electromagnetic waves, and increased their confidence in using the equations related to electromagnetism
- Students have gained an understanding about how electromagnetic waves are created, travel through space, and are detected.

Week 9

Procedure:

- Greet the class.
    - If Week 6 was needed to revise previous topics, then this week should be an exam week on the topics covered up to now.
    - If Week 6 was not needed for revision, then this week should be used to revise for midterm exams.
    - Given the time limits of class, 3 or 4 problems could be selected from each topic and presented as a midterm exam
        - Students that have the study guides for physics should feel free to use them

    - Students will need to be able to select the right equation, and understand the situations in which they are used

Mid Term Conclusion:

- Students have gained some understanding of the topics relevant to electromagnetism
- This understanding was measured and ensured by problem solving in each class meeting, and then again on the mid-term exam

Topic 4, Temperature and Thermal Energy, weeks 10-12

Objectives:

- Students will learn how temperature relates to the potential and kinetic energies of atoms and molecules.
- Students will distinguish heat from work.
- Students will calculate heat transfer and the absorption of thermal energy.

Materials:

- The class will be delivered in lectures and tutorials held in class
- A study guide covering major topics from the unit
- Handouts, and worksheets come from Chapter 12 of Physics Principles and Problems

Week 10

Procedure:

- Greet the class
- Students will revise for midterm exam, and be assessed of their individual abilities

Conclusion:

- Students have just completed their midterm exam preparation.
- Scores will be determined and entered into the school system in a timely manner

Week 11

Procedure:

- Greet the class
- This Begins the start of a very different kind of physics
  - Some students will be relieved that this topic is something that easier to observe with the naked eye
  - However, there will be more formulas to use and remember how to use
- Begin the class discussing temperature and thermal energy
  - Revise some basic topics about heat, transfer of heat, volume and pressure
  - This will hopefully facilitate the main aims of relating temperature to thermal energy
  - Point out an obvious fact that given enough time two objects of different temperature will reach an equilibrium point where the temperatures are equal
- Start a follow up discussion the process of heat transfer, conduction, convection, and radiation
  - We can discuss that different materials allow the heat transfer more readily than others, this is known as **specific heat** of the material in question
  - This leads to our first equation; $Q = mC\Delta T$, or $Q = mC(T_f - T_i)$
    - Q is the amount of heat that is transferred (J)
    - m is the mass of the object (kg)
    - C is the specific heat of the materials (J/(kg K))
    - ΔT is the change in temperature (K)
- Teacher can work an example at the board
  - When finished students can spend some time trying out practice problems for themselves
  - Teacher can monitor, and offer help as needed
  - When finished, several students can present their solutions on the board
  - Teacher can ensure the quality of student board work

- Discuss the conservation of energy.
  - In a closed system the total amount of thermal energy is constant
  - i.e. If two objects A, and B are placed into a closed system, then $E_A + E_B$ = constant amount
- Teacher can work an example of conservation of energy on the board
  - When finished, students can try to solve some of the problems about this
  - Teacher can monitor, and offer help as needed
  - When finished, several students can present their solutions on the board
  - Teacher can ensure the quality of student board work

Conclusion:

- This unit is quite long, and may spill over into the next class meeting
- Students were reminded about some basic facts of temperature, and thermal energy
- Students gained an understanding of heat transfer, and conservation of energy by working examples out at the board.
- Next we will continue down this topic by exploring the Laws of Thermodynamics

Week 12

Procedure:

- Greet the class
- Revise topics from last class
- Begin the discussion about the states of water.
  - At normal temperatures water is liquid
  - If water loses enough energy, it will freeze into a solid
  - If water gains too much energy, it will turn into steam
- This is called a phase change, and it is true for all materials
  - Just as different materials have different specific heat, different materials have different conditions that will allow them to form a solid, liquid, and gas
    - The heat required to melt a solid is $Q = mH_f$

        - The heat required to vaporize a liquid is $Q = mH_v$
- Teacher can work out an example on the board
    - When finished, students can try to solve some of the problems about this
    - Teacher can monitor, and offer help as needed
    - When finished, several students can present their solutions on the board
    - Teacher can ensure the quality of student board work
- From here we can begin discussing the Laws of Thermodynamics
    - The first law of thermodynamics follows from the conservation of energy
    - Energy is not created or destroyed, merely transformed into other forms. We could say the change in thermal energy is equal to the heat in the system minus the amount of work done by the system
        - $\Delta U = Q - W$
    - With this equation we can think about how engines, particularly steam engines, and other devices work
- Teacher can work out an example on the board
    - When finished, students can try to solve some of the problems about this
    - Teacher can monitor, and offer help as needed
    - When finished, several students can present their solutions on the board
    - Teacher can ensure the quality of student board work
- Second Law of Thermodynamics involves a strange quantity known as entropy.
    - Teacher can discuss entropy with the class, and some of its stranger properties, consequences
    - Entropy may well be the main mechanic by which we can perceive the flow of time
    - Changes in entropy are equal to the heat of an object divided by the temperature in K
        - $\Delta S = (Q/T)$
- Teacher can work out an example on the board
    - When finished, students can try to solve some of the problems about this

    - Teacher can monitor, and offer help as needed
    - When finished, several students can present their solutions on the board
    - Teacher can ensure the quality of student board work

Conclusion:

- This unit is quite long, and may spill over into the next class meeting
- Students learned about how work can result from the transfer of heat
- Students learned about the laws of thermodynamics, and some practical applications
- Students gained experience and confidence manipulating the equations pertaining to the flow of heat in a system by solving practice problems at the board
- The following class meeting is scheduled as a practice problem session. If the time is needed to finish previous topics then the next period can be used as a time to catch up on the lecture

Week 13

Procedure:

- Greet the class.
- This week is set aside to work practice problems.
    - Teacher will hand out a variety of problems from the previous unit, and give students a chance to work individually, or in groups on the problems
        - Teacher should monitor the class, and offer help as needed
    - When students have completed several practice problems the solutions can be presented in class
    - Teacher can ensure the quality and accuracy of presented work, taking care to make sure that any diagrams are appropriate to the situation
- Alternatively, if students have performed exceptionally well up to this point, this week can be used help fit the scheduling needs of the course, and accommodate holidays, or other special occasions.

Conclusion:

- One of two things happened this class meeting;
    - Either students got further practice and gained confidence in their ability to solve problems
    - Or this class meeting is used to accommodate scheduling needs of the class

Topic 5: States of Matter, weeks 13 to 17

Objectives:

- Students will be able to explain the expansion and contraction of matter caused by changes in temperature.
- Students will apply Pascal's, Archimedes', and Bernoulli's principles in everyday situations.

Materials:

- The class will be delivered in lectures and tutorials held in class
- A study guide covering major topics from the unit
- Handouts, and worksheets come from Chapter 13 of Physics Principles and Problems

Week 14

Procedure:

- Greet the class
- Teacher will spend some time developing key vocabulary, and concepts with students
- Teacher will help students understand pressure in fluids, $P = F/A$
    - This will lead into the concept of pressure exerted by gases, and the pressures exerted on gases
    - Boyle's Law (of gases) $PV = k$, the pressure of gas by the volume gives a constant value, or $P_1V_1 = P_2V_2$
    - Charles's Law (of gases) $V/T = k$, the volume of gas divided by temperature gives a constant, or $V_1/T_1 = V_2/T_2$
    - We can combine these expressions as $(P_1V_1)/T_1 = (P_2V_2)/T_2$
- This leads directly into the Ideal Gas Law, $PV/T = kN$.
    - k, is called Boltzmann's constant, and its value is 1.38×10^{23} (Pa m^3)/K

- N, the number of particles, is a very large number. Instead of using *N*, using a unit called a mole is more convenient.
- One mole represents 6.022×10^{23} particles. This number is called Avogadro's number
- Using moles instead of the number of particles changes Boltzmann's constant. This new constant is abbreviated R, and it has the value 8.31 (Pa $m^{3)}$/(mol K).

- Ideal Gas Law PV = nRT
  - For an ideal gas, the pressure times the volume is equal to the number of moles multiplied by the constant R and the Kelvin temperature.
- This lecture portion may take too long and need to be split into part of the next lesson.
- From here, Teacher can work out some example problems before giving students practice problems to solve
  - Teacher can monitor the class, and offer help as needed
  - When finished, students can present solutions at the board

Conclusion:

- Students were given a lot of information this lesson
- Students learned a bit about pressure, in fluids and in gases.
- We developed the Ideal Gas Law
- Students gained experience and confidence working the problems

Week 15

Procedure:

- Greet the class
- Revise topics from last class
  - This lesson is much lighter than previous, so if extra time is needed to finish last week's work, this is good opportunity to catch up
- Teacher will develop key vocabulary, and concepts for forces within fluids.
  - Cohesive, and adhesive forces

    - Viscosity
    - Evaporation, and condensation
    - Evaporative cooling
- Teacher will give students conceptual questions to round out this lecture period
- Answers can be revised as a class

Conclusion:

- Students learned about concepts related to fluid
- Students demonstrated their understanding of the materials by answering several concept questions about the lecture

Week 16

Procedure:

- Greet the class
- Revise important topics from previous
- Teacher will develop key vocabulary and concepts related to fluids at rest and in motion
    - Many of these concepts follow from our previous equation P = F/V
- Pressure applied at any point on a confined fluid is transmitted undiminished throughout the fluid, a fact that is now known as Pascal's principle.
    - When fluids are used in machines to multiply forces, Pascal's principle is being applied
    - If a force, F_1, is exerted on the first piston with a surface area of A_1, the pressure,
    - P_1, exerted on the fluid can be determined by using the following equation. $P_1 = F_1/A_1$
    - The pressure exerted by the fluid on the second piston, with a surface area A_2, can also be similarly determined. $P_2 = F_2/A_2$
    - According to Pascal's principle, pressure is transmitted without change throughout a fluid, so pressure P_2 is equal in value to P_1.
        - $F_1/A_1 = F_2/A_2 \rightarrow F_2 = F_1A_2/A_1$ or $F_2 = P_1A_2$

- When swimming, you feel the pressure of the water increase as you dive deeper. This pressure is actually a result of gravity
  - The pressure of the water is equal to the weight, F_g, of the column of water above you divided by the column's cross-sectional area, A.
  - $P = (F_g/A)$
  - The weight of the column of water is $F_g = m \times g$, and the mass is equal to the density, ρ, of the water times its volume, $m = \rho V$. The volume of the water is the area of the base of the column times its height, $V = Ah$. Therefore, $F_g = \rho Ahg$. Substituting ρAhg for F_g in the equation for water pressure gives $P = Fg/A = \rho Ahg/A$.
  - $P = \rho hg$
- Why do some objects float, and others sink?
- The increase in pressure with increasing depth creates an upward force called the buoyant force.
  - Suppose that a box is immersed in water. It has a height of l and its top and bottom each have a surface area of A. Its volume, then, is $V = lA$. Water pressure exerts forces on all sides
  - To find out whether the box will float in water, you will need to determine how the pressure on the top of the box compares with the pressure from below the box
  - $F_{top} = P_{top} \times A = \rho hgA$
  - $F_{bottom} = P_{bottom} \times A = \rho(l + h)gA$
  - $F_{buoyant} = F_{bottom} - F_{top} = \rho(l + h)gA - \rho hgA = \rho gA(l + h - h) = \rho Vg$
  - $F_{buoyant} = \rho_{fluid}Vg$
    - For water $\rho = 1.00 \times 10^3$ kg/m^3
- Archimedes' principle explains why ships can be made of steel and still float; if the hull is hollow and large enough so that the average density of the ship is less than the density of water, the ship will float.

  - This can be verified with the equation for $F_{buoyant}$. If the net force is positive, the object floats when submerged in water
- Bernoulli's principle states that as the velocity of a fluid increase, the pressure exerted by that fluid decreases.
  - Hold a strip of notebook paper just under your lower lip. Then blow hard across the top surface. Why does the strip of paper rise?
  - The blowing of the air has decreased the air pressure above the paper. Because this pressure decreases, the pressure in the still air below the paper pushes the paper upward.
- This section seems quite long and may require part of the next class to resolve.
  - Worksheets and practice problems may need to be divided so that as one class topic is finished, students have a chance to practice
  - T should monitor the class as they work so as to offer help as needed
  - As students finish the practice problems, T select a few to work at the board

Conclusion:

- Students learned about pressure in fluids, and what causes objects to sink or float
- Students gained confidence with the new materials and equation. This was demonstrated through the completion of practice problems

Week 17

Procedure:

- Greet the class
- Revise topics from the previous week
  - If needed, sometime can be used to introduce topics that weren't covered last time.
- Teacher will develop the topic for the class

- When the temperature of a liquid is lowered, the average kinetic energy of the particles decreases. As the particles slow down, the cohesive forces have more effect, and for many solids, the particles become frozen into a fixed pattern called a crystal lattice
    - Although the cohesive forces hold the particles in place, the particles in a crystalline solid do not stop moving completely.
    - Rather, they vibrate around their fixed positions.
- In other materials, such as butter and glass, the particles do not form a fixed crystalline pattern.
    - Such a substance, which has no regular crystal structure but does have a definite volume and shape, is called an amorphous solid.
    - Amorphous solids also are classified as viscous, or slowly flowing, liquids.
- As a liquid becomes a solid, its particles usually fit more closely together than in the liquid state, making solids more dense than liquids.
    - Water is an exception because it is most dense at 4°C.
    - For most liquids, an increase in the pressure on the surface of the liquid increases its freezing point. Because water expands as it freezes, an increase in pressure forces the molecules closer together and opposes the freezing
- External forces applied to a solid object may twist or bend it out of shape. The ability of a solid object to return to its original form when the external forces are removed is called the elasticity of the solid.
    - If too much deformation occurs, the object will not return to its original shape because its elastic limit has been exceeded. Elasticity depends on the electromagnetic forces that hold the particles of a substance together.
    - Malleability and ductility are two properties that depend on the structure and elasticity of a substance. Because gold can be flattened and shaped into thin sheets, it is said to be malleable. Copper is a ductile metal because it can be pulled into thin strands of wire.

- It is standard practice for engineers to design small gaps, called expansion joints, into concrete-and-steel highway bridges to allow for the expansion of parts in the heat of summer.
    - Objects expand only a small amount when they are heated, but that small amount could be several centimeters in a 100-m-long bridge. If expansion gaps were not present, the bridge could buckle or parts of it could break.
    - High temperatures can also damage railroad tracks that are laid without expansion joints
- The change in length of a solid is proportional to the change in temperature
    - A solid will expand in length twice as much when its temperature is increased by 20°C than when it is increased by 10°C.
    - The expansion also is proportional to its length. A 2 m bar will expand twice as much as a 1 m bar with the same change in temperature.
    - The length, L_2, of a solid at temperature T_2 can be found with the following equation, where L_1 is the length at temperature T_1 and alpha, α, is the coefficient of linear expansion.
        - $L_2 = L_1 + \alpha L_1(T_2 - T_1)$ or
        - $\Delta L = \alpha L_1 \Delta T$, and
        - $\alpha = (\Delta L)/(L_1 \Delta T)$
- Since solids expand in three directions, the coefficient of volume expansion, β, is about three times the coefficient of linear expansion.
    - $\beta = (\Delta V)/(V_1 \Delta T)$
- From here, Teacher can present some practice problems for the students.
    - Teacher should monitor the class and offer help as needed
    - When finished, several students can volunteer to show their solutions at the board.

Conclusion:

- Students gained some understanding of the structure of solid materials, and how heat affects these materials
- Students gained confidence in their ability to manipulate the equation through practice problems

Week 18

Procedure:

- Greet the class
- This week has been set aside to facilitate the schedule.
- If the time is not needed to catch up on previous topics, this week will be used to work mixed review practice problems ahead of the final exam
- Specific topics will be revised as needed

Conclusion:

Students revised materials, and worked more practice problems

The practice problems will be selected so as to help boost student confidence heading into the final exam.

Week 19

Procedure:

- Greet the class
- This week will mark the end of course.
- Students will revise for final exam, and assessed of their individual abilities

Conclusion:

- Students have just completed their final exam preparation.
- Scores will be determined and entered into the school system in a timely manner

Scoring For the Course

Student scores will be determined from a combination of in class quizzes, classwork, and exams (midterm, and final).

Currently, I plan to have one quiz per unit. Classwork will periodically be collected and scored. This periodic nature will be used as an incentive to complete classwork, and as a way to help pad out scores if the quiz results should be less than expected.

The midterm, and final exams will be held at regularly scheduled exam periods.

When all the scores are in, they will be adjusted to meet the specific requirements of the school, and with the student's best interest in mind.

I expect classwork and quizzes to account for roughly 25% of the total score, student attitude and cooperativeness accounting for roughly 25%, and midterms and finals accounting for the balance. This expectation, as stated above, will be scaled appropriately to the situation as it exists in reality, and with the student's best interests in mind.