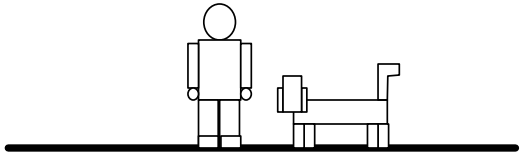
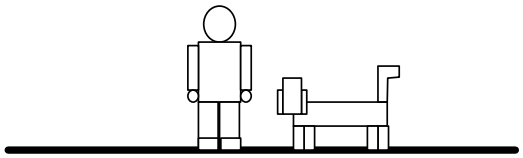
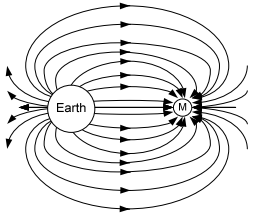
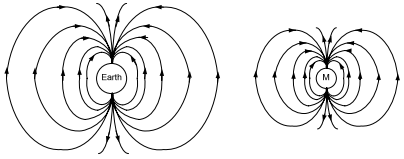
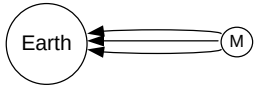
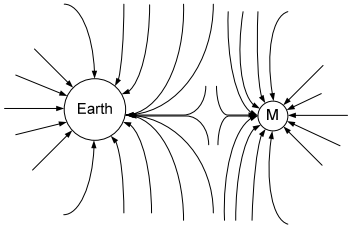
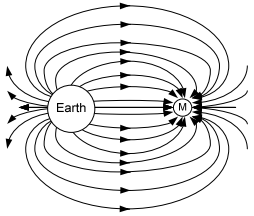
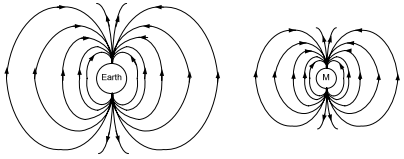
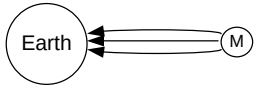
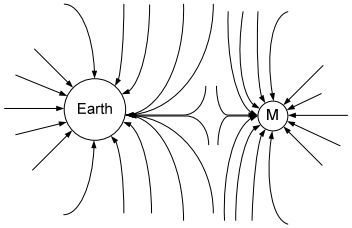
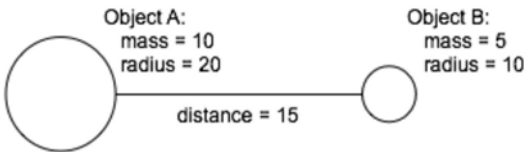
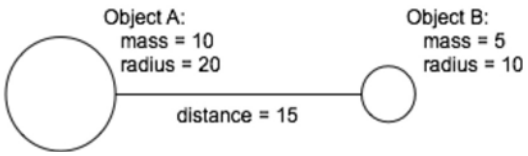
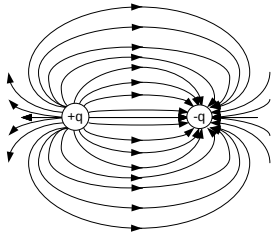
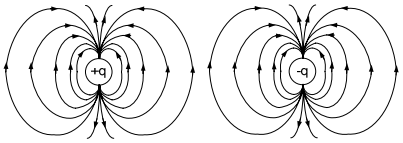
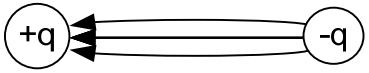
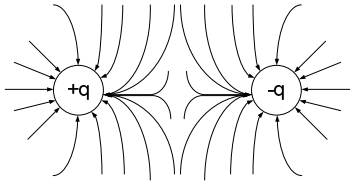
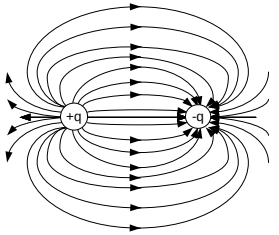
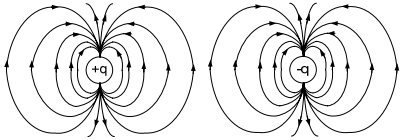
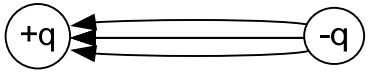
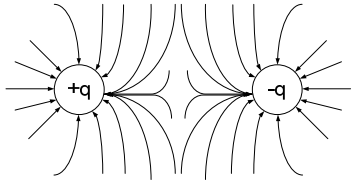
GRAVITY			
Level I			
Claims	**Evidence**	**Tasks (Pre-Test)**	**Tasks (Post-Test)**
The learner is able to recognize and identify the field interactions for two mass elements	Given a description of one or more objects with mass in proximity to the Earth, the student must indicate: 1 - that there is a gravitational interaction with the Earth and each object 2 - that there are also gravitational interactions among the objects themselves.	 **PRE Q 1.** A person is with their dog in a park. Which of the following statements are correct? A) There is a gravitational field from the Earth and the person. B) There is a gravitational field from the person and the dog. C) Both A and B. D) Neither of the above. Code: 1 No understanding of force interactions between two mass elements. Ans: D 2 Basic understanding that Earth has a gravitational field. Ans: A 3 Basic understanding that two interacting mass elements have a gravitational field. Ans: B 4 Correctly identify that there are gravitational fields between all of the mass objects. Ans: C	 **POST Q.1** A person is with their dog in a park. Which of the following statements are correct? A) There is a gravitational field towards the Earth. B) There is a gravitational field between the person and the dog. C) Both A and B. D) Neither of the above. Code: 1 No understanding of force interactions between two mass elements. Ans: D 2 Basic understanding that Earth has a gravitational field. Ans: A 3 Basic understanding that two interacting mass elements have a gravitational field. Ans: B 4 Correctly identify that there are gravitational fields between all of the mass objects. Ans: C

The learner is able to indicate the direction of the force vectors resulting from a mass element. (Engineering students will also be able to compute the magnitude of those vectors)	Given a description of a single object with mass, the student can [draw / select / describe in words / or otherwise indicate] that the gravitation field of the mass can be represented using vectors, and that each of these vectors points towards the center of mass of that object.	**PRE Q.2** What is the direction of the gravitational force on the Earth's surface? A) Gravity does not have direction. B) Towards the Earth's center of mass. C) Away from the Earth's center of mass. D) Tangent to the Earth's surface. Code: 1 No understanding that gravity can be described using vectors. Ans: A 2 Basic understanding that the force vector is oriented relative to the center of mass for an element. Ans: D 3 Basic understanding that the force vector is oriented parallel to vector pointing towards the center of mass for an element. Ans: C 4 Correctly identify that the force vector points towards the center of mass for an element. Ans: B	**POST Q.2** What is the direction of the gravitational force on the Earth's surface? A) Gravity does not have direction. B) Towards the Earth's center of mass. C) Away from the Earth's center of mass. D) Tangent to the Earth's surface. Code: 1 No understanding that gravity can be described using vectors. Ans: A 2 Basic understanding that the force vector is oriented relative to the center of mass for an element. Ans: D 3 Basic understanding that the force vector is oriented parallel to vector pointing towards the center of mass for an element. Ans: C 4 Correctly identify that the force vector points towards the center of mass for an element. Ans: B

The learner is able to indicate the direction of the force vectors resulting from a mass element. (Engineering students will also be able to compute the magnitude of those issues of the representation and the phenomena being represented – could involve multiple claims	The student's description of a gravitation field includes the following: there is a single force vector tangent to the gravitational field at all points in the gravitational field. If field lines were to intersect, this implies that there would be multiple directions for that force vector.	**PRE Q.3** Explain why gravitational field lines never cross. Code for written descriptions. 1 No understanding of gravitational force fields around mass elements 2 Basic understanding that mass elements have gravitational force fields but not necessarily the shapes or continuous nature 3 Basic understanding of gravitational force fields with some understanding of gravitational field interactions and shapes 4 Correctly select gravitational field image with vector at desired point two interacting interaction mass elements.	**POST Q.3** Explain why gravitational field lines never cross. Code for written descriptions. 1 No understanding of gravitational force fields around mass elements 2 Basic understanding that mass elements have gravitational force fields but not necessarily the shapes or continuous nature 3 Basic understanding of gravitational force fields with some understanding of gravitational field interactions and shapes 4 Correctly select gravitational field image with vector at desired point two interacting interaction mass elements.

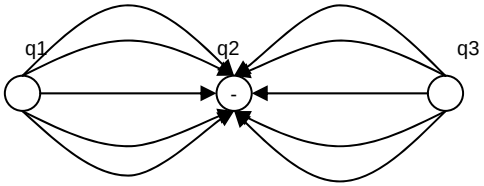
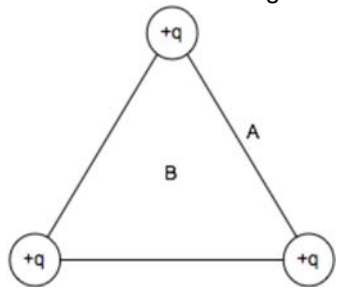
Level II			
The learner is able to correctly identify the net gravitational field of multiple interacting mass elements	Given several representations of the net gravitation field surrounding multiple interacting masses, the student selects the representation that best illustrates: 1 – the continuous nature of the net field 2 - the correct direction of the field vectors 3 – that the field generated by each mass linearly adds together to create the net field	**PRE Q.4** Which of the following images correctly represents the gravitational field for the Earth and Moon? A)  B)  C)  D)  Code: 1 No understanding of gravitational force fields around mass elements. Ans: C 2 Basic understanding that mass elements have gravitational force fields but not necessarily the correct shape, vector orientation, or continuous nature. Ans: B 3 Basic understanding of gravitational force fields with some understanding of gravitational field interaction and shape. Ans: A 4 Correctly select gravitational field image with correct orientation of vectors and shape of gravitational field. Ans: D	**POST Q.4** Which of the following images correctly represents the gravitational field for the Earth and Moon? A)  B)  C)  D)  Code: 1 No understanding of gravitational force fields around mass elements. Ans: C 2 Basic understanding that mass elements have gravitational force fields but not necessarily the correct shape, vector orientation, or continuous nature. Ans: B 3 Basic understanding of gravitational force fields with some understanding of gravitational field interaction and shape. Ans: A 4 Correctly select gravitational field image with correct orientation of vectors and shape of gravitational field. Ans: D

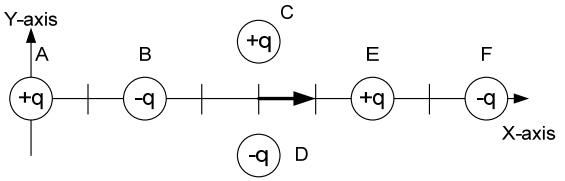
Level III			
The learner will be able to manipulate mass elements in a system to affect a desired outcome for a specific mass element	Given several possible manipulations, the student will choose a manipulation (or set of manipulations) that will achieve the desired outcome based on their reasoning of which parameters in Newton's Law of Gravity will correctly affect the system. Their responses should indicate that changing the mass of each object and/or the distance between their corresponding centers of mass will affect the magnitude of the force between them.	**PRE Q.5** Given the following two objects  Which of the following will increase the force on object B: A) increasing the radius of object A B) increasing the mass of object B C) increasing the distance between objects A and B D) none of these will affect the force on B Code: 1 No understanding of gravitational force between mass elements. Ans: D 2 Basic understanding that mass elements have gravitational force. Ans: C 3 Basic understanding of gravitational force fields with some understanding of gravitational field interaction and the gravitational field equation. Ans: A 4 Correctly select gravitational field image with correct orientation of vectors and shape of gravitational field. Ans: B	**POST Q.5** Given the following two objects  Which of the following will increase the force on object B: A) increasing the radius of object A B) increasing the mass of object B C) increasing the distance between objects A and B D) none of these will affect the force on B Code: 1 No understanding of gravitational force between mass elements. Ans: D 2 Basic understanding that mass elements have gravitational force. Ans: C 3 Basic understanding of gravitational force fields with some understanding of gravitational field interaction and the gravitational field equation. Ans: A 4 Correctly select gravitational field image with correct orientation of vectors and shape of gravitational field. Ans: B

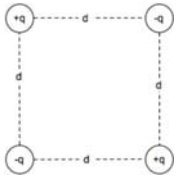
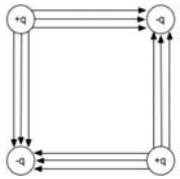
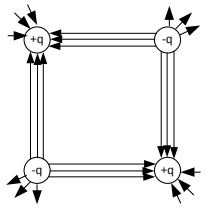
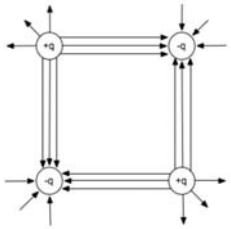
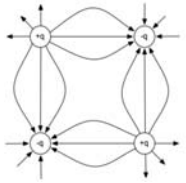
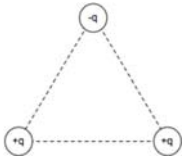
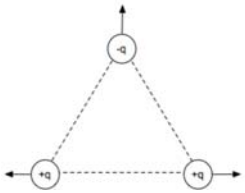
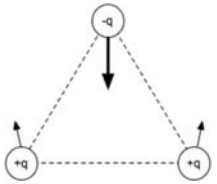
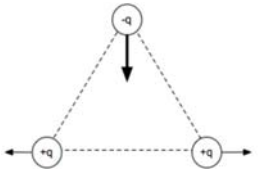
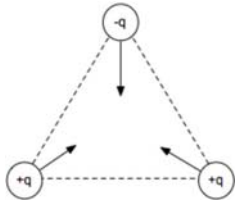
ELECTRIC FIELDS			
Level I			
The learner will be able to recognize and identify the electrostatic field interactions for two charged elements	Given several possible visual representations of the electrostatic field around multiple interacting charged elements, the student will correctly select the visual representation that best illustrates: 1 – the continuous nature of the field 2 - the correct direction of the field vectors 3 – that the field generated by each element linearly adds together to create the overall field	**PRE Q.1** Which image most accurately represents the electric field lines when there are two opposite charges, +q and –q, separated by a distance d. A)  B)  C)  D)  Code: 1 No understanding of electric field interactions between two charged elements. Ans: C 2 Basic understanding that static charged elements have an electrostatic electric field. Ans: B 3 Basic understanding that two interacting charged elements have an electrostatic electric field but not the correct interaction. Ans: D 4 Correctly identify there is an electrostatic field around both charged elements with the field vectors in the correct orientation. Ans: A	**PRE Q.1** Which image most accurately represents the electric field lines when there are two opposite charges, +q and –q, separated by a distance d. A)  B)  C)  D)  Code: 1 No understanding of electric field interactions between two charged elements. Ans: C 2 Basic understanding that static charged elements have an electrostatic electric field. Ans: B 3 Basic understanding that two interacting charged elements have an electrostatic electric field but not the correct interaction. Ans: D 4 Correctly identify there is an electrostatic field around both charged elements with the field vectors in the correct orientation. Ans: A

	The students will correctly reason how the force in a field is affected by the magnitudes of the charges.	**PRE Q.2** Two electric charges are separated by a finite distance. Somewhere between the charges, the electric field they produce is zero. What can you conclude about the sign of the charges? A) Both charges are negative. B) One charge is positive and one charge is negative. C) Answers A and B D) Do not know Code: 1 No understanding of electrostatic force interactions between charged elements. Ans: D 2 Basic understanding that static charged elements have an electrostatic electric field. Ans: B 3 Basic understanding that two like charges will have repelling electrostatic fields in the region where they interact. Ans: A 4 Basic understanding that any two like charges will have repelling electrostatic fields in the region where they interact.. Ans: C	**PRE Q.2** Two electric charges are separated by a finite distance. Somewhere between the charges, the electric field they produce is zero. What can you conclude about the sign of the charges? A) Both charges are negative. B) One charge is positive and one charge is negative. C) Answers A and B D) Do not know Code: 1 No understanding of electrostatic force interactions between charged elements. Ans: D 2 Basic understanding that static charged elements have an electrostatic electric field. Ans: B 3 Basic understanding that two like charges will have repelling electrostatic fields in the region where they interact. Ans: A 4 Basic understanding that any two like charges will have repelling electrostatic fields in the region where they interact.. Ans: C

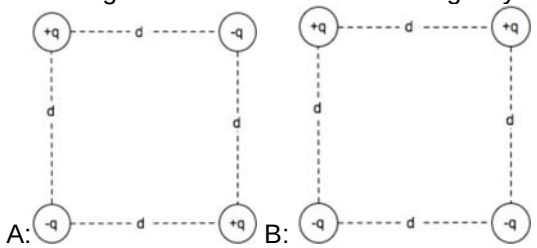
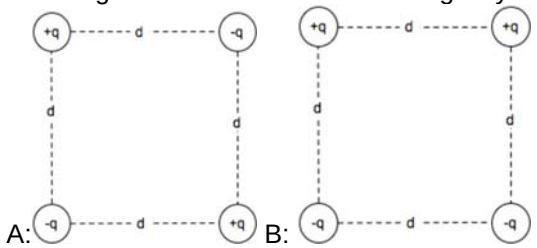
The learner will be able to recognize (or compute for engineering/science students) the direction for the force vector acting between two charged elements.	Given a description of a single element with charge, the student will identify that the electrostatic field around the element can be described using vectors, and that each of these vectors points away from the center of a positively charged element and towards the center of a negatively charged element.	**PRE Q.3** Under normal conditions, the electric field at the surface of the Earth's ground points downward, into the ground. What is the sign of the electric charge on the ground? A) The ground is positively charged B) The ground is negatively charged C) Do not know Code: 1 No understanding of electrostatic force feilds. Ans: C 2 N/A Ans: N/A 3 No recollection that a positively charged element has field vectors that point away from the element and that a negatively charged element has field vectors that point towards the element. Ans: A 4 Correctly indicates that a negatively charged element has field vectors that point towards the element direction. Ans: B	**POST Q.3** Under normal conditions, the electric field at the surface of the Earth's ground points downward, into the ground. What is the sign of the electric charge on the ground? A) The ground is positively charged B) The ground is negatively charged C) Do not know Code: 1 No understanding of electrostatic force fields. Ans: C 2 N/A Ans: N/A 3 No recollection that a positively charged element has field vectors that point away from the element and that a negatively charged element has field vectors that point towards the element. Ans: A 4 Correctly indicates that a negatively charged element has field vectors that point towards the element direction. Ans: B

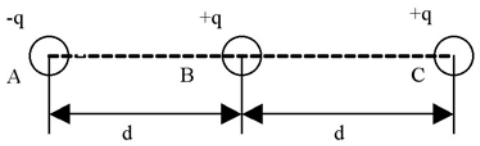
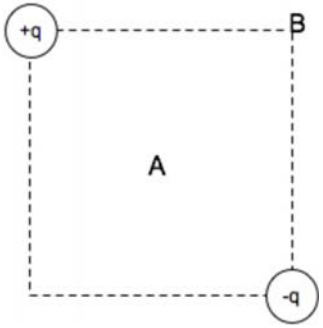
The learner will be able to recognize (or compute for engineering/science students) the direction for the force vector at a specific point in an electric field.	Given a visual representation of multiple interacting charged elements, the student will reason about the properties of the field at a given location (or set of locations) based on their knowledge of: 1 – the continuous nature of the field 2 - the correct direction of the field vectors (pointing towards negative charges and away from positive charges) 3 – that the field generated by each element linearly adds together to create the overall field	**PRE Q.4** The electric field lines surrounding three charges are shown below. The center charge is a negative q2.  What are the signs of q1 and q3 A) q1 is +, q3 is + B) q1 is -, q3 is - C) q1 is -, q3 is + D) q1 is +, q3 is - Code: 1 No understanding of electrostatic force interactions between charged elements. Ans: D 2 Basic understanding that electric fields interact around charged elements. Ans: C 3 No recollection that a positively charged element has field vectors that point away from the element and that a negatively charged element has field vectors that point towards the element. Ans: B 4 Correctly indicates that a negatively charged element has field vectors that point towards the element direction and that a positively charged element has filed vectors that point away from the element. Ans: A	**POST Q.4A** A positive point charge is placed at each corner of an equilateral triangle with sides length d. Point A is located at the midpoint of one side of the triangle. Point B is located at the center of the triangle  Which statement below best describes the magnitude of the electric field at point B: A) it is greater than at point A B) it is the same as at point A and both are greater than zero C) it is less than at point A D) the magnitude at A and B are both zero Code: 1 No understanding of electrostatic force interactions between charged elements. Ans: A 2 Basic understanding that electric fields interact around charged elements. Ans: B 3 No recollection that a positively charged element has field vectors that point away from the element and that a negatively charged element has field vectors that point towards the element. Ans: D 4 Correctly indicates that a negatively charged element has field vectors that point towards the element direction. Ans: C

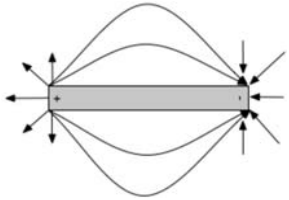
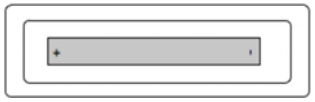
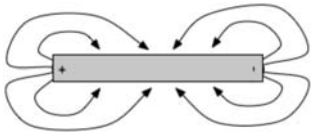
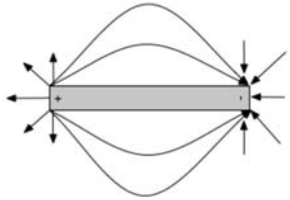
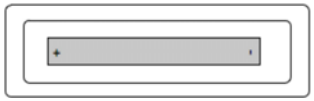
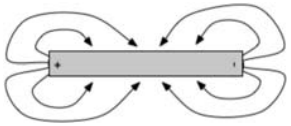
			POST Q.4B The electric field at the point x=5.0 cm and y=0.0 points in the positive x direction (with a magnitude of 15.0 N/C.) as shown below: Assuming this electric field is produced by a  single, point charge, what is the sign and location of the charge. A) Either C or D B) Either B or E C) Either A or F D) none of these could produce that field Code: 1 No understanding of electrostatic force interactions between charged elements. Ans: D 2 Basic understanding that electrostatic fields exists around charged particles. Ans: A 3 No recollection that a positively charged element has field vectors that point away from the element and that a negatively charged element has field vectors that point towards the element. Ans: B 4 Correctly indicates that a negatively charged element has field vectors that point towards the element direction. Ans: C (Engineers compute the magnitude)

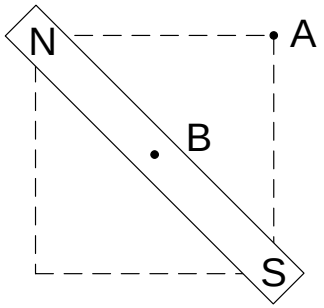
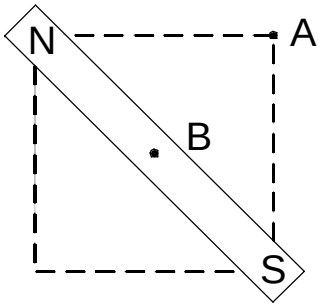
Level II			
The learner will select that best image for multiple interacting charged elements	Given several possible visual representations of the electrostatic field around multiple interacting charged elements, the student will correctly select the visual representation that best illustrates: 1 – the continuous nature of the field 2 - the correct direction of the field vectors (pointing towards negative charges and away from positive charges) 3 – that the field generated by each element linearly adds together to create the overall field 4 - the magnitude of the force vectors is based on parameters in Coulomb's Law	**PRE Q. 5** Which image below most accurately represents the electric field lines produced by the four charges arranged in the following configuration:  A)  B)  C)  D) 	**POST Q.5** Select the correct answer for the direction and relative magnitude of the electric force experienced by each of the 3 charges shown below:  A)  B)  C)  D) 

		Code: 1 No understanding of electrostatic force interactions between charged elements. Ans: A 2 Basic understanding that electrostatic fields exists around charged particles. Ans: B 3 Recollection that a positively charged element has field vectors that point away from the element and that a negatively charged element has field vectors that point towards the element. Ans: C 4 Correctly identifies the linear superposition of multiple interacting charges. Ans: D	Code: 1 No understanding of electrostatic force interactions between charged elements. Ans: A 2 Basic understanding that electrostatic fields exists around charged particles. Ans: C 3 Recollection that a positively charged element has field vectors that point away from the element and that a negatively charged element has field vectors that point towards the element. Ans: D 4 Correctly identifies the linear superposition of multiple interacting charges. Ans: B

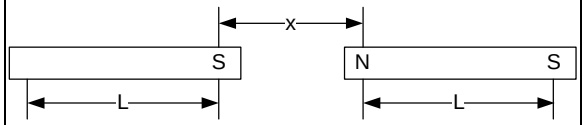
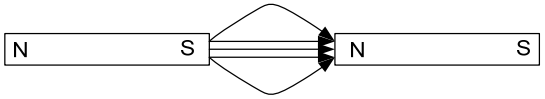
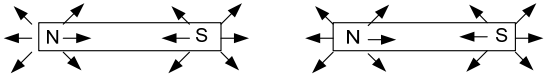
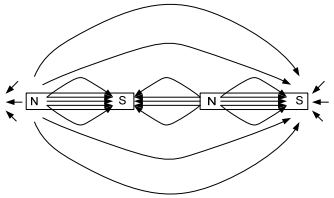
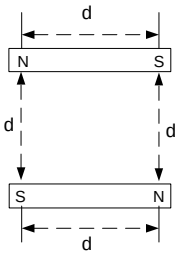
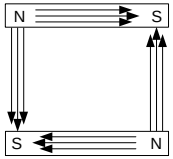
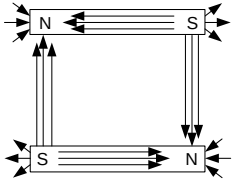
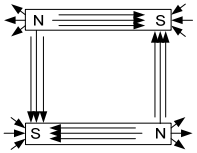
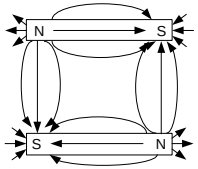
The student will be able to predict the changes in intensity/magnitude of the electric field when manipulating element parameters (size, shape, mass, position)	Given several possible configurations multiple interacting charged elements, the student will compare and contrast those configurations, and then select the response that best achieves the indicated outcome based on: 1 – the continuous nature of the field 2 - the correct direction of the field vectors (pointing towards negative charges and away from positive charges) 3 – that the field generated by each element linearly adds together to create the overall field 4 - the magnitude of the force vectors is based on parameters in Coulomb's Law	**PRE Q.6** Four point charges, each of magnitude q, are located at the corners of a square with sides of length a. Two of the charges are +q, and two are –q. The charges are arranged in one of the two following ways:  In which case will the electric field at the center of the square have the greatest magnitude? A) The magnitude is greatest in A B) The magnitude is greatest in B C) The magnitude is identical and greater than zero in both cases D) The magnitude is zero in both cases Code: 1 No understanding of electrostatic force interactions between charged elements. Ans: D 2 Basic understanding that electrostatic fields exists around charged particles. Ans: A 3 Recollection that a positively charged element has field vectors that point away from the element and that a negatively charged element has field vectors that point towards the element. Ans: C 4 Correctly identifies the linear superposition of multiple interacting charges. Ans: B (Engineers Calculate the electric field at the center of the square for each case.	**POST Q.6** Four point charges, each of magnitude q, are located at the corners of a square with sides of length a. Two of the charges are +q, and two are –q. The charges are arranged in one of the two following ways:  In which case will the electric field at the center of the square have the greatest magnitude? A) The magnitude is greatest in A B) The magnitude is greatest in B C) The magnitude is identical and greater than zero in both cases D) The magnitude is zero in both cases Code: 1 No understanding of electrostatic force interactions between charged elements. Ans: D 2 Basic understanding that electrostatic fields exists around charged particles. Ans: A 3 Recollection that a positively charged element has field vectors that point away from the element and that a negatively charged element has field vectors that point towards the element. Ans: C 4 Correctly identifies the linear superposition of multiple interacting charges. Ans: B (Engineers Calculate the electric field at the center of the square for each case.

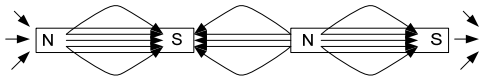
The learner will be able to predict the net force and direction acting on a given charge when added to an existing electric field from predetermined charged elements.	Given a visual representation of the electrostatic field around multiple interacting charged elements, the student will reason about the properties of the field at a given location (or set of locations) based on their knowledge of: 1 – the continuous nature of the field 2 - the correct direction of the field vectors (pointing towards negative charges and away from positive charges) 3 – that the field generated by each element linearly adds together to create the overall field 4 - the magnitude of the force vectors is based on parameters in Coulomb's Law	**PRE Q.7** Consider the three electric charges shown below: List the charges in order of the magnitude of the force they experience, starting with the smallest.  A) The force is identical on each charge B) A then C then B C) B then C then A D) C then A then B Code: 1 No understanding of electrostatic force interactions between charged elements. Ans: A 2 Basic understanding that electrostatic fields exists around charged particles. Ans: C 3 Recollection that a positively charged element has field vectors that point away from the element and that a negatively charged element has field vectors that point towards the element. Ans: B 4 Correctly identifies the linear superposition of multiple interacting charges. Ans: D (Engineers Calculate the electric field at the center of the square for each case.	**POST Q.7** A charge +q and a charge –q are placed at opposite corners of a square. At which location below will a third point charge experience a greater force?  A) at point A B) at point B C) the force is identical and greater than zero at points A and B D) there is no force at points A or B Code: 1 No understanding of electrostatic force interactions between charged elements. Ans: D 2 Basic understanding that electrostatic fields exists around charged particles. Ans: C 3 Recollection that a positively charged element has field vectors that point away from the element and that a negatively charged element has field vectors that point towards the element. Ans: B 4 Correctly identifies the linear superposition of multiple interacting charges. Ans: A (Engineers Calculate the electric field at the center of the square for each case.

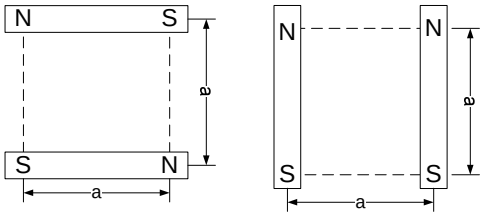
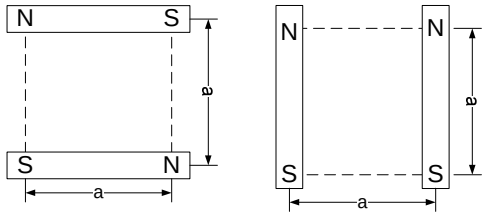
MAGNETIC FIELDS			
Level I			
The learner will be able to recognize and identify the magnetic field for a single magnet.	Given several possible visual representations of the magnetic field around an equipotential magnet, the student will correctly select the visual representation that best illustrates: 1 – the continuous nature of the field 2 - the correct direction of the field vectors (towards the negative[south] pole, and away from the positive[north] pole) 3 – that the field generated by each pole linearly adds together to create the overall field	**PRE Q.1** Which of the following images correctly represents the magnetic field surrounding a single magnet? A)  B)  C)  D)  Code: 1 No understanding of magnetic field for a single magnet with two poles. Ans: C 2 Basic understanding that a magnet has two poles. Ans: A 3 Basic understanding that a single magnet has two poles and the fields of these two poles are interacting. Ans: D 4 Correctly identify there is a magnetic field around the two opposite poles and the field vectors are in the correct orientation. Ans: B	**POST Q.1** Which of the following images correctly represents the magnetic field surrounding a single magnet? A)  B)  C)  D)  Code: 1 No understanding of magnetic field for a single magnet with two poles. Ans: C 2 Basic understanding that a magnet has two poles. Ans: A 3 Basic understanding that a single magnet has two poles and the fields of these two poles are interacting. Ans: D 4 Correctly identify there is a magnetic field around the two opposite poles and the field vectors are in the correct orientation. Ans: B

The learner will be able to recognize (or compute for engineering/science students) the direction for the force vector at a specific point in a magnetic field.	Given a visual representation of an equipotential magnet, the student will reason about the properties of the field at a given location (or set of locations) based on their knowledge of: 1 – the continuous nature of the field 2 - the correct direction of the field vectors (towards the negative [south] pole, and away from the positive[north] pole) 3 – that the field generated by each pole linearly adds together to create the overall field 4 - the magnitude of the force vectors is based on parameters in <someone's> equation	**PRE Q.2** A equipotential magnet is oriented so that is lie along the diagonal of a square. At which location below will there be the strongest magnetic field?  A) at point A B) at point B C) the force is identical and greater than zero at points A and B D) there is no force at points A or B Code: 1 No understanding of electrostatic force interactions between charged elements. Ans: D 2 Basic understanding that electrostatic fields exists around charged particles. Ans: C 3 Recollection that a positively charged element has field vectors that point away from the element and that a negatively charged element has field vectors that point towards the element. Ans: A 4 Correctly identifies the linear superposition of multiple interacting charges. Ans: B (Engineers Calculate the electric field at the center of the square for each case.	**POST Q.2** A equipotential magnet is oriented so that is lie along the diagonal of a square. At which location below will there be the strongest magnetic field?  A) at point A B) at point B C) the force is identical and greater than zero at points A and B D) there is no force at points A or B Code: 1 No understanding of electrostatic force interactions between charged elements. Ans: D 2 Basic understanding that electrostatic fields exists around charged particles. Ans: C 3 Recollection that a positively charged element has field vectors that point away from the element and that a negatively charged element has field vectors that point towards the element. Ans: A 4 Correctly identifies the linear superposition of multiple interacting charges. Ans: B (Engineers Calculate the electric field at the center of the square for each case.

Level II

The learner will select that best image for two interacting magnets	Given several possible visual representations of the magnetic field around multiple equipotential magnets, the student will correctly select the visual representation that best illustrates: 1 – the continuous nature of the field 2 - the correct direction of the field vectors (towards the negative[south] pole, and away from the positive[north] pole) 3 – that the field generated by each pole linearly adds together to create the overall field 4 - the magnitude of the force vectors is based on parameters in <someone's> equation	**PRE Q.3** Which image below most accurately represents the magnetic field lines produced by the two magnetic bars as arranged below where the strength of the magnetic poles are equal:   A)  B) C) D) 	**POST Q.3** Which image below most accurately represents the magnetic field lines produced by the two magnetic bars as arranged below where the strength of the magnetic poles are equal:  A)  B)  C)  D)  Code: 1 No understanding of magnetic field interactions. Ans: A 2 Basic understanding that magnetic fields exist

		 Code: 1 No understanding of magnetic field interactions. Ans: A 2 Basic understanding that every magnet has two poles with fields for each pole. Ans: B 3 Recollection that magnetic field vectors that point away from the North or (+) pole and that they point towards the (-) or Sourth pole. Ans: C 4 Correctly identifies the linear superposition of multiple interacting poles. Ans: D Engineering Students Calculate the Strength of the Magnetic Fields at Predetermined points. Engineering students will calcuate the net Force and direction of the vector between the two magnets.	from each pole. Ans: B 3 Recollection that a North pole has field vectors that point away from the pole and that a South pole has field vectors that point towards the pole. Ans: C 4 Correctly identifies the linear superposition of multiple interacting poles. Ans: D Engineering students will calcuate the net Force and direction of the vector between the two magnets.

The learner will be able to predict the net force and direction for a magneticfields at specified locations.	Given several possible configurations of equipotential magnets, the student will compare and contrast those configurations, and reason about the properties of the field at a given location (or set of locations) based on their knowledge of: 1 – the continuous nature of the field 2 - the correct direction of the field vectors (towards the negative[south] pole, and away from the positive[north] pole) 3 – that the field generated by each pole linearly adds together to create the overall field	**PRE Q.5** Two equipotential magnets (i.e. the magnetic poles have the same strength) are arranged in a square as shown below. The magnets are arranged in one of the two following ways: A: B:  In which case will the magnetic field at the center of the square have the greatest magnitude? A) The magnitude is greatest in A B) The magnitude is greatest in B C) The magnitude is identical and greater than zero in both cases D) The magnitude is zero in both cases Code: 1 No understanding of magnetic field interactions between two magnets (four pole interactions). Ans: D 2 Basic understanding that magnetic fields exists around each pole. Ans: A 3 Recollection that the North pole has field vectors that point away from the pole and that the South pole has field vectors that point towards the pole. Ans: C 4 Correctly identifies the linear superposition of multiple interacting poles. Ans: B (Engineers Calculate the magnetic field vector at the center of the square for each case.	**POST Q.5** Two equipotential magnets (i.e. the magnetic poles have the same strength) are arranged in a square as shown below. The magnets are arranged in one of the two following ways: A: B:  In which case will the magnetic field at the center of the square have the greatest magnitude? A) The magnitude is greatest in A B) The magnitude is greatest in B C) The magnitude is identical and greater than zero in both cases D) The magnitude is zero in both cases Code: 1 No understanding of magnetic field interactions between two magnets (four pole interactions). Ans: D 2 Basic understanding that magnetic fields exists around each pole. Ans: A 3 Recollection that the North pole has field vectors that point away from the pole and that the South pole has field vectors that point towards the pole. Ans: C 4 Correctly identifies the linear superposition of multiple interacting poles. Ans: B (Engineers Calculate the magnetic field vector at the center of the square for each case.