P2 – Energy and Matter

Number of weeks (between 6&8)	**Content of the unit**	**Assumed prior learning** (tested at the beginning of the unit)
7 weeks – Autumn 1/2 Approx. 28 lessons	• States of matter • Conduction, convection and radiation • Insulators	• Compare and group materials together, according to whether they are solids, liquids or gases • Observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C) • Identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature.
Assessment points and tasks	**Written feedback points**	**Learning Outcomes** (tested at the end and related to subject competences)
- Pre-unit test (baseline) - Badger 7G (formative) - 6 mark question (formative) - Scientific skills investigation (formative) - End of unit test (summative)	- diagnostic marking on badger - diagnostic marking on 6 mark question - diagnostic marking on skills investigation - feedback on progress after end of topic test (*these opportunities in AfL column)	I can name the three states of matter I can list the changes of states I can describe how changes of states occur I can describe the properties of the three states of matter I can represent the three states of matter with drawings of particles I can explain changes of states with reference to energy levels of particles I can describe how pressure occurs in gases I can explain the properties of the three states of matter with reference to the particle model I can explain how pressure in gases may change I can state that energy gives the ability to do things I can state that thermal energy is transferred by conduction in solids I can state that thermal insulators reduce thermal energy transfer I can name some thermal insulators I can name different energy stores I can state that thermal energy is transferred from hotter objects to colder objects I can state that thermal energy is transferred by convection in fluids I can describe situations where energy is transferred I can state that thermal energy is transferred by radiation in transparent objects and vacuums I can state that the effect of a thermal transfer is that one object increases in temperature whilst the other decreases in temperature I can describe some uses and applications of thermal insulators I can state that thermal energy is transferred between objects until thermal equilibrium is reached I can describe how thermal energy is transferred by conduction I can describe how materials which are heated will expand I can explain how thermal energy is transferred by conduction, in terms of particles I can describe how thermal energy is transferred by convection I can describe how thermal energy is transferred by radiation I can explain how thermal energy is transferred by radiation in terms of particles I can explain how thermal energy is transferred by convection, in terms of particles I can explain the expansion of heated materials, with reference to energy levels of particles I can discuss how all materials have a store of energy inside them

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		I can suggest how thermal energy transfer by convection may be changed I can suggest how thermal energy transfer by conduction may be changed I can suggest how thermal energy transfer by radiation may be changed I can suggest why thermal insulators reduce thermal energy transfer

Lesson	Clear learning intentions (KQ)	Clear success criteria (Bands) (Keywords)	Hook (starter)	Presentation of content (teacher input)	Guided practice (pupil activities)	Requisition (per group)	Independent practice (homework)	Closure (AfL)
1. Pre unit test	How much do I know from KS2?	To complete exam	Word-search on keywords from KS2	Mind map of what pupils remember from KS2 as refreshers before exam	Pupils complete baseline test in silence	None	Homework 1 set	Pupil complete sentences: *One thing I know about this topic is…* *One thing I don't understand is…* *One question I have is…*
2. Energy	What is energy?	I can state that energy gives the ability to do things (H) I can name different energy stores (G) I can describe situations where energy is transferred (E) I can discuss how all materials have a store of energy inside them (D)	Ask pupils to write down how many ways they have used energy today	-Introduce the concept of energy Introduce 9 types of energy - explain concept of energy transfer	-Pupils write down true statements about energy -Energy circus: Pupils write down the energy transfer in each example as they go around each 'station' (B2-3), **Ext**: how energy is stored then transferred (B6)	P2.1 – Energy Circus Example of each type of energy as a transfer: Light bulb, drum, kettle, food/battery, spring/rubber band, parachute, picture of nuclear power station, toy car, solar panel		Application to real world: Give pupils 3 scenarios to choose from and ask them to: • State the stored energy (B2) • Describe the energy transfer (B3) • Explain how all materials have energy stored in them (B6)
3. States of matter	What's the difference between solids, liquids and gases?	I can name the three states of matter (G) I can represent the three states of matter with drawings of particles (F) I can explain the properties of the three states of matter with reference to the particle model (D)	Pictures of objects in different states. Ask pupils to group the objects (with no hint at stares of matter)	-Animation to show particles in 3 states of matter -Use animation to help pupils explain properties found in melting ice	-Pupils draw 3 states of matter in particle diagrams (B2) -Pupils heat ice and describe how the properties change as it heats up -Pupils explain each property in terms of particles (B6)	P2.2 – Properties of ice, water and steam • Ice cube • Beaker • Bunsen • Heat proof mat • Tripod • Glass rod		Pupils complete sentences: I can now … I can prove this by … I could improve by …

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4. Changes of state	How do substances change state?	I can list the changes of states (H) I can describe how changes of states occur (F) I can explain changes of states with reference to energy levels of particles (D) I can explain the properties of the three states of matter with reference to the particle model (C)	Pupils label change of state diagram Low ability given words to fill in gaps	- Animation showing changes of state in terms of particles - Use animation to explain energy of particles and resulting properties	- Pupils describe how to cause each change of state labelled on diagram (B2) - Pupils melt salol and record temperatures as it cools **Ext**: HA could plot cooling curve -Pupils explain results relating energy/movement of particles to properties (B5-B6)	P2.3 – Change of state of salol • Test tube containing salol • Beaker • Access to kettle • Thermometer		Application of knowledge: Pupils choose an real world example of change of state and: • State the change of state occurring (B1) • Describe how properties change (B2) • Explain in terms of particles energy (B5) • Explain in terms of particle model (B6)
5. Conduction	How is heat transferred through solids?	I can state that thermal energy is transferred by conduction in solids (H) I can state that thermal energy is transferred from hotter objects to colder objects (G) I can describe how thermal energy is transferred by conduction (E) I can explain how thermal energy is transferred by conduction, in terms of particles (D)	Show a diagram of a saucepan and ask pupils to copy and label with which materials they would use for each part. **Ext**: Can you explain your choices?	Use animation and demo to help pupils understand the concept of conduction, in terms of thermal energy and particles. Ask pupils where the heat moves from and to.	Pupils to annotate saucepan diagram to show how heat travels through pan and handle **Ext**: Which part will heat transfer through quickest? Why?	P2.4 - Conduction **Demo**: Metal rod with pins stuck on with Vaseline Bunsen, heat proof mat, and clamp stand.	Homework 1 due Homework 2 set	
6. Insulators	What materials make the best insulators?	I can name some thermal insulators (H) I can state that thermal insulators reduce thermal energy transfer (G) I can describe some uses and applications of thermal insulators (F) I can suggest why thermal insulators reduce thermal energy transfer (D) I can explain why metals are better conductors than non-metals in terms of delocalised electrons (C)	Show pictures of metal, wooden and plastic spoons. Ask pupils to write down which one they would use to stir hot soup and why.	Show pupils animation showing the different atomic structure of metals and non-metals. Ask pupils why they think metals are better conductors. Explain how insulators stop conduction.	Pupils test prediction from starter. Pupils think of situation where insulators are useful. They should draw a diagram, describe how the insulator helps in this situation and explain how it helps reduce heat transfer by conduction.	P2.5 - Insulators • Plastic, wooden and metal rods • Beaker • Access to kettle • Stop watch		

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7. Investigating heat transfer*	How can we keep hot drinks warm?	I can make simple qualitative predictions using scientific knowledge and understanding (G) I can identify the independent and dependent variables in an investigation (F) I can identify the control variables in an investigation (E) I can explain the importance of control variables (C)	Keyword match up on variables	Go over key points needed in investigation. Independent: Material wrapped around boiling tube Dependent: Temp change Control: Lid, starting temp, room temp Look at sources as a class.	Pupils write: Hypothesis Variables Equipment Method Risk assessment Use sources to help pupils plan method	P2.6 - Insulating boiling tube • Boiling tube • Bung with thermometer • Access to kettle • Stopwatch • Bubble wrap • Tin foil • material (cotton) One set per table to look at		SPAG each other's methods
8. Investigating heat transfer*	How can we keep hot drinks warm?	I can present observations and data using an appropriate table (F) I can present observations and data using an appropriate bar graph (E) I can interpret observations and data to identify more complex patterns of correlation (D)	Draw a results table for you results.	Feedback on 'good' results tables. Teacher demos method. Teacher gets feedback on results.	Pupils carry out practical. Pupils draw graph if finished.	P2.6 - Insulating boiling tube • Boiling tube • Bung with thermometer • Access to kettle • Stopwatch • Bubble wrap • Tin foil • material (cotton) One set per pair		
9. Investigating heat transfer*	How can we keep hot drinks warm?	I can interpret observations and data to identify simple patterns of correlation (G) I can draw simple conclusions from the interpretation of data (F) I can present observations and data using an appropriate bar graph (E) I can suggest ways to reduce and/or overcome random and systematic error (D)	Bar chart or line graph. Give pupil description of investigations and get them to decide which graph is suitable and why. Which should we draw today (bar chart)?	Go over what a good graph looks like (model one) Discuss how we make conclusions and evaluate investigations.	Pupils draw graph. Pupils write evaluation and conclusion.	Pencils, rulers, graph paper	Homework 2 due Homework 3 set	

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10. Convection	How does a hot air balloon work?	I can state that thermal energy is transferred by convection in fluids (G) I can describe how gases which are heated will expand (E) I can describe how thermal energy is transferred by convection (D) I can explain how thermal energy is transferred by convection, in terms of particles (C)	How does a hot air balloon work? Why should you crawl in a room filled with smoke? Pupils write ideas down for either question.	Demo convection using iodine crystals, smoke. Discuss convection in terms of density of gases/liquids.	Pupils make poster explaining one of the starter questions in terms of convection and particles.	Convection demos: http://www.schoolphysics.co.uk/age11-14/Heat%20energy/Transfer%20of%20heat%20energy/text/Convection_/index.html		
11. Radiation	What colour car should you have a in a hot country?	I can state that thermal energy is transferred by radiation in transparent objects and vacuums (F) I can describe how thermal energy is transferred by radiation (D) I can suggest how thermal energy transfer by radiation may be changed (B)	Show pictures of thermograms. What do they show?	Discuss concept of radiation through thermograms. Introduce practical. Use Boardworks animation to enhance understanding from practical results.	Pupils carry out practical to see which can cools quickest (best radiator). Pupils discuss results.	P2.11 - Radiation: • Silver tin • Black painted tin • Kettle • Thermometer • Lid x2 • Stopwatch		Odd one out – Boardworks.
12. 6MQ*	*How do I answer a 6 mark question?*	Can I give a brief description of advantages or disadvantages? (D) Can I give a description of one advantage and one disadvantage? (C) Can I give a description of 2 advantages and 2 disadvantages? (B)	Show pupils 2 6MQ responses. Decide which is best and why.	Silver: Compare conduction and convection Gold: Compare conduction, Convection and radiation. Look at success criteria for this question. Talk through planning of answers.	Pupils plan and answer 6MQ.	None		

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13. Rate of transfer	How can we cool hot objects down quickly?	I can state that thermal energy is transferred from hotter objects to colder objects (G) I can state that thermal energy is transferred between objects until thermal equilibrium is reached (E) I can explain how surface area affects the rate of energy transfer (C) I can suggest ways to increase the rate of energy transfer (B)	Compare desert and arctic fox ears. How are they different? Why are they different?	Discuss factors that affect rate of transfer (temperature, surface area and material)	Pupils investigate one of these factors and present to class. Pupils apply knowledge to real life scenarios: - drying washing - cooling tea	P2.13 – Rate of transfer: Each group investigates one of the following: • 100ml, 250ml and 500ml beakers • Polystyrene, plastic cup, 250ml beaker • Cold, warm and hot water in 250ml beaker Every group needs: • Thermometer • Stopwatch • Lids	Homework 3 due Homework 4 set	
14. Evaporation	How does sweating cool you down?	I can state the factors that affect the rate of evaporation (F) I can describe what happens to liquids during evaporation (E) I can explain how sweating cools you down (D) I can explain evaporation in terms of particles (C)	Why do we sweat? How does it work?	Discuss starter. Introduce practical. Watch video whilst waiting for water to cool: http://www.bbc.co.uk/learningzone/clips/changes-of-the-state-of-water/1858.html How does it relate. Discuss results.	Pupils carry out practical. Pupils watch video and discuss in relation to sweating. Pupils explain how sweat cools them down (low ability could do card sort of stages).	P2.14 – Evaporation • Boiling tube • Boiling tube wrapped in tissue • Bung with thermometer • Kettle • Stopwatch		
15 & 16. GAT*	What grade am I working at?	See GAT grade ladder	True/false recap of everything learnt so far.	Introduce task. Discuss ideas. Plan out structure.	Pupils complete GAT.	None		
17. Expansion	Why do objects expand when they get hot?	I can state materials expand when heated (H) I can describe how materials which are heated will expand (E) I can explain the expansion of heated materials, with reference to energy levels of particles (C)	Keyword anagrams: Expand Contract Energy Particle Heat Vibrate	Demonstrate examples of expansion: Heat ball and ring over Bunsen. Discuss changes. Put balloon over bottle and place in hot water. Balloon should expand. Discuss.	Pupils choose one example to explain in terms of particles.	Expansion demos: Ball and ring, Bunsen. Ballon, bottle, kettle.		

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18. Gas Pressure	How is gas pressure useful?	I can name examples where gas pressure is used usefully (G) I can describe gas pressure in terms of particles (E) I can explain how objects use gas pressure (C) I can analyse situations involving gas pressure (B)	Show picture of gas pressure being used usefully. Ask pupils how the gas helps in each situation. Tyres, aerosol, straw.	Demonstrate examples of gas pressure. Discuss.	Pupils describe and explain each demo. Pupils apply knowledge to one use given in starter.	Gas pressure demonstrations: Egg in bottle. Marshmallow in vacuum. Collapsing can	Homework 4 due Homework 5 set	
19. Vacuum Flask	How does a vacuum flask work?	I can list the factors that affect the rate of energy transfer (E) I can describe how we can control energy transfer (D) I can explain how the design of a vacuum flask reduces rate of energy transfer (C) I can analyse energy transfers in terms of particle energy (B)	Conduction, convection or radiation. Give examples of heat transfers and pupils choose which type(s) of transfer is taking place.	Show vacuum flask. Discuss features. Annotate diagram.	Pupils draw and label diagram of vacuum flask. Pupils complete GCSE questions on vacuum flask.			6 mark question*
20&21. Insulating houses Project	How can we save money on our heating bills?	I can list ways to insulate a house (H) I can state which heat transfer is stopped by each type of insulation (G) I can calculate payback time (E) I can explain in terms of particles how insulation stops heat transfer (C)	Show a picture of s house with snow and one with snow mostly melted. Which one would be warmer inside and why (assuming heating is on in both)?	Discuss ways heat can be lost from a house. HA- Payback time. Introduce house design project.	Pupils come up with solutions to each form of heat loss. Pupils work in 2-3 to come up with presentations to home owners on ways to insulate their house. They use experimental results to back up their proposal.	Per group: House template printed on card. 100ml beaker Thermometer Stop watch Kettle Bubble wrap, cotton wool, foil.		
22. Specific Heat Capacity	Why do objects get hotter than others?	I can predict which objects will reach a higher temperature if given the same energy (G) I can define specific heat capacity (E) I can calculate specific heat capacity (D) I can complete more complex calculations (B)	Why do you burn your mouth on the filling of a pie but not the pastry?	Introduce idea of specific heat capacity. Show equation. Explain practical.	Pupils calculate the amount of energy delivered by a Bunsen in 1 minute by heating 100ml (0.1kg) of water and measuring temperature change. Pupils complete specific heat capacity calculations.	Per group: 250ml beaker Bunsen Tripod Heat proof mat Thermometer Scales		
23. Revision	How much do I know?	PLC from success criteria	Match keywords with their definition	What did we cover in the unit? What did you clearly understand What do you need to revise?	Identity areas of weakness Make revision notes Produce a mind map for the topic		Homework 5 due Revision set	Complete quiz

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24. End of unit test	How much do I know?	Complete test	Questions about the test	Supervise pupils	Complete test			Complete title page for next chapter