Subject: Science Year5: Properties and changes of materials

NC/PoS:

•compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets
•give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic
•demonstrate that dissolving, mixing and changes of state are reversible changes
•explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda

Prior Learning (what pupils already know and do)

check the children can recall information from the units *Science, Year 2, Uses of everyday materials* and *Science, Year 4, States of matter*:

- The names of a range of materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard.
- The suitability of these materials for particular uses.
- The characteristics of solids, liquids and gases.
- Changes of state (melting, freezing, condensing and evaporating).

End goals (what children MUST know and remember)

- Know that heat travels from warmer materials to colder ones
- Know that some materials let heat pass through them easily; these are thermal conductors (metals and sedimentary rocks)
- Know some materials do not let heat pass through them; these are called thermal insulators (plastic, cork, wood, and fabrics)
- Know that thermal insulators are good for keeping heat out as well as in
- Know in a reversible change a material turns into something that looks and feels different but is not changed forever – it can be changed back
- Know all changes of state are reversible
- Know mixing and dissolving are reversible changes
- Know in an irreversible change a completely new material is formed and cannot be changed back
- Know some things, react when you mix them (vinegar and bicarbonate of soda) to make new materials

Key Vocabulary: matter, natural, filtering, sieving, evaporation, condensation, freezing, melting, dissolving, solute, solvent, solution, soluble, insoluble, decanting, waterproof, absorbent, thermal conductor, insulator, reversible, irreversible, formation

Session 1: Use resources from Kapow lesson 1: Hardness

Review prior learning – uses of everyday materials and states of matter

Compare and group every day materials including liquids and gases (water in a balloon, air in a balloon)

Show me an item that is a natural material, a conductor of heat etc.

Revisit rocks, states of matter

Use the ***Attention Grabber*** to sort materials according to hardness.

LO: To determine the hardness of materials and link this to their uses.

Inform the class they will investigate the enquiry question:

- How does the hardness of the materials vary?

Explain that they will investigate using a **pattern seeking** enquiry, in which they perform a **scratch**

test and observe how easily each material scratches.
Working scientifically LO: To evaluate the hardness test to determine the degree of trust in the results.
Discuss and record individually:

- **Which variables were hard to control?** (The force used to scratch the materials could vary between the pupils and materials; the size, thickness and shape of the object because smaller or oddly shaped objects might be harder to scratch uniformly; the sharpness of the nail; the angle at which the nail is used to scratch because a different angle might affect the scratch depths.)
- **Which variable was hard to measure?** (The length and depth of the scratch because the scratches were small and measuring equipment, such as a ruler, was not used.)
- **Based on your answers to the previous two questions, how trustworthy are our results: fully trustworthy, somewhat trustworthy or not at all trustworthy?** (The results are somewhat trustworthy rather than fully trustworthy because each material was not scratched in precisely the same way and the scratches were not measured accurately.)

Vocabulary: variable, control, hard, soft, property, trustworthy, evaluate

Session 2: Use resources from Kapow Lesson 2: Transparency
Recap and recall: Display the *Presentation: Agree or disagree?* and discuss the statements about materials.
LO: To determine the transparency of different materials and link this to their uses.
Use the ***Attention Grabber*** to introduce a light meter and the property of transparency, which refers to how much light passes through a material.
Working scientifically LO: To plan and draw a table of results.
Use the ***Main Event*** section to investigate transparency. Using the resources provided children should design their own results table and record their results.
Vocabulary: light intensity, light meter, lux, opaque, translucent, transparency, transparent

Session 3: Use resources from Kapow lesson 3: Conductivity
Recap and recall: Watch the *Pupil video: Investigating electrical conductors and insulators* and discuss each test material.
LO: To determine the conductivity of different materials and link this to their uses.
Do not do the ***Attention Grabber*** as our new fire alarms are too sensitive to use tealights in the classroom. Move straight onto the ***Main Event*** section to conduct a comparative test to investigate the enquiry question:

- How does the conductivity of different materials compare?

Teacher demonstrates the conductivity experiment and children record notes about the method as they watch.
Ask the children to use their notes to write a method for the investigation, including:

- The variable they are changing (suggest they choose the materials they predict will be the best and worst thermal insulators, along with one they think will be in between).
- The variable they are measuring (temperature).
- Which variables they need to control and how they can control them (the amount of water in each cup and the starting temperature of the water).
- The sequence of steps needed to carry out the experiment successfully.
- Safety measures (an adult should pour the hot water).

The aim of the lesson is to write a method- they do not need to complete the investigation to meet the objective. If time allows the teacher could choose one method to follow.
Vocabulary: conductor, electrical conductivity, insulator, method, thermal conductivity

Session 4: Use resources from Kapow lesson 4: Reversible changes
Recap and recall: States of matter
LO: To demonstrate reversible changes.
Use the ***Attention Grabber*** to discuss reversible changes.
Working scientifically LO: To write a prediction using prior knowledge of the states of matter.
Teacher to demonstrate experiments that explore the following (these may need to be done in the outdoor classroom because of the fire alarm):

- Melting (changing from solid to liquid) and freezing (changing from liquid to solid) are the reverse of one another.
- Evaporating (changing from liquid to gas) and condensing (changing from gas to liquid) are the reverse of one another.

The aim of the lesson is for the children to make predictions using their prior knowledge. These predictions should be recorded individually in their books.
Use the ***Wrapping Up*** section to check understanding and address any misconceptions.
Inform the class that they will explore irreversible changes in the next lesson. These are changes that cannot be easily undone, such as rusting. To illustrate rusting, show the children the steel wool scouring pad. Submerge this pad in a jar of water and secure the lid ready for next week's lesson.
Vocabulary: change of state, condensing, dissolve, evaporating, freezing, hazard, melting, mixture, reversible change, safety, states of matter

Session 5: Use resources from Kapow lesson 5: Irreversible changes- Burning and rusting
Recap and recall:
LO: To demonstrate irreversible changes.
Working scientifically LO: To analyse observations about rusting and use them to support a conclusion.
Watch the link: BBC Bitesize - Irreversible changes and ask the class to discuss:

- **What is an irreversible change?** (When a material undergoes a change that cannot be easily undone and which produces a new material.)
- **What are some examples of irreversible changes?** (Answers may include cooking, mixing concrete and burning.)

Use the ***Main Event*** section to explore rusting and burning (use the *Pupil video: Investigating burning* as an alternative to doing the experiment in class)
Summarise key points and record individually.
Vocabulary: burning, irreversible change, rust, rusting

Session 6: Use resources from Kapow lesson 6: Irreversible changes- Mixing
Recap and recall: Use the 'Retrieval Race' to recap and recall the unit.
LO: To demonstrate irreversible changes.
Use the ***Attention Grabber*** to discuss reversible and irreversible changes.
Follow the ***Main Event*** section to introduce the class to the experiment: mixing vinegar and bicarbonate of soda.
Use the experiment to observe the irreversible change. Get the children to explain how the mixture forms a gas which inflates the balloon. Summarise that the larger the amount of vinegar, the more gas was produced. (The children do not need to record measurements). Their explanation and summary can be written in their books using the appropriate scientific vocabulary.
Complete the Unit Quiz.

Vocabulary: reversible, irreversible, formation, gas, liquid

Career: Materials engineer
Chemist https://www.youtube.com/watch?v=8tRv0Cs2GR8

Scientists who have helped develop understanding in this field: Spencer Silver https://www.youtube.com/watch?v=ij9bgRRY6x8 and Ruth Benerito https://www.youtube.com/watch?v=UtSdDv-m0E8