Screen 1: Acid sulfate soils

1. Suggest reasons why pyrite sediments occur in coastal regions of Australia.

.....

.....

.....

.....

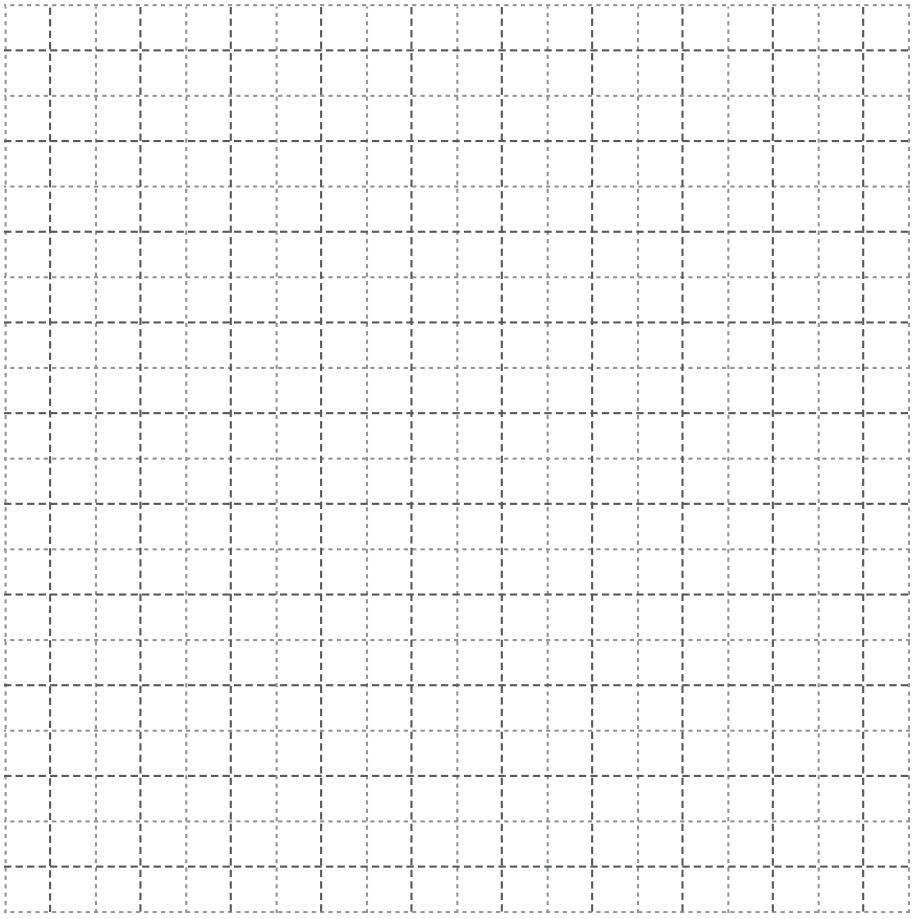
Screen 2: Water and oxygen in the soil

2. What happens to oxygen levels in the soil when soil becomes waterlogged?

.....

.....

3. Draw a line graph to show how the masses of oxygen and water change when a bucket of soil becomes waterlogged.



4. Describe the relationship between mass of water and mass of oxygen as the water level is changed?

.....

.....

.....

5. Would all soils require the same amount of water to be added to become waterlogged? Explain your answer.

.....

.....

.....

6. Why is the mass of oxygen in the soil 9 mg, even when the bucket is full of water?

.....

.....

.....

Screen 3: Reactions in the soil

7. Look at the animation that represents waterlogged soil and answer the following questions. Note: the process of pyrite formation is complex and proceeds through intermediate compounds such as mackinawite (FeS) that are not shown in the animation, eg $Fe^{2+} + HS^{-} \rightarrow FeS + H^{+}$.

   a) Write a half equation to show how Fe^{3+} changes to Fe^{2+}.

   .....

   b) Is this an oxidation or reduction reaction? How can you tell?

   .....

   .....

   .....

   c) Write a half equation to show how SO_4^{2-} changes to S^{2-}.

   .....

   d) Is this an oxidation or reduction reaction? How can you tell?

   .....

   .....

   .....

e) The animation is simplified and does not show all of the chemistry that occurs. How can you tell, from the equations you have written, that other chemical reactions must occur in soil?

.....

.....

.....

.....

8. Look at the animation that represents drained soil. Write two half equations to show what happens to iron and sulfur in FeS_2.

.....

.....

9. How are the equations you have written for waterlogged soil and drained soil related?

.....

.....

.....

10. What is the major difference between waterlogged soil and dry soil that promotes the formation of pyrite?

.....

.....

.....

11. The acidity of drained water is increased when pyrite reacts with water and oxygen. What species contribute to soil acidity?

.....

.....

Screen 4: Reactions underwater

12. Complete the following table to show where substances in waterways could come from. The first row has been completed for you.

FACTOR	SOURCE
sulfate ions	within the environment from soils
iron (II) ions	
organic carbon	
salt	
sulfate-reducing bacteria	
low oxygen concentration	

13. Which substance or substances did you need to add to form MBO?

.....

.....

14. Which variable or variables had no impact on whether MBO was formed or not? (You may need to try different selections of variables on the screen to answer this question).

.....

.....

15. Based on your answers to questions 13 and 14, what areas may be affected by acid sulfate soils?

.....

.....

16. MBO is stable when it is formed at the bottom of a waterway. Why is this?

.....

.....

.....

17. What may happen if the MBO is disturbed?

.....

.....

.....

Screen 5: Acid sulfate chemical reaction

18. What is the oxidation number in the following cases?

iron in FeS_2	
sulfur in FeS_2	
oxygen in O_2	
hydrogen in H_2O	
oxygen in H_2O	
iron in $Fe(OH)_3$	
oxygen in $Fe(OH)_3$	
hydrogen in $Fe(OH)_3$	
sulfur in SO_4^{2-}	
oxygen in SO_4^{2-}	
hydrogen in H^+	

19. Is the following equation an example of a redox equation? Use the oxidation numbers you calculated in question 18 to support your answer.

$4FeS_2 + 15O_2 + 14H_2O \rightarrow 4Fe(OH)_3 + 8SO_4^{2-} + 16H+$

.....

.....

.....

.....