Research-Based Curricula

Designing drugs to fight fatty liver disease

Key Stage 3

Biology

Teacher Guide

2022

access ed

Building global university access programmes

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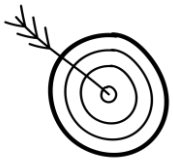
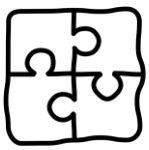


The Research-Based Curriculum is resources based on cutting-edge research, tailored for KS3, KS4 or KS5. The resources:

- *Support student attainment and progression*
- *Promote intellectual curiosity in students of all prior attainment*
- *Build understanding for more accessible 'stretch' beyond the curriculum*
- *Develop core academic skills that aid progression, including critical thinking, metacognition, and written and verbal communication*
- *Encourage students to see these subjects as engaging, worthwhile and inspiring for continued study*

Content



The RBC packs contain four chapters (resources) suitable for Key stage 3 study. The resources span a range of exciting and interdisciplinary topics related to STEM (Science, Technology, Engineering and Maths), Social Sciences or Arts & Humanities. Each pack includes roughly 6 hours of teaching and practical, student-led activity content.

Each RBC pack contains 1) Four resources that function as subject 'lessons'; 2) Activities at the end of each resource for students to test their learning; 3) Further Reading links related to the subject; 4) Final Reflection Activity as the final assignment; and 5) Teacher Guide and model activity answers (this document).

For Teachers

Using RBC packs

Suggested School Use

Teachers can use these resources flexibly. Students can complete the resources individually or in groups, in or out of the classroom. These packs help teachers:

- *Use research-based learning to engage whole classes, not just as a 'stretch' for the most able*
- *Support more students earlier in high academic achievement*
- *Improve all-school enrichment strategies by providing opportunities and resources*
- *Increase motivation and subject interest*

To do this, we encourage the 'supported use' approach. In other words, teachers provide some guidance and support to students in their independent use of the RBC packs.

Delivery Options

To ensure all students can benefit from these materials, we recommend they are delivered with 'supported use.'

Supported Use means this resource is designed to be used partially with teacher introduction or instruction. While not marked, each chapter and the final reflection activity are set up so a teacher can help ease the students into the subject area or use the resource in class.

More ideas for using these packs in your school:

1. Research Challenge

The resources can ignite curiosity about new topics and encourage independent research. Schools could hold a research challenge across a class or year group to submit a work based on the resources. Pupils could submit individually or in small groups, with a final celebration event.

For Teachers

Using RBC packs

Delivery Options [cont.]

2. "STEM", "Social Sciences" or "Arts & Humanities" Morning/ Day

We know class time can be tight, so some schools 'launch' these packs and have students start them as part of a special subject day. This can be great for all-staff engagement too.

3. After School Club

The resources can be completed in small groups (4-8 pupils) across weekly lunch clubs or after-school clubs. Groups can reflect on their learning by presenting a talk or poster on the subject matter at the end of the course.

4. Classroom Debate/ Discussion if a written Final Reflection Activity isn't possible

Resource packs can function as 'transition' projects over the summer, serving as an introduction to the next level of study between KS3 and KS4, or KS4 and KS5. Students could present their reflections on the experience in a journal.

Origin and Evaluation

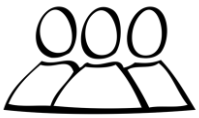
The RBC programme builds on the University Learning in Schools programme (ULiS), which was successfully delivered and evaluated through the London Schools Excellence Fund in 2015. The project was designed in a collaboration between Achievement for All and The Brilliant Club, the latter of which is the sister organisation of AccessEd. ULiS resulted in the design and dissemination of 15 schemes of work based on PhD research for teachers and pupils at Key Stage 3.

LKMCo evaluated the project. Overall, pupils made higher-than-expected progress and felt more engaged with the subject content.

For Teachers

Why RBCs and EAL support

Target Pupils



Using an RBC coursebook to provide EAL support benefits your school and the individual students.

1. Increased academic achievement

When students feel supported and are helped to understand and use the language of topics that support their curriculum learning, they are more likely to achieve at the expected level (or above). EAL students with appropriate support often do well alongside monolingual students in school due to their perseverance and higher-level abstract thinking skills from speaking more than one language.

2. Higher self-esteem

A consequence of feeling supported and properly included in lessons is higher self-esteem and self-confidence for the student.

3. Helping to eliminate inequality

RBC coursebooks support teachers in tackling achievement gaps and building life chances. EAL resources which support classroom learning help students to have equal opportunities and achieve well.

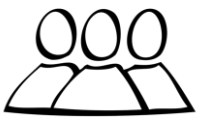
4. Stronger learning environments

Bilingual and multilingual students often have strong working memories and attention spans (see Adescope, Lavin, & Thompson, 2010). This helps build a robust learning environment and encouragement amongst the rest of the class. Students in diverse groups have an enhanced ability to think creatively and to use higher-order cognitive thinking skills.

For Teachers

Why RBCs and EAL support

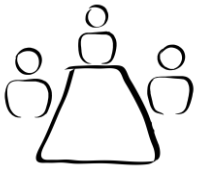
Target Pupils [cont.]



5. Different perspectives

Students with different language skills bring diverse cultural experiences to the classroom, supporting all students to understand other perspectives better. Additional learning resources can help all students feel valued in the classroom, with diversity of all kinds being celebrated.

Meeting the needs of EAL learners



Various strategies can be used to meet the differing needs of EAL learners and help them achieve at and above age-related expectations. Below are some suggestions on how to use these packs with EAL learners.

1. Classroom organisation

- Place EAL learners in pairs or groups with supporting pupils who are language role models. This is important for developing language and understanding new subject-related words.
- Make available and encourage learners to use age-appropriate bilingual and English dictionaries and thesauruses for clear definitions, pronunciation, and translation.

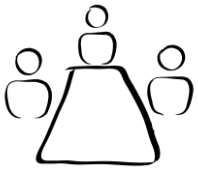
2. Differentiation

- Repeatedly check understanding of the topic, learning aims and objectives and what to do in a task.
- Provide learners with subject-specific vocabulary and structures, and check understanding of the language involved in carrying out activities.

For Teachers

Why RBCs and EAL support

Meeting the needs of EAL learners [cont.]



- Provide learners with instructions they are likely to encounter in their subject and ask them to translate them into their language. For example, common instructions in Science could include: what do we want to find out, what equipment do we need, how can we show our results, what is the conclusion, etc.
- Encourage EAL learners to research new words and create their vocabulary lists using the bilingual word list templates provided for each chapter in the Student packs.
- Provide model answers, gap-fills, or speaking and writing frames for students to complete with or without word banks for extra support.

Support and stretch responses

Look out for stickers throughout this coursebook which indicate different model answer responses to cater for varied student levels and attainment. These include:

- **Support –** Responses and techniques for students who might require further support.

- **Stretch –** Responses and techniques for students to be further challenged and stretched in the activities they do and responses that they give.

Tips for delivering activities and model answers

Throughout this coursebook, you will see stickers with ‘tips’ for engaging students and strategies to support them in answering questions and completing activities. Stickers include:

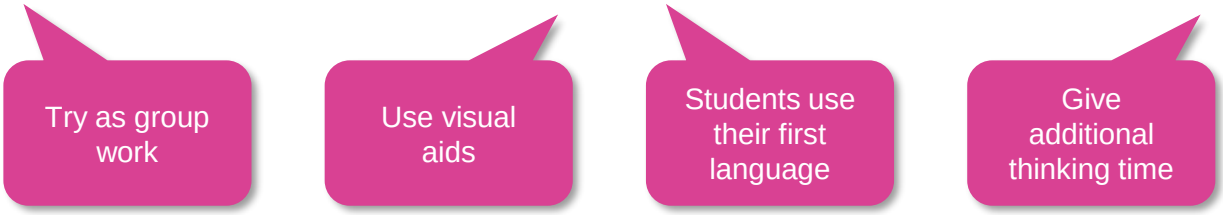
- **Use visual aids -** Visual learning can be helpful for EAL students struggling to process the spoken language. Use labelled images and videos to illustrate the answers, so everyone understands the references.

For Teachers

Why RBCs and EAL support

Tips for delivering activities and model answers [cont.]

- **Try as group work -** Group work can increase student engagement and allow EAL learners to practice speaking in a less intimidating context. This will enable learners to learn from one another.
- **Students use their first language –** Using first language can be a valuable foundation to build on – it allows students to compare words and sentence structures and understand more quickly. Particularly with new subject content, this can help students relax and engage with concepts at a higher level.
- **Give additional thinking time –** Allow extra time or space for processing new or more complex topics where required.



Further resources

For more resources, visit:

- https://www.learningvillage.net/more_info
- https://www.bell-foundation.org.uk/

Questions

For more information, contact: **hello@access-ed.ngo.**

Resource One
Model Answers

Answers

1. The liver does NOT carry out these functions:

   - ❑ Creates and produces important hormones like insulin (insulin is created in the pancreas).
   - ❑ The site at which food is absorbed into the bloodstream (this is the small intestine).

2. **Normal liver → Steatohepatitis → Fibrosis → Cirrhosis**

Try as group work

At the start, the liver is normal and healthy and can carry out its functions as normal. If fat begins to build up in liver cells, it leads to the liver becoming swollen and inflamed. Scar tissue begins to form around the damaged liver tissue. Eventually, cirrhosis occurs when the damage becomes irreversible, and the liver starts to shrink, becoming scarred and lumpy.

3. *To support students when answering Question 3, prompt them to describe the graph in general terms.*

The graph shows the survival (%) versus the number of years in the study of patients with low fibrosis, medium fibrosis or fibrosis and early cirrhosis.

To stretch students further when answering Question 3, prompt them to include specific figures to explain their answer.

The graph shows the survival rate of patients with different levels of fibrosis or fibrosis with early cirrhosis. Patients with low fibrosis have the highest survival rate after eight years in the study, with almost a 100% chance of survival. However, patients with increased fibrosis, such as those with medium fibrosis, have a decrease in survival with only an 80% rate.

Resource One
Model Answers

Answers

3. [Cont.] Fibrosis with cirrhosis decreases the survival rate the most, with only a 20% survival rate after eight years. Cirrhosis negatively impacts the survival rate of patients. Patients with fibrosis and cirrhosis are less likely to be alive 8-10 years later than patients with low or medium fibrosis only.

4. Any of the answers below are acceptable.

To stretch students further when answering Question 4, encourage them to think critically about the wider impact of the disease.

Students use their first language

For example, funding for finding cures, what is known about diseases, and attitudes towards various diseases.

Patients with cirrhosis have lower survival rates; patients may require liver transplants if the damage is very severe and waiting lists may be long; the liver disease can lead to liver cancer; NAFLD affects lots of people, so naturally, more deaths; NAFLD is associated with type 2 diabetes and obesity, so if these increase, there will be more incidences of liver disease; NAFLD is hard to diagnose, so many people may not get diagnosed until the damage is much worse; liver disease research receives less funding than other things such as cancer research.

5. Students can choose what to include, but posters should highlight the function of the liver and some of the problems that can occur if things go wrong.

Resource Two
Model Answers

Answers

1. See answers in the table below.

DNA	Protein
Found in the nucleus.	Is made up of small building blocks called amino acids.
Contains genetic information.	Do most of the work in our cells.
Is made up of four building blocks called nucleotides.	Can be found in the nucleus or cytoplasm.
Contains instructions for particular characteristics, such as hair colour.	Can be many different sizes and shapes depending on how the chain of amino acids folds.
Contains instructions on how to make proteins.	

Give additional thinking time

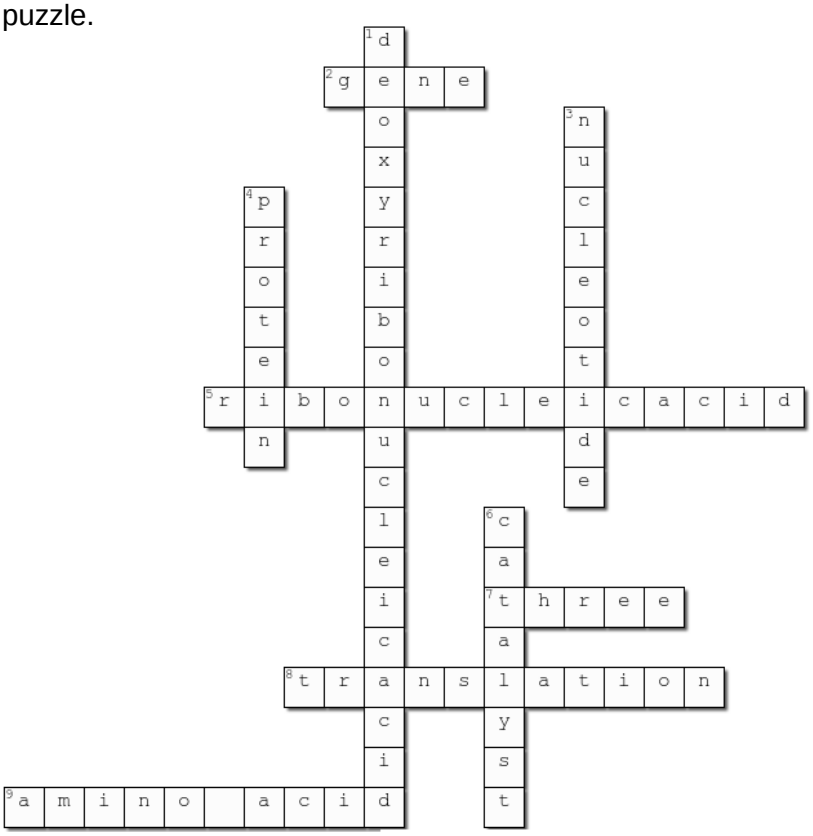
2. 1 – **DNA**
   2 – **RNA**
   3 – **Nucleus**
   4 – **Cytoplasm**
   5 - **Amino acids**
   6 – **Protein**

Try as group work

Resource Two
Model Answers

Answers

3. Below are the responses needed to complete the crossword puzzle.



Down

1 – **deoxyribonucleic acid**

3 – **nucleotide**

4 – **protein**

6 – **catalyst**

Across

2 – **gene**

5 – **ribonucleic acid**

7 – **three**

8 – **translation**

9 – **amino acid**

Resource Three
Model Answers

Answers

1. **Ligand -** An atom/ molecule or substance that binds to a (usually larger) molecule. In the body, ligands bind to protein molecules known as receptors to activate a specific cellular function.

   Agonist - A ligand which activates a receptor or initiates a biological response.

   Antagonist - A ligand which interferes or prevents the biological response of another.

Students use their first language

2. B, C and A - Nuclear receptors bind to and can switch gene transcription on or off. Nuclear receptors are usually inactive when at rest, and their ligand-binding pockets are empty. When an agonist binds in the pocket, this causes a change in the receptor's shape, which switches on the gene the receptor is bound to. If an antagonist binds to the receptor, there is no change in shape, and the gene remains switched off.
3. Transcription (Refer back to Resource Two).
4. The answers below are acceptable.

Give additional thinking time

- ❑ Nuclear receptors have small pockets that can accommodate different molecules, such as artificial ligands (also known as drugs).
- ❑ Nuclear receptors can regulate several other processes in the cell, so one drug's activation can have many different effects, which may help treat diseases.

Resource Three
Model Answers

Answers

5. An advantage is that one drug that binds to one type of nuclear receptor can activate many different processes and so may be able to be used for different diseases. However, this may also be a disadvantage because if one of the processes regulated by the nuclear receptor has a negative effect, switching on just one process at a time is hard. It acts in an 'all-or-nothing' manner.

Try as group work

6. Any of the answers below are acceptable.
   - ❑ Liver X Receptor because it controls fat levels- high-fat levels cause NAFLD, it controls cholesterol, and high cholesterol is a risk factor for NAFLD.
   - ❑ Farnesoid X Receptor because it controls levels of fat - high levels of fat cause NAFLD, controls cholesterol – high cholesterol is a risk factor for NAFLD, controls glucose – type 2 diabetes is a risk factor for NAFLD, controls liver disease.
   - ❑ Peroxisome Proliferator-activated Receptor because it controls fat levels – high-fat levels cause NAFLD; it controls diabetes and obesity, both risk factors for NAFLD.
7. Activating the Farnesoid X Receptor increases cholesterol levels. Because high cholesterol is a risk factor for NAFLD and increases the chance of a patient developing the disease, it may be better to inactivate FXR.

To stretch students further when answering Question 7, encourage them to include the type of ligand that may be appropriate for targeting FXR.

An antagonist may be better instead.

Resource Four
Model Answers

Answers

1. Refer to the diagram below for the answer.

2. B, C and E – The molecules which look as though they will fit the shape of the pocket. The molecules may need to be rotated or flipped to fit, but they all align in the pocket.

To stretch students further when answering Question 2, encourage them to reflect on option B.

Give additional thinking time

Even though B is not as effective as the other two potential drugs, it is still a candidate in the early stages of drug development.

3. All new drugs must be given to 2 species of mammals - usually rats or mice - and a (non-rodent) mammal. 3 Mammals are like humans and are likely to have similar reactions. Therefore, mammals are used to test potential side effects before drugs are given to human volunteers. See example answers in the table below.

Students use their first language

Pros	Cons
There are strict laws to ensure animals are given the best treatment and care (better than in the wild).	Testing in animals is only sometimes necessary (many Covid-19 vaccines skipped the animal testing stage).
Animals are bred especially for research purposes (they are not captured from the wild).	There are alternatives to animal testing.
There is not alternative for testing drugs in a whole organism.	Drugs that pass animal testing are not necessarily safe.
Animals have shorter life cycles, so the effects of drugs on lifespan or ageing can be monitored.	Drugs that have no effect on animals may be discarded, but they might actually impact humans.
It is unethical to test on humans in some cases.	

Resource Four
Model Answers

Answers

5. Answers may include any of the following or other plausible ideas from students' independent research.
   - ❑ Cells in culture, stem cells which can be differentiated into almost any cell type, organ on chip devices can mimic tissues such as heart, lungs, gut, etc.
   - ❑ Human tissues from biopsies, transplants, postmortems, etc.
   - ❑ Computer models, simulations and artificial intelligence.
   - ❑ Consenting human volunteers.
6. Patients may have a weakened immune system or have biological processes altered by the disease. During the testing stages, it's important to know how the drug will affect those with a healthy immune system and normal biological functions before giving it to patients, as we do not want to worsen their conditions.
7. Students can be creative and expressive as they wish here. The important thing to highlight is why cells are essential to the drug discovery process. Human cell lines are a good substitute for the body and allow us to test how well potential drugs work; they also allow us to understand how the body normally works in various diseases.

Give additional thinking time

To stretch students further when answering Question 7, encourage them to do independent research on HeLa cells to help support their answer.

Final Reflection Activity

Further Guidance

An excellent report/ presentation should:

- ❑ Include information from each resource to help answer the bullet points. Students may wish to do some independent research or use further resources to help add extra bits of information or to give examples of the points they are making.
- ❑ Have similar ideas and points separated into paragraphs or slides and try to connect or link different points or ideas together so that the report/ presentation flows.
- ❑ Display critical thinking by suggesting ideas that address some challenges with targeting nuclear receptors, ethical concerns about the drug development process, etc.
- ❑ Think about how this topic impacts society. For example, patients worldwide, doctors, governments, etc.
- ❑ Use technical words correctly with explanations of what the words mean.
- ❑ Be engaging and informative for non-expert audiences.

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