This is your own personal guide to the world of Kitsat.

Start your journey by reading the table of contents before you begin the course with your students.

Next read through the main topics of this course and the main learning goals before you begin the course with your students.

After this read through the section number 3 ("How to set up and execute the course) before you start the course with your students.

Next make sure you have printed out the printables needed during the course. These printables include the information sheets for students and other printable materials that you and the students are going to need during the course.

Or if you want the students to go through the course at their own pace print out the printable version of the course and have it ready as you start the course.

In section 4 it is time to start the course. This section is the walkthrough of the game. This section will tell you what to do in different stages of the course and what the students will do and how. This section is your guideline on how to implement the course. This section also includes the correct answers to each assignment and task the students will face during the course.

TABLE OF CONTENTS:

In this teacher material you will find the following

1) The main topics of this course are:

- Setting up and executing a simple scientific test and reporting it accordingly (setting hypothesis, testing it and reporting if their hypothesis was right and explaining why it was right or wrong.)
- Kinetic energy: potential energy, mechanical energy and changes in the states of these energies
- Heat as scientific phenomenons
- Force and power

2) The main learning goals of this course are:

- Students gets an understanding of the topics listed above
- Students learn how to set up a simple scientific test and know how to report it.
- Basic understanding of different kinds of energy.
- Students get to know heat as a scientific phenomenon
- Students get the basic understanding of force and power and how they work in a day to day life

21st century skill goals of this course are:

- Thinking and learning to learn skills
- Participation, involvement and building a sustainable future
- Cultural competence, interaction and expression
- Multiliteracy

3) How to set up and execute the course

Topics listed above are divided into lessons. Each lesson's minimum duration is 45 minutes. Duration of the lesson can vary depending on the topic. And also you as a teacher can decide if you want to go deeper into some of the topics listed above.

Course is built on a story which continues towards the end as students solve problems, tasks and assignments. Assignments are done by searching, reading and applying knowledge they have acquired. Information can be found in the information material provided with the course or you can use different kinds of information sources during this course.

Green colour indicates an assignment
Red colour indicates the time when students should look for information from the informational material provided
Blue colour indicates when it's time to give the students a satellite piece.

The course can be teached by the lead of the teacher or the teacher can share the course with students so that they can progress at their own pace. You are free to choose how you will approach the course. Divide the class into groups. Number of groups should be the same as the number of Kitsat satellites you have at your disposal so that every group gets a satellite at the end of this course. YOu can have the students report their assignments to you by paper, using a digital platform in which the students can send their assignments to or have them present their assignments to you or to the other groups while you observe and give them feedback.

4) Implementation of the course

Open the Kitsat chemistry course 1 student version on your computer and project it on a screen. You can also print out the student version of the course and hand it out to the students.

Start the story from slide number 1 and continue the story until you reach slide number 12. You can read the story yourself or have the students read it.

Assignment 1: In this assignment the students need to calculate the amount of energy of the pod's collision to the frozen ground. They have the formula ready in the assignment and additional information can be found in the student's information package provided. Have the students present their results to you or go around and check that they have done the assignment correctly.

Correct answer is: 360 000 000 joules

Continue the story until you reach the slide number 16

Assignment 2: This assignment is all about investigating the equipment and attributes of the Kitsat satellite and implementing that information. Let the students be creative but make sure that they will explain their solutions. The students can present their solutions to you or you can have the groups present their solutions to other groups.

Continue the story until you reach slide number 20.

Assignment 3: In this assignment the students will get to know the Kitsat satellite a bit better. They have to find out what is the coldest temperature that the Kitsat satellite can function. They also have to examine if and how the Kitsat is protected from cold temperatures. Students can find out more information about insulation and cold resistance from their info sheets. Have the students report their findings to you or have a session where you go through the findings together.

Continue to the next slide.

Assignment 4: In this assignment the students have to instruct the android to insulate itself from the inside to avoid freezing. Let them be creative but make sure that they find out the correct way and right materials to insulate the android's insides. You can use a thermos cup or some other objects that have good insulation capacities as an example and the students can look for additional information in the information sheets provided. Have the students present their solutions to you and other groups.

Correct answer: *The students should instruct the android to stay in the cave for the night and keep close to the fire which produces thermal energy. The android should somehow reduce the amount of heat transformation of heat from its body through insulation. Good materials to use in insulation are for example plastics, glass, wood and different types of gases such as air. In designing the thermos insulation for the android's insides students can combine different materials to come up with the best solution possible.*

Continue the story until you reach slide number 23.

Assignment 5: In this assignment the students will have to make a decision to climb up the hill or go around it. First they will have to choose an option that consumes less energy and they have to explain why they chose the way they chose and why it consumes less energy than the other option. Next they will have to choose an option that would be the fastest. This option they also have to explain thoroughly. Have the students present their solutions to you or to the other groups. The students can look for additional information in the information sheets provided.

Correct answers:
Long route around consumes less energy than climbing. Because the amount of work is smaller than if the android should climb up the steep hill. Thus climbing the hill would be a faster way to get to the top of the hill.

Continue the story until you reach slide number 27.

Assignment 6: In this assignment it's time to feed the android. Despite the cold and harsh conditions the android must have its food warm. Students have to come up with a way how the android can warm its food and also how to keep it warm in cold conditions. They also have to give the android instruction on how to stay warm in cold conditions as the android recharges its energy levels. The students can look for additional information in the information sheets provided. Have the students present their solution to you or have them share their solutions to others.

Correct answers: *Android can use the fire in the cave to warm its food. The fire produces thermal energy through a burning reaction. To keep its food warm the android should wrap the warm food into a material that prevents the heat from escaping. Or the android should create a box that keeps the heat from escaping the food. Good materials for these kinds of solutions are for example tin foil and styrofoam.*

Continue the story until you reach slide number 30

Assignment 7: In this assignment the students will try out a basic exercise considering friction. When they rub their hands against each other they will notice that the movement causes friction and produces thermal energy. Same things can be noticed when they rub their hands against their thighs. Android's hands are made of a material with low friction coefficient and when it rubs them together there is almost no friction at all. Students have to come up with a material that rubbed together causes a lot of friction and order the android to change the material of its hand temporarily into the one that they think will cause a lot of friction when rubbed together. Thus they have to find out a material that has a high friction coefficient. The students can look for additional information in the information sheets provided. Have the students present their solutions for you or have them share it with other groups.

Correct answers:
Example of materials that have high friction coefficient:

- *Rubber*
- *Aluminium*
- *Gold*
- *Silver*
- *Cast iron*
- *Abrasive paper*

Continue the story until you reach slide number 34.

Assignment 8: This assignment is divided into three different slides (slide numbers 34, 35 and 36). In this assignment the android faces a landslide with rocks coming at it. The rocks have different masses and different velocities. The android can only withstand blows that have no more than 500 joules of energy without falling from the cliff. Students have to use the formula of kinetic energy to calculate the amount of energy of different kinds of rocks coming in for it. It is good to point out that different variables affect the amount of kinetic energy (velocity and mass) The students can look for additional information in the information sheets provided. Have the students present their solution to you or to the other groups. Have them explain how different variables affect the amount of kinetic energy.

Correct answers:

First wave of stones:
The android can withstand small sized stones and medium sized stones.
The correct amount of joules is:

A) 1 joule
B) 100 joules
C) 1000 joules

Second wave of stones:
The android can withstand small sized stones and medium sized stones. The correct amount of joules is:

A) 100 joules
B) 400 joules
C) 1600 joules

Third wave of stones:
The android can withstand only the small sized stones in this wave. The correct amount of joules is:

A) 100 joules
B) 2500 joules
C) 1000 joules

Continue the story until you reach slide number 41.

Assignment 9: In this assignment the android is using a lever to lift up a heavy rock. Under the heavy rock there is a missing satellite piece. The students have to calculate how much rocks the android has to pile up onto the other end of the lever in order to lift the heavy rock. The formulas for the calculation can be found from the assignment slide and also from the students information material. After the calculations have the student present their results to you. You can also have them think about in what kinds of situations in real life a lever can or could be used. After this assignment provide the groups with a satellite piece. You can choose which piece you will provide to which group.

The correct answer is :
F(v) x b = F(k) x a
F (v) x 2 m = 20000 N x 0,5 m
F (v)= (20000 N x 0,5 m) : 2 m
F (v) = 5000 N which equals to about 510 kg

Continue the story until you reach slide number 44.

Assignment 10: In this assignment the android is sliding down an icy slope. The students have to come up with at least three ways how the android can slow down its speed and be able to stop. It is good to remind the students that the android has a built in 3D printer that can produce different things amazingly fast. The students have to also think about what forces affect the android when it's sliding down the slope, when it's speed is slowing down and when it has stopped. Have the students present their solutions to you or to the other groups. Let them be creative when coming up with ways to slow down the speed of the android but emphasize the importance of being able to explain their solution in terms of physics and force.

The correct answers:

A) *The gravity of the planet that the slope is redirecting into movement. Friction between the icy slope and the android.*
B) *The gravity of the planet that the slope is redirecting into movement. Friction between the icy slope and the android. And the students own solution to slow the speed of the android (counterforce to the slide)*
C) *The gravity of the planet that the slope is redirecting into movement. Friction between the icy slope and the android. And the students own solution to slow the speed of the android (counterforce to the slide)*

Continue the story until you reach slide number 46.

Assignment 11: In this assignment the android is falling down and the students have to come up with different ways to slow down the free fall of the android. It is good to remind the students that the android has a built in 3D printer that can produce different things amazingly fast. Have the students first demonstrate a steady movement, accelerated movement and slowing down movement using the Kitsat satellite. The students can come up with different ways to demonstrate these different kinds of movements. Let them be creative but make sure that they demonstrate each type of movement correctly. If you want you can also analyze the data that the satellite gives you after the demonstrations. The students can find additional information from their information sheets. Have the students present their demonstrations to you or the other groups while you observe them. There are a variety of correct ways to do this assignment but below you will find few examples.

"Correct" answers:

Even movement: The student is walking at a steady pace with the satellite in hand.

Accelerated movement: The student is starting to walk slowly and little by little increasing the pace and ending up running with the satellite.

Slowing down movement: The student starts with a pacy walking speed or running fast and then slowing down the pace of walk or run little by little while holding the satellite.

Continue the story until you reach slide number 49.

Assignment 12: In this assignment the android is underwater and the students have to explain why the android moves slower in water than at land. They will also have to come up with a solution that how the android can move faster in water and beat the Universe Order's underwater vehicle to get to the missing satellite piece. Let the student be creative in finding ways to move faster in water but make sure that they explain their solution according to terms of kinetic energy and force. Have the students present their solution to you or to the other groups as you observe.

Correct answers:
Water has a density of 1000 kg/m³
Air has a density of 1,225 kg/m3
This means that water is roughly 1000 times as dense as air. Because of the increased density, the atoms in the object in question come into contact with molecules a lot more than they do in air. This contact creates friction and drag. Water is a liquid while the air is a gas. This means that the links between the water molecules are a lot stronger than the practically non-existent ones found in air, which creates more resistance.

To move faster in water the android needs something to push it forward so a device that creates a force that helps the android move forward and counter the friction, resistance and drag caused by the water's density. For example a motor or swim fin.

Continue the story until slide number 55.

Assignment 13: In this assignment the android is facing a scorching heat and it has to cool down itself in order to remain functional. The students have to come up with three different ways how the android can cool itself down. Remind the students about the androids 3D printer. Let them be creative in this assignment but take into consideration the effectiveness of the students solutions and would they help or be possible in a real life situation. Have the students present their solutions to you or to the other groups as you observe and give feedback.

The students also have to explain what is a boiling point and what is a melting point. They also have to choose three materials form the Kitsat satellite and find out their melting and boiling points.

Correct answers:
Melting point: The melting point of a substance is the temperature at which it changes state from solid to liquid. At the melting point the solid and liquid phase exist in equilibrium.

Boiling point: Boiling point is the temperature at which the vapor pressure of a liquid is equal to the pressure of the atmosphere on the liquid, equal to 212°F (100°C) for water at sea level.

*Melting points and boiling points of **some** of the materials in the Kitsat satellite.*

Plastic: Depending on the plastic the melting point is between 260 and 360 degrees celsius. BOiling point is a temperature above this range. Depending again on the plastic in hand.

Copper: Melting point 1085 degrees celsius. Boiling point 2562 degrees celsius.

Fiberglass: Melting point 1200 degrees celsius. Boiling point 1713 degrees celsius.

Aluminum: Melting point 660 degrees celsius. Boiling point 2470 degrees celsius.

Silicon: Melting point 1414 degrees celsius. Boiling point 3265 degrees celsius.

Tin: Melting point 231 degrees celsius. Boiling point 2602 degrees celsius.

Iron: Melting point 1538 degrees celsius. Boiling point 2862 degrees celsius.

Continue the story until you reach slide number 58.

Assignment 14: In this assignment the students should come up with an idea on how the android can recharge its energy levels so it can continue the mission. Let the students be creative in this one but emphasize that the solution should be possible in real life. There are many options to complete this assignment. Have the students present their ideas to you or to the other groups while you observe and give feedback.

***Correct answer:** One solution could be that the android would print out a solar panel in order to turn the sun's solar energy into electricity which the android could use to recharge its energy levels. Other solutions could be to instruct the android to hunt and gather food and recharging the android's energy levels by the chemical energy that the food contains.*

Continue the story until you reach slide number 60. The android finds the rest of the satellite pieces. And you can provide the groups the rest of the satellite pieces they need. You can instruct the students to assemble the satellite by following the instructions provided.

Continue the story until you reach slide number 62.

Assignment 15: The satellite is ready and the android has to launch the satellite back to the space station for analysis. The students have to do some calculations in this assignment. In order to get the satellite's thrusters to work the satellite has to gather enough potential energy. This potential energy is being gathered through work against the gravity of the planet. Students can use the formulas presented in the assignment slide. The same formulas can be found in the information sheets of the students.

Correct answer: *The android should climb to an altitude of more than 100 meters in order to gather enough potential energy.*

Continue the story until you reach the last slide of the presentation.

Assignment 16: In this assignment the students should come up with a plan on how the android can get out of the planet and save the Kitsat satellite from the incoming threat. Let the students be free and creative on this one. They can examine the satellite and maybe use some of its equipment and functions to help or assist the android. The students can draw, write or explain their plan to you or the other groups.

After this assignment congratulate the students on completing the course!

Assessment:

Below you'll find a few tips on how to assess a gamified course.

When assessing the course you can use different kinds of digital platforms to gather the student's solution to different assignments. Through these platforms you can give them feedback and evaluate their answers. You can evaluate every assignment as an individual assignment or view and evaluate them as a whole.

You can also use group assessment so that every group assesses how they worked together as a group during the course. It's good to also add a self-assessment for every student so that you get the group's opinion and the individual opinion on how they managed the course.

If you want to gamify your assessment also you can add a value to each assignment. For example on a grade scale from 4-10 (4 being failed and 10 excellent) each accomplished assignment can raise the groups or the student's grade by for example maximum 0,5 (half a grade). Every group or a student starts from grade 4 and assignment by assignment they begin to raise their grade. If the assignment is not done that good you can give them a smaller raise to their grade.