SINUS - Thüringen
Steigerung der Effizienz des mathematisch-naturwissenschaftlichen Unterrichts

How to play the PHYSICSMASTER game

Player:	2–6 players
The purpose of the game:	The player who is the first in reaching the finish is the winner. He or she may feel extremely proud for being the **PHYSICSMASTER**!
How to prepare the game:	Before you start your game, first open the **playing board** between the players. Mix the **knowledge cards** and the **action cards**, and put these two stacks (upside down) next to the playing board. Every player selects a **gaming piece**, and puts it on the starting space. Roll the dice to determine who starts (highest number of points).
The game itself:	The first player rolls the dice, and moves his or her piece forward according to the value obtained. After this, the next player (in a clockwise order) rolls the dice, etc. Several pieces may be put on one place at a time. If you score SIX points, you may roll again, and add the value obtained to the six. The last face value rolled before reaching the finish may be higher than required, but also smaller, of course.
Action card:	When a player reaches an **action space**, he or she should pick the topmost **action card** from the stack, read it out to all the others, and follow the instruction given. This uncovered card is put under the stack after that.
Knowledge card:	When a player reaches a **knowledge space**, his or her **predecessor** picks the topmost **knowledge card** from the stack, and reads it aloud. ■ If the player, who has rolled the dice, comes up with the right answer, he or she may advance to the next knowledge space, and pass the dice to the next player. ■ But if the player doesn't know the answer, fails to answer completely, or gives a wrong answer, he or she has to return to the previous knowledge space, and pass the dice to the next player. The uncovered card is put under the stack after that.
Accessories:	■ 1 Playing board ■ 1 Game instructions ■ 1 Dice ■ 6 Coloured gaming pieces ■ Knowledge cards ■ Action cards **After your game, please check that the accessories are really complete to make sure that you can start the fun of your next game full of zeal and enthusiasm right away without having to look for any accessory. Thank you!**

Material for action cards

You were chatting with the person next to you. **Roll once and move as many spaces backwards.**	The last lesson is cancelled because of the heat. **Move three spaces forward.**	Your teacher has praised you for a great answer. **Roll again.**	You studied hard for today and you volunteered for an assessment. **Move five spaces forward.**
Your parents were pleased with your last report and are taking you on a trip. **Move six spaces forward.**	You drew on your desk and so you have to spend the afternoon cleaning all the benches in the physics classroom. **Miss a turn.**	Because you regularly help your little brother/sister with their homework **you can move four spaces forward.**	You forgot to get a signature for the last assessment again. **Move four spaces backwards.**
You were so fast asleep this lesson that you didn't hear the bell for break-time. **The person behind you can move six places forward.**	Your teacher has caught you cheating. You get a six. **Move that many spaces back.**	You didn't say good morning to your physics teacher today. **Roll once and move backwards.**	You were just dreaming of your favourite music and you didn't hear the question. **Roll once and move backwards.**
You've been put in front of the door because you've been messing about a lot in the lesson. **Miss a turn.**	You voluntarily made a wall display and you receive a homework joker card. **Move six spaces forward.**	You saw someone lose some money and you gave it back to him/her. As a reward he/she buy you an ice-cream. **Roll again.**	On parents' day your physics teacher praised you. **You can move five spaces forward.**

Material for action cards

You forgot to do your homework and you have to catch up.

Miss two goes.

You didn't study enough for the work given and you got a six.

Go twice as many spaces as that backwards.

You did not wipe the board properly.

Go two spaces back.

Your teacher has caught you day-dreaming.

Go two spaces back.

You forgot to bring your money for the drinks machine.

Miss a turn.

You put your hand up a lot today.

Move two spaces forward.

You were secretly listening to music on headphones.

Go two spaces back.

You got a good mark in a voluntary mini-presentation.

Roll again and move forward.

You overslept and so you arrived late.

Miss a turn or roll once and move backwards.

In the last assessment you were better than ever.

You can move forward the value of your last roll.

The headmaster caught you smoking.

Miss two goes.

Because you finally have all your work equipment

you can move two spaces forward.

During break you explained to your friend again what he/she had not understood earlier.

Move four spaces forward

You got a one today and

you can move six spaces forward.

You helped your friend with his/her homework.

Move four spaces forward.

Your friend has forgotten his sandwich. Because you share yours with him/her

you can move three spaces forward.

action action action

Material for knowledge cards »Optics«

What do you call a lens that is thicker in the middle than round the edge?

Collecting lens

What kind of device generates parallel light beams in a single colour?

A laser

What is a penumbra?

The area where the shadow of only one light source falls when there are two light sources.

What do you call the event when light moves from one transparent object into another translucent object?

Refraction

What is a Fata Morgana?

It is an optical illusion, which occurs through reflection of light off layers of air with different temperatures.

What is the area of physics called that deals with light?

Optics

What is an umbra?

The area where the shadow from two light sources falls.

What happens to light when it falls on a matt black object?

It is swallowed or absorbed.

What do you call a lens that is thinner in the middle than round the edge?

A dispersing lens.

What eclipse occurs when the Moon is between the Sun and the Earth?

Solar eclipse

Under which Law does a mirror image occur.

The Law of Reflection

Name at least two transparent materials!

Water, air, glass ...

How can light be directed along any curved path?

With a light conducting cable.

What eclipse occurs when the Earth is between the Sun and the Moon?

Lunar eclipse.

What do you call the event when an object rebounds the light falling on it?

Reflection

Name at least two translucent objects!

Matt glass, clouds, thin paper, curtains ...

Material for knowledge cards »Optics«

What makes small things really big?

A microscope

Why is it called a collecting lens?

Parallel light rays are focussed to a focal point and so they are »collected«.

How is light broken when moving from air into glass?

Towards the axis of incidence

What is the name of the sight defect where people cannot see far away objects in sharp focus but can see nearby objects well.

Short-sightedness

What are used by pirates, soldiers and astronomers alike?

Telescopes

What is the name of someone who deals with lenses for their job.

Optician

How is light broken when moving from glass into air?

Away from the axis of incidence

What is the Law of Reflection?

The angle of incidence and the angle of reflection are equal in size.
Penetrating rays, reflected rays and the axis of incidence are on one level.

What toy produces many similar colourful images through various mirrors.

Kaleidoscope

How is light broken when moving from air into water?

Away from the axis of incidence

Name at least three properties of a mirror image!

upright, interchanged sides, equally large, virtual or apparent

What funny name does a reflector on a bicycle have?

Cats' eyes

What is the device called that is used in submarines to see above the water during diving?

Periscope

How is light broken when moving from water into air?

Towards the axis of incidence

What is the name of the sight defect where people cannot see nearby objects in sharp focus but can see far away objects well.

Far-sightedness

What insect is a natural light source?

A glow-worm

Material for knowledge cards »Optics«

What optical device looks the same as the mathematical object of the same name? Prism	**What do we understand by a light source?** It is an object that sends out light itself and does not simply reflect it.	**What are the names of the three special rays that are needed for construction an image on a lens?** Focal point ray, mid-point ray and parallel ray	**What is the name of the sensory organ of many organisms for optical perception (seeing)?** The eye
Name at least three properties of light! e. g.: Light disperses very quickly, in straight lines and on all sides. It can be reflected and broken.	**Name at least four light sources!** e. g.: Sun, lightning, candle, electric torch, light bulb ...	**What optical device did Sherlock Holmes use in his investigations?** A magnifying glass	**What optical device do holidaymakers like to use?** A camera
What is the speed of light? c = 300 000 km/s	**Is the Moon a light source in a physical sense?** No, because it only reflects the sunlight.	**What optical device rests on the nose?** Glasses	**What is a projector also known as?** A slide projector
Name at least three illuminated objects. All objects that you see but do not themselves produce light are possible.	**Name at least three artificial light sources that people knew before electric light!** e. g. candle, matches, torch, gas lamp ...	**What was the predecessor of glasses?** Monocle or pince-nez	**With what optical device can you project something hand-written onto the wall?** An overhead projector (OHP)

Material for knowledge cards »Thermodynamics«

Name the component parts of a liquid thermometer.

Scale, indicator tube, thermometer fluid, thermometer vessel

Temperature can be expressed in various units. Name two!

Degrees Celsius, Kelvin, degrees Fahrenheit, degrees Reaumur

What is the name given to the unusual behaviour of water at temperatures between 0 °C and 4 °C?

The Water Anomaly

Name three artificial heat sources!

e. g. oven, radiator, patio heater, ...

What is the name of a double strip of two metals that expand differently?

A bi-metal

Name two examples of where bi-metal strips can be used!

e. g. thermometer, iron, toaster ...

Name the types of heat dispersal!

Radiation, conduction, convection

Give an example of each for convection, conduction and radiation!

e. g. convection: radiator;
conduction: eater in central heating;
radiation: the sun

What is the name given to the formation of a liquid from a gas?

Condensation

What is the name given to the transformation of a liquid into a gaseous state?

Boiling, evaporation

Name the formal symbol for temperature

Greek letter Theta: J

Name two types of thermometer!

e. g. clinical thermometer,
fridge thermometer, room thermometer, ...

What is the name given to the transformation of a solid object into a liquid state?

Melting

What is the name given to the hardening of a liquid?

Solidification

What units is temperature measured in?

Degrees Celsius

Name the device for measuring temperature!

Thermometer

Material for knowledge cards »Thermodynamics«

What is the freezing point of water? 0 °C	**What is the boiling point of water?** 100 °C	**Name three bad heat conductors!** e. g. air, wool, wood, plastic, ...	**What happens in the individual strokes of a petrol motor?** 1. Stroke: Intake; 2. Stroke: Compaction; 3. Stroke: Combustion; 4. Stroke: Expulsion
Name the formal symbol for heat! Q	**In what units is heat expressed in?** Joules: J	**Name the forms of matter!** Solid, liquid, gas	**Give two examples of combustion engines!** Petrol engine, Diesel engine, Wankel (rotary) engine
What elements of a petrol engine are not present in a diesel engine? Carburettor, spark plugs	**Why does the anomaly of water aid the weathering of rock?** Because water expands when it freezes the ice can »snap off« pieces of the rock.	**Why can you not melt iron in a copper bowl?** The melting point of iron is higher than that of copper.	**What is (the temperature of) absolute zero in degrees Celsius?** -273 °C
Why are moulds larger than the final cooled moulded item? When the moulded item cools it contracts.	**Why is it that thick glasses sometimes shatter when hot liquid is poured into them?** The temperature difference between the inner and outer edge of the glass. The inner edge expands but the outer edge does not.	**Why is a saucepan with a rippled bottom not suited to an electric hob?** The air between the bottom of the pan and the hob is bad at transferring the heat.	**Why do radiators have ribs?** So that the surface area is increased and more heat can be radiated.

Material for knowledge cards »Thermodynamics«

Name three natural heat sources! e. g. the sun, fire, body heat, ...	**What is a heat source?** An object that gives off heat.	**What combination temperature occurs when water at 0 °C is mixed with the same amount of water at a temperature of 100 °C?** 50 °C	**You are having a shower and the mirror in the bathroom steams up. What is this change in the state of matter called?** Condensation
Why are bridges supported in sections? The length varies depending on the changes in temperature.	**You enjoy letting a piece of chocolate disappear in your mouth. What is the physical event occurring?** Melting	**At what temperature is water thickest?** at 4 °C	**Give the lowest temperature on Earth!** at –88 °C in Antarctica
What is the temperature on the surface of the Sun? 6000 °C	**What is the unit of temperature in America?** Fahrenheit	**What type of heat transfer occurs with a hot-air balloon?** Convection	**Name two examples of heat insulation on and in the house.** e. g. multiple glazed windows, styrofoam insulation in the walls, insulation fibre under the roof, ...
Why is lighter clothing better in the summer? It reflects the heat radiation.	**Give two examples of evaporation.** e. g. drying up of puddles, drying of laundry on a clothes line, ...	**Why should you empty the water butt in the garden before frost?** Because water expands when it cools below 4 °C the water butt can split. (The Water Anomaly)	**Why do racing cars fill up with petrol at a temperature of –20 °C before a race?** The volume of the fuel is lower at this temperature and so more fits in the tank.

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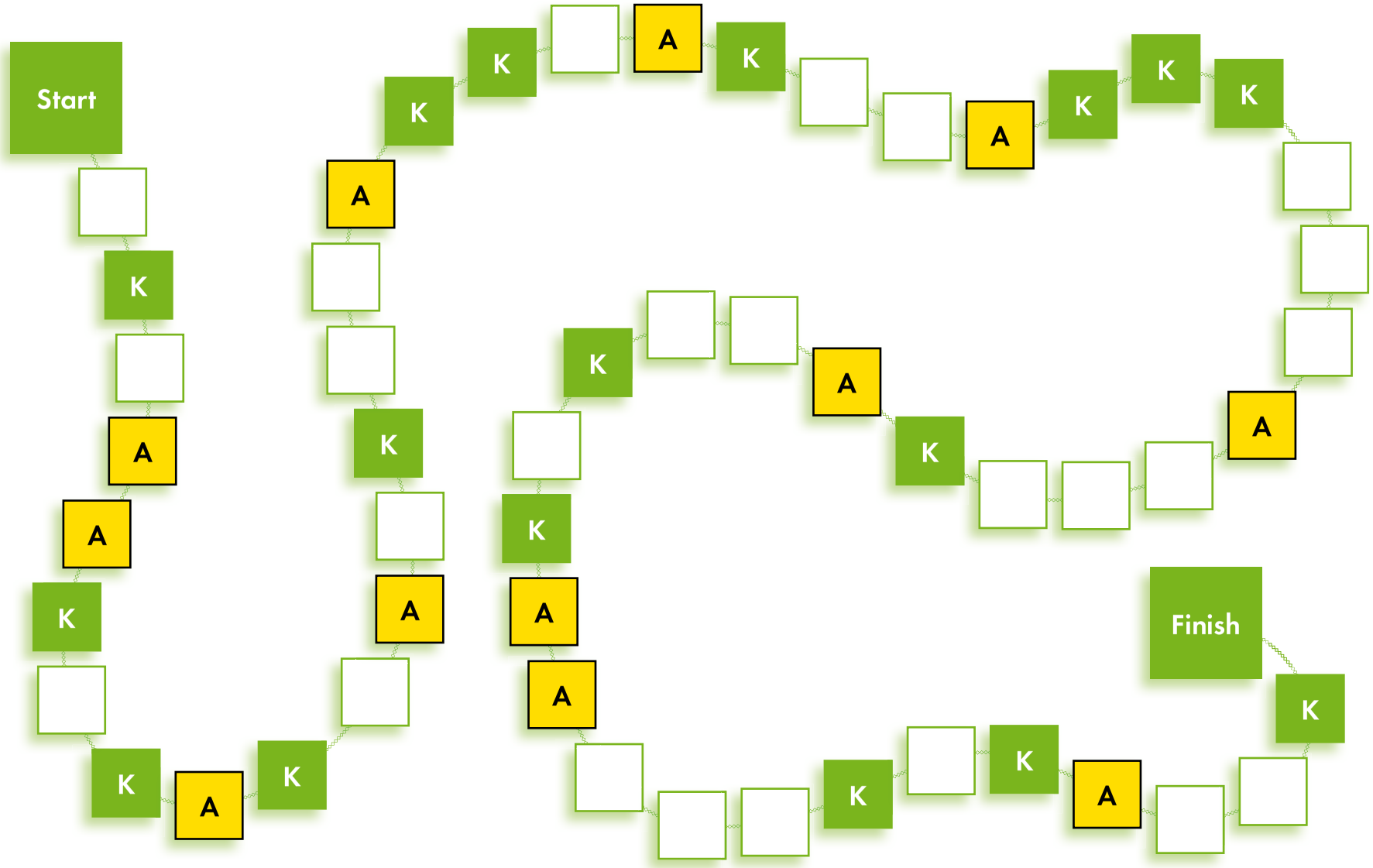
Material Playing board PHYSICSMASTER